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Technical communicators' use of special language reference tools

Measuring the influence of chronological and organizational age

Abstract

Language professionals such as translators and technical communicators need special language information for their work. However, technical communicators' information needs and requirements for reference tools have not received a lot of attention in the literature. The present article aims at filling this gap by presenting the results of an empirical study (written online survey). Our focus is on the links between technical communicators' age and their use of special language reference tools, based on survey responses. After setting the scene in section 1, the overall research framework is sketched out in section 2. Section 3 describes respondents' general profiles, while section 4 characterises respondents in relation to reference tools. By combining the data from section 3 and section 4, section 5 gives new insights into the associations between various explanatory variables and response variables. Section 6 concludes the article and provides an outlook. The survey questions treated in the present article are in an appendix.

1 Introduction and fundamental concepts

Every day, we encounter a vast amount of information due to the increasing use of the Internet for producing and distributing information. Not only is this an obvious development in our private lives, it also affects many work settings. In particular, the ubiquitous spread of unstructured and structured information influences language professionals such as translators, interpreters, localizers, terminologists and technical communicators. The concept 'technical communicator' is defined here as "person who develops, creates and updates information for use of products" (tcworld 2019). According to Henning and Bemer,

> technical communicators […] produce documents in a variety of media to communicate complex and technical information. They employ theories and conventions of communication to develop, gather, and disseminate technical usable information among specific audiences such as customers, designers, and manufacturers.[1] (Henning/Bemer 2016: 328)

[1] The terms "technical communicator" and "technical writer" are considered synonyms, as for instance stated in Henning and Bemer (2016: 328) and United States Department of Labor (2018).

A considerable amount of literature has been published on the information needs of and language resources for translators (cf., for instance, Lissance 1949; Vermeer 1989; Mikkelsen 1991; Budin/Galinski 1992; Duvå/Laursen 1994; Snell-Hornby 1996; Mayer 1998; Austermühl/Einhauser/Kornelius 1999; Hohnhold 1999; Agirre et al. 2000; Bowker 2000; Nord 2002; Wiesmann 2004; Dancette/Halimi 2005; Gómez González-Jover 2005; Kudašev 2007; Derouin/Le Meur 2009; Durán Muñoz 2010, 2011; Löckinger 2011, 2014, 2015b; Szemińska 2011; Dancette 2015; Zaretskaya/Corpas Pastor/Seghiri 2016, 2017; Błażek 2017). In addition, many freely available terminological resources are somehow translation-oriented. There are several directories that list such language resources, for instance Cologne University of Applied Sciences (2009), Universität Innsbruck (ca. 2015), University of Applied Sciences Upper Austria (2018), European Parliament (ca. 2019), Universität Wien (ca. 2018). Furthermore, an international standard is dedicated to translation-oriented terminography (ISO 12616 2002).

There is also a growing body of literature on technical communication studies. So far, however, technical communicators' information needs and their use of special language reference tools have received scant attention.[2] For our purposes, the concept 'special language' is defined as "natural language […] used in communication between experts in a domain […] and characterized by the use of specific linguistic means of expression" (ISO 1087 2019: 2). Furthermore, "[t]he specific linguistic means of expression always include domain-specific terminology […] and phraseology and also can cover stylistic or syntactic features" (ISO 1087 2019: 2). Since the research described in the present article is exploratory in nature, we cannot provide a terminological definition of the concept 'reference tool'. Instead, we use the following explanation as a concept description: "information source about one or more domains".

To fill the research gap mentioned above, Löckinger (2015a: 17–18) outlines a three-stage research methodology: literature review (stage 1), written survey (stage 2), and prototype testing (stage 3). This methodology is at the interface between academic research and daily practice and focuses on technical communicators as content producers; cf. the models and discussions in Krings (1996: 112ff) and Schubert (2007: 255ff). Stage 2 was completed in 2017, and the first research results were published in Löckinger and Takacs-Schwarzinger (2017, 2018).

2 Research framework

The written online survey was sent to the members of German, Austrian and Swiss technical communicators' professional associations (tekom Deutschland, tekom Österreich and TECOM Schweiz). Out of about 450 respondents who started the survey, 265

[2] Earlier research by the authors is published in Löckinger and Takacs-Schwarzinger (2017, 2018). Similarities and differences between translators and technical communicators as users of special language reference tools are briefly described in Löckinger (2016: 154–155). Giacomini (2017) discusses data presentation options for designations in e-dictionaries for translators and technical communicators; Behles (2013) investigates the use of online collaborative writing tools.

actually completed it. Those 265 complete questionnaires form the basis for the present article.[3] The overall research framework for our empirical study is shown in Figure 1 below.

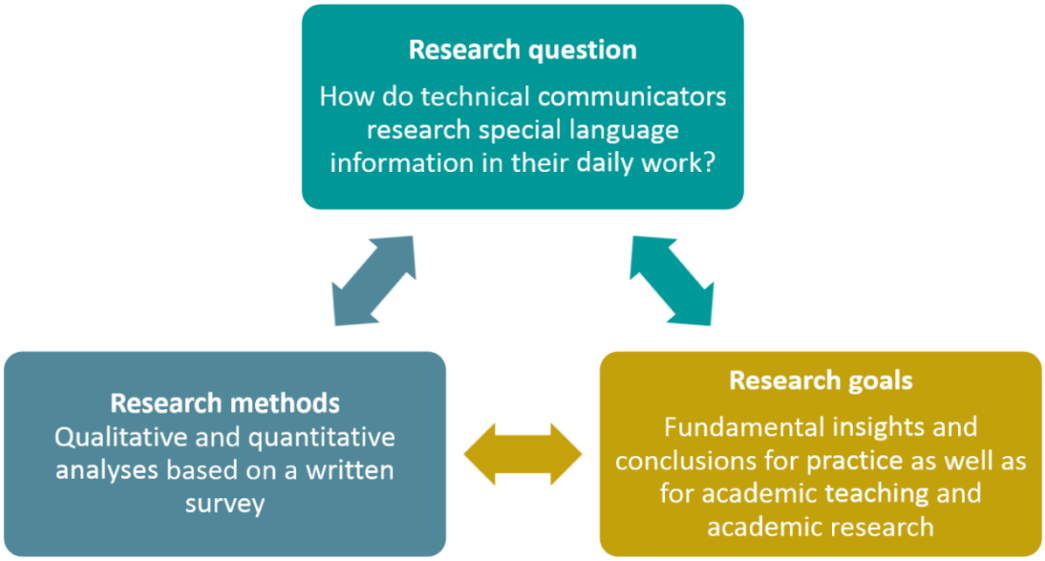

Figure 1: Overview of research framework, translated and adapted from Löckinger and Takacs-Schwarzinger (2018: 53)

Based on this research framework, the present article explores the following research questions:

(a) How often do technical communicators use special language reference tools?

(b) How satisfied are technical communicators with their special language reference tools?

(c1) What types of special language information do technical communicators search?

(c2) What types of special language information do technical communicators wish for?

(d) How much working time do technical communicators spend researching special language information?

Taking these research questions as the starting point, we consider the following to be response variables: (a) 'frequency of use'; (b) 'level of satisfaction'; (c1) and (c2) 'types of special language information'; (d) 'working time spent researching special language information'. The article addresses the question whether 'chronological age' and 'organizational age' are explanatory variables with respect to these response variables.

[3] The numbers of usable responses differ from question to question. They are provided in the relevant sections and in the appendix. An unusable response may be missing, contrast with the question or contradict other responses.

This produces another series of research questions, all of which show the following pattern:

(e) What are the associations, if any, between [explanatory variable] and [response variable]?

Research questions (a) to (d) will be answered in section 4, research question (e) in section 5. To do so, we will first present the results of our empirical study related to individual survey questions (section 3 and section 4). Then, we will describe the results of statistical tests carried out on associations between data from section 3 and section 4. We will use both qualitative and quantitative analyses to this end (section 5). Finally, we will conclude and give ideas on possible future research (section 6).

3 Respondents' personal and professional profiles

For our study, we collected data about the respondents' personal and professional profiles. Thereby, we intended to ensure that our sample of respondents adequately mirrors the community of technical communicators in general. Specifically, we asked them about properties such as chronological age, gender, employment status, organizational age and primary task. To ensure that our study results are representative, we compared relevant data with other publications.[4]

3.1 Chronological age

With regard to respondents' chronological age, we matched our results with relevant industry reports. The concept 'chronological age' is defined here as "age of a person as measured from birth to a given date" (Merriam Webster ca. 2018; cf. Bruggmann 2000: 6; Bieling 2011: 10). Thus, Figure 2 and Figure 3 below show the chronological age structures for technical communicators, as determined in our study as well as in Straub (2016: 9, 2017: 10).[5] Straub (2016, 2017) presents data that are in principle representative of the entire population of the German communicators' professional association (tekom Deutschland). These data provide a useful yardstick for comparison.

In our study, respondents had to select one out of five chronological age groups, with an additional option 'prefer not to say'. Although our grouping differs somewhat from that used in Straub (2016, 2017), the data are distributed similarly. The youngest age groups show a difference because our study did not include students in the survey population. Conversely, the industry report surveys were open for students.

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4 This section is a translated, revised and expanded version of Löckinger and Takacs-Schwarzinger (2018: 52–53). It is provided here in its entirety for the sake of completeness and ease of reference.

5 We did not include more recent industry reports because of the time of data collection (spring 2017).

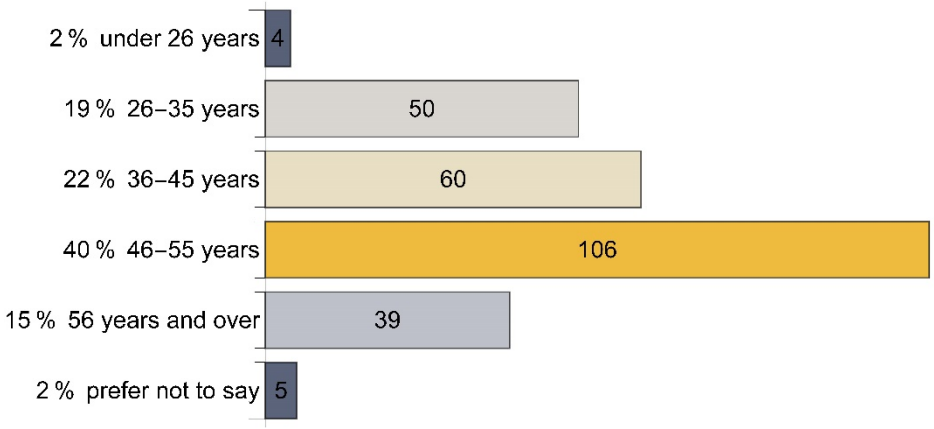

Figure 2: Respondents' chronological age by age groups, in percent and numbers: our study

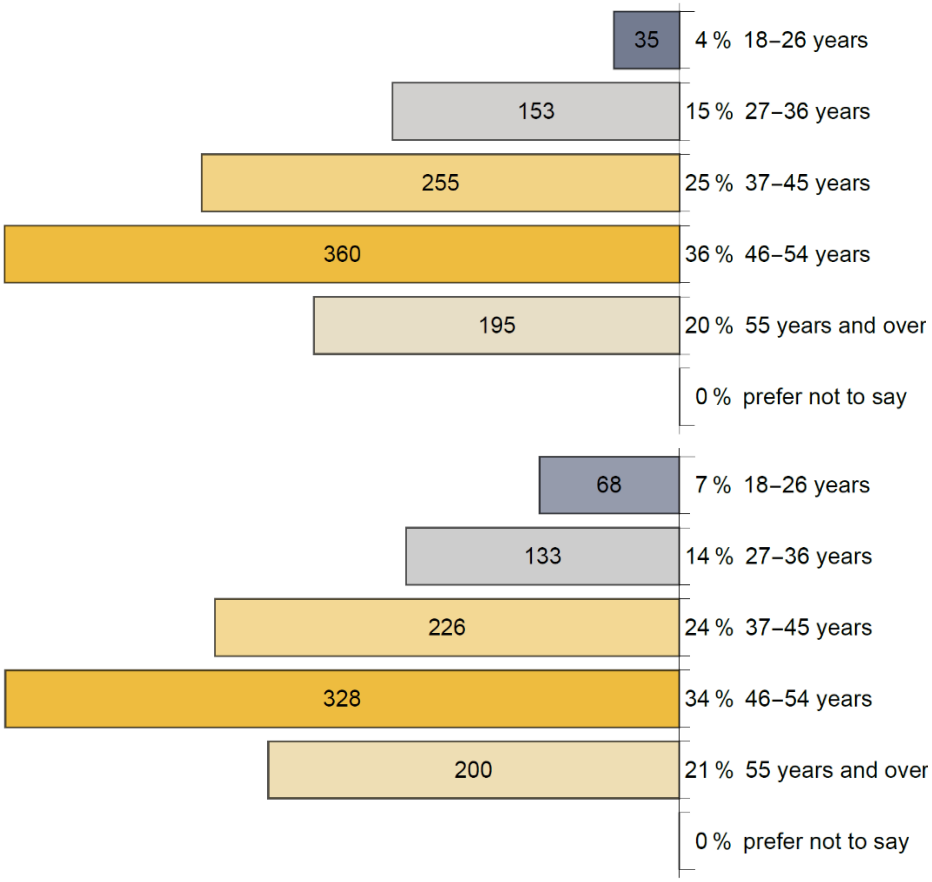

Figure 3: Respondents' chronological age by age groups, in percent and numbers: upper part: Straub (2016: 9), lower part: Straub (2017: 10)

3.2 Gender

One survey question addressed respondents' gender. According to our study, the gender balance is clearly in line with those in industry reports: Slightly less than half of respondents are female, while slightly more than half are male (only 2 % selected the option "Prefer not to say"). Table 1 below gives the necessary details, based on those respondents who indicated a specific gender. It is apparent from these data that the distribution between the binary values "female" and "male" is more or less even within the community of technical communicators. By contrast, other fields of the language services industry such as "translation, localization, interpreting, and language technology are female" (Common Sense Advisory 2017: 4). There, the ratio is about 70 % female to 30 % male (cf. Common Sense Advisory 2017: 4). The discrepancy between the community of technical communicators and other language service communities is probably due to engineering and technology sectors generally being male-dominated in Germany, Austria and Switzerland (cf. Federal Statistical Office 2016: 20, Eurostat 2018, Statistik Austria 2018: 43, Statistisches Bundesamt 2019).

Source	Straub (2016: 10)	Straub (2017: 11)	Our study
Percentage of female respondents	46	45	47
Percentage of male respondents	54	55	53

Table 1: Gender balance in our study and according to industry reports

3.3 Primary employment status

We asked respondents about their current primary employment status. We introduced the word "primary" in this question because one and the same respondent may both be employed at an enterprise and be self-employed. Figure 4 below illustrates the data and gives a clear picture. With 94 %, the vast majority of respondents indicate an employee status, whereas only 4 % state to be self-employed. A tiny minority "Other" includes individuals who are students or unemployed, for instance.

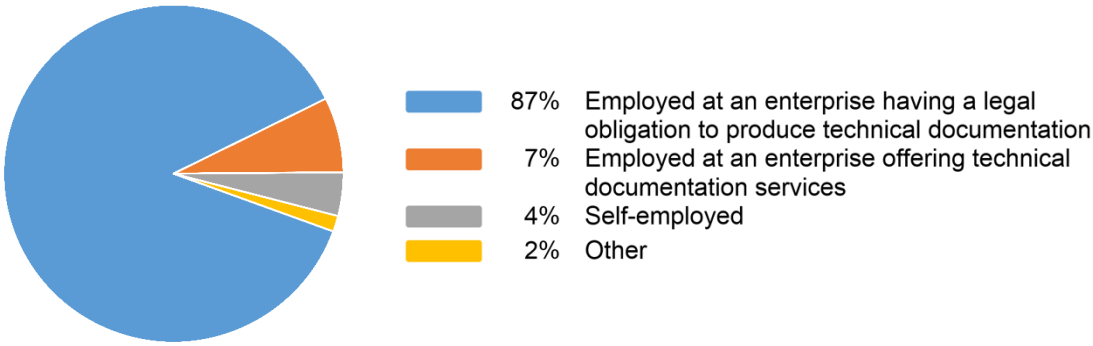

Figure 4: Respondents' primary employment status

Table 2 below compares the data of our study and the data published in the cited industry reports. All in all, the data patterns are comparable, with the share of self-employed people being somewhat smaller in our study than in industry reports. When reading the data, the following should be borne in mind:

(a) The industry report survey asks respondents for their current professional position, without the "primary" specification that we used in our study.

(b) The industry reports contain a separate category 'managers', which is not clearly attributed to employees nor to self-employed people. Because of that, the second and third columns contain two values reflecting the two interpretations, respectively.

(c) As mentioned earlier, our study specifically addressed active technical communicators, which is why students of technical communication degree programmes were not part of the survey population. By contrast, the industry report surveys are open for students, too. This is why the percentages in the last row are generally higher for the industry reports than for our study.

Source	Straub (2016: 10)	Straub (2017: 11)	Our study
Percentage of respondents 'employed at an enterprise …', excluding (including) managers	86 (89)	84 (86)	94
Percentage of respondents 'self-employed', including (excluding) managers	8 (5)	8 (6)	4
Percentage of respondents with status 'Other'	6	8	2

Table 2: Respondents' (primary) employment status

3.4 Organizational age

Another survey question focused on organizational age. For our purposes, we can define the concept 'organizational age' as age of a person measured by how long he or she has held a job (cf. Sterns/Miklos 1995: 258; Bruggmann 2000: 9; Bieling 2011: 11). Thus, we asked respondents how long they had been working as a technical communicator so far. They had to indicate their organizational age in years of full-time work.

The responses are shown in Figure 5 below, per chronological age group and in association with organizational age. Interestingly, organizational age varies widely within the individual chronological age groups. On average, respondents who are 10 years older chronologically indicated about 5 years more of organizational age. Both results may be explained by technical communicators working part-time and the career change factor. Although more and more technical communication degree programmes are becoming available, a considerable proportion of technical communicators still come from other occupations and fields. For example, it can be seen from the first bar in Figure 5 that each chronological age group has more than a negligible share of respondents with up to 5 years of organizational age.

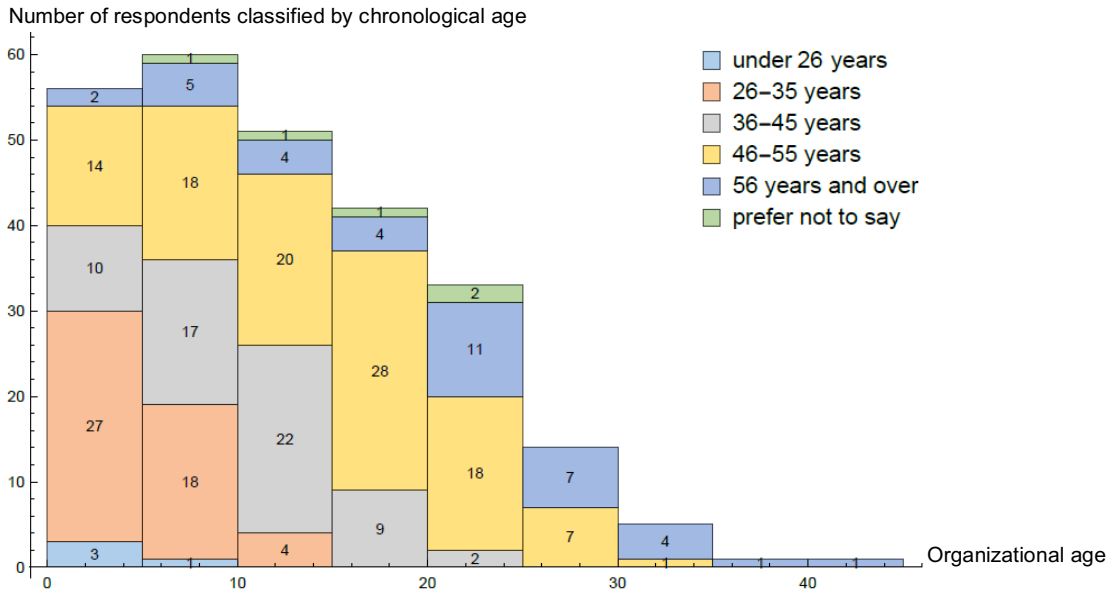

Figure 5: Respondents' chronological age and organizational age

Another interesting observation of our study is that, on average, female respondents have more than four years less of organizational age than their male counterparts. An analysis of variance test revealed a significant difference in organizational ages based on gender ($p < 0.003$, depending on modelling). This gender disparity can be explained by women in the language services industry being more likely to work part-time. As described in Common Sense Advisory (2017: 19, 22, 24), having children generally affects women's careers much more than men's.

For the analysis of associations in section 5, we will use the following organizational age groups:

- under 6 years
- 6–10 years
- 11–15 years
- 16–20 years
- 21–41 years

The last group represents a wider range of organizational age for two reasons: (a) For statistical testing, groups should have an adequate size. (b) We assume that technical communicators within that group have more or less the same high level of experience.

3.5 Primary task

Respondents were also asked to state what primary task they carry out in their current role (see Figure 6 below). A large majority of respondents reported technical documentation as their primary task (87 %). Quality management, technical support, corporate communication and terminology work are displayed as well because they have a share

of at least 1 %. With 7 % in total, the category 'Other' includes highly diverse tasks such as translation management, usability design, product information management, marketing, or training (cf. Löckinger/Takacs-Schwarzinger 2017: 12).[6]

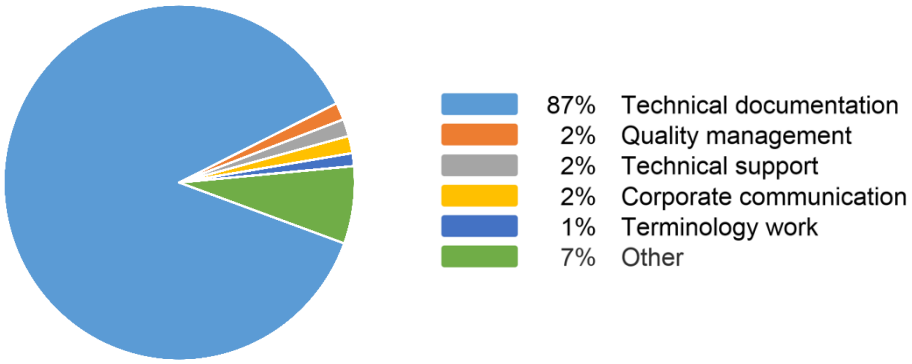

Figure 6: Respondents' primary tasks

Since our survey addressed technical communicators, it is not surprising that technical documentation has received the lion's share of responses. At the same time, however, respondents reported (in a separate survey question) management positions as the second most frequent category after technical documentation positions. "This lets us conclude that the main job of most people in management positions, just as for any other respondents, is technical documentation".[7] Furthermore, "it means that people in management positions more often grow out of existing technical communication teams than being recruited externally".[8]

4 Respondents' use of special language reference tools

Based on earlier publications (Löckinger 2014, 2015a,b, Löckinger/Takacs-Schwarzinger 2017, 2018), we concentrate on the following traits of technical communicators related to reference tools: frequency of use, level of satisfaction, working time spent researching special language information, and types of special language information searched and wished for.

4.1 Frequency of use

In an icebreaker introductory question, respondents were asked how often they use special language reference tools in their work. For this question about frequency of use,

6 Note that percentages add up to 101 instead of 100, due to round-off errors created by calculation.

7 "Das lässt darauf schließen, dass die meisten Führungskräfte – wie auch alle anderen Befragten – in überwiegendem Ausmaß die Kernaufgabe 'Technische Dokumentation' wahrnehmen." (Löckinger/Takacs-Schwarzinger 2018: 53, translated from German by the authors).

8 "Dies bedeutet, Führungskräfte wachsen aus den Redaktionsteams heraus, so dass Leitungspositionen in der Regel nicht mit externen Fachleuten besetzt werden müssen." (Löckinger/Takacs-Schwarzinger 2018: 53, translated from German by the authors).

a 5-point German-language scale by Rohrmann (1978: 231) was used. For our purposes, a 5-point English-language scale as described in Rohrmann (2015: 33,47) serves to represent the original German scale.

It can be seen from Figure 7 below that only a few respondents never (3 %) or always (4 %) use special language reference tools for their work. Conversely, a total of 94 % do so either seldom (23 %), sometimes (44 %) or often (27 %).[9] These data provide one starting point for filling the research gap pointed out in Löckinger (2015a: 23–24): they demonstrate that technical communicators are more or less regular users of special language reference tools. Thus, the results of our study support the idea of "creating new tailor-made reference tools or […] adapting existing ones" for that specific target group (Löckinger 2015a: 23).

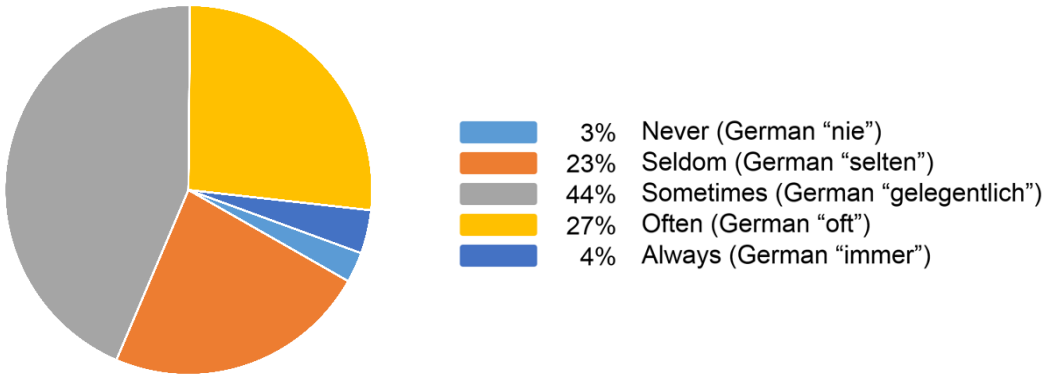

Figure 7: Respondents' frequency of use of special language reference tools

4.2 Level of satisfaction

The second introductory question of the survey centred around respondents' satisfaction with those special language reference tools that they actually use. As in section 4.1, a 5-point German-language scale was used (Aschemann-Pilshofer 2001: 15). Again, a 5-point English-language scale as described in Rohrmann (2015: 47) serves to represent the original German scale.

Figure 8 below illustrates a clear result. Only some respondents indicated levels of satisfaction at the ends of the scale: no respondent (0 %) reported to be not at all satisfied, and only 1 % stated that they were extremely satisfied. Furthermore, only 4 % are slightly satisfied. With 45 % and 49 %, by far the largest portions of respondents reported to be either moderately satisfied or considerably satisfied, respectively.[10] It is remarkable that almost half of the respondents indicated the second highest level of satisfaction. At the same time, a considerable room for improvement remains given that almost nobody is extremely satisfied with the special language reference tools at their disposal.

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9 Note that percentages add up to 101 instead of 100, due to round-off errors created by calculation.
10 Note that percentages add up to 99 instead of 100, due to round-off errors created by calculation.

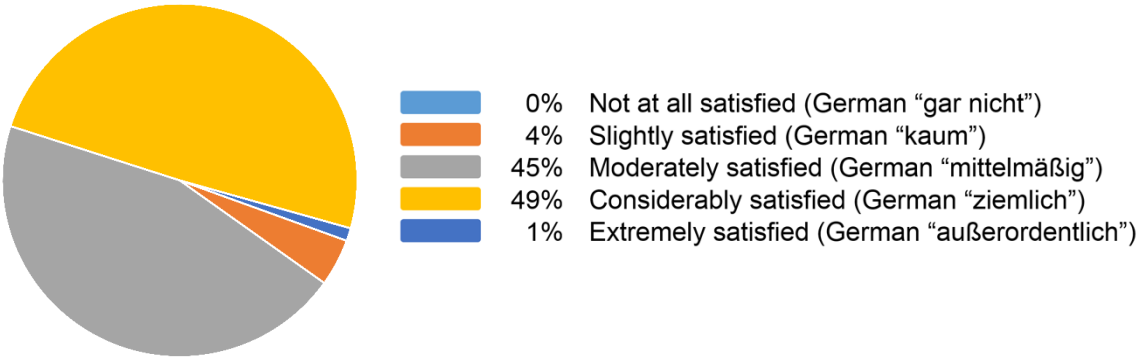

Figure 8: Respondents' satisfaction with special language reference tools that they actually use

4.3 Working time spent researching special language information

Respondents were also asked to estimate the percentage of their working time which they spend researching special language information. The relevant survey question explicitly stated that respondents' answers should include both their own individual research in various information sources and research interaction with other people, for example in conversations with colleagues within the same enterprise.[11]

Figure 9 below depicts the results for the said survey question. Slightly more than half of the respondents (52 %) reported to spend up to 10 % of their working time researching special language information. Conversely, slightly less than half of the respondents dedicate more than 10 % of their working time to this activity. More precisely, roughly one third (30 %) stated that the relevant percentage is 11 % to 20 % for them. Another 10 % said that the relevant percentage is 21 % to 30 %. The shares of respondents of the remaining percentage ranges (31 % to 40 %, 41 % to 50 %, more than 50 %) are rather small with 3 %, 3 %, and 2 %, respectively.

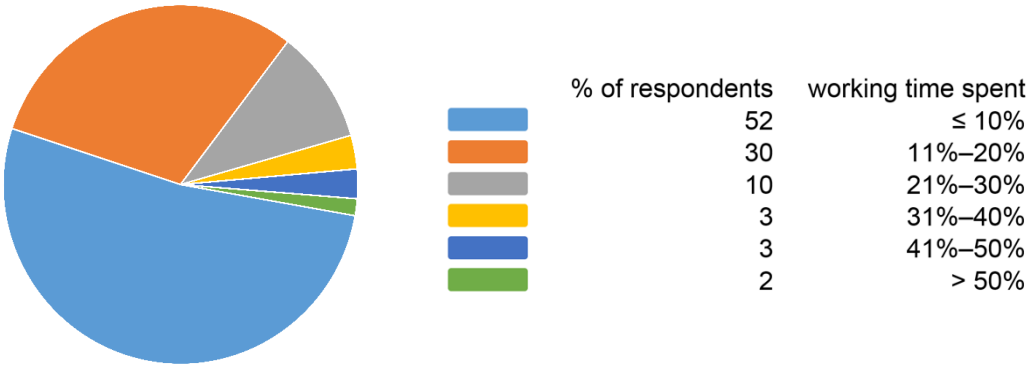

Figure 9: Percentage of working time spent researching special language information

[11] Note that the results do not include time used for researching other information than special language information: information about document and documentation structures, target groups, purposes of deliverables, language versions, publication media, etc.

So far, there has been a lot of anecdotal evidence about the time necessary for researching special language information. The above results present a well-founded basis for further discussion and study. We can assume that optimizing technical communicator's research activity can help to (a) increase productivity (searching successfully within less time), (b) increase satisfaction with work (finding necessary information in a better way), and (c) improve the quality of content produced in the long run (using more reliable solutions based on better informed decisions).

4.4 Types of special language information

Technical communicators need various types of special language information. More specifically, Löckinger states that technical communicators

> need domain-specific information at four different levels […]. Thus, their intention is to
> - search for information at object level,
> - search for information at concept level,
> - search for information at designation level, or
> - search for information at context level. (Löckinger 2015a: 14)

Information at object level is about the properties of a given product, e. g. various materials used for the production of computer screens. Information at concept level usually refers to concept descriptions, e. g. a definition of the concept 'computer screen'. Information at designation level can be linguistic and other expressions which describe concepts and objects, e. g. the term "computer screen". Information at context level shows the real-life usage of designations in authentic texts, e. g. the word combination "touching the computer screen", which contains the term "computer screen".

In the survey, two questions were related to the four levels including their accompanying types of special language information.[12] One question asked respondents about the types of information they search ("reality"). Another question asked them what types of information they wish to have in an ideal reference tool ("dream"). Figure 10 below shows that the value pairs for the first three levels, expressed in % of respondents, are quite balanced: 35 % vs. 30 % (object level), 75 % vs. 80 % (concept level), and 86 % vs. 89 % (designation level) (cf. Löckinger/Takacs-Schwarzinger 2017: 23; Löckinger/Takacs-Schwarzinger 2018: 56).

There is only one major difference between these three levels: for the object level, there are more respondents searching for such information than respondents wishing to have it included in reference tools. Also, the values for the object level are generally much lower than for the other three levels. This result might be due to respondents not expecting special language reference tools to contain object level information. However, it is somewhat surprising since both general encyclopaedias (cf., for instance, Encyclopædia Britannica 2007) and specialised encyclopaedias (cf., for instance, Baillieul/

[12] Note that technical communicators' technical requirements for special language reference tools were the subject of a separate survey question. They are thus beyond the scope of the present article. Research results about that survey question are published in Löckinger (2019).

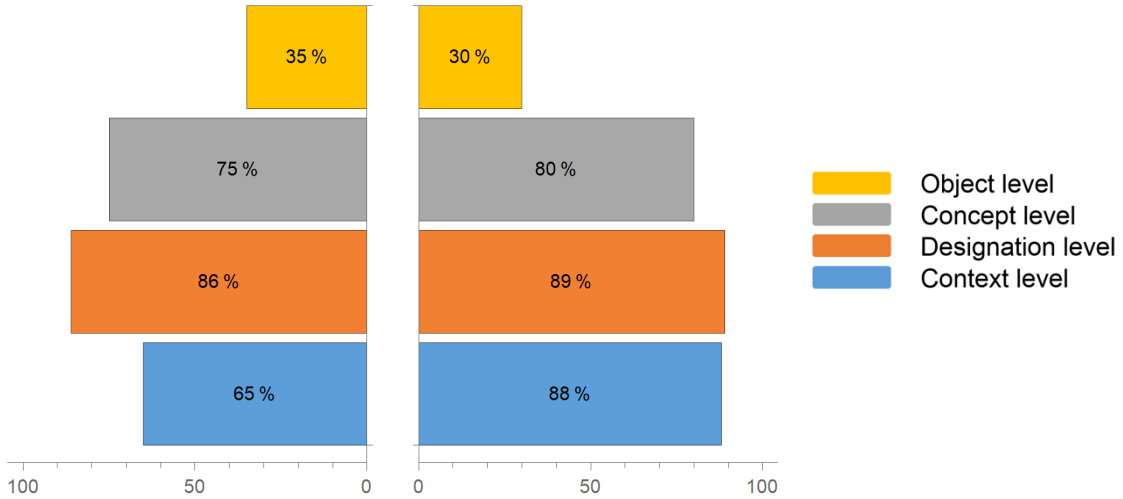

Figure 10: Information types at object, concept, designation, and context levels: searched ("reality", on the left) and wished for ("dream", on the right)

Samad 2015) are well-known types of reference tools that contain object level information. Another reason might be that respondents do not (need to) clearly differentiate between the object level and the concept level in their practical work. For example, a technical communicator might search a definition of 'concrete dumper' and then find both a definition and technical details about specific concrete dumpers produced by a given manufacturer. Strictly speaking, this search procedure includes both the concept level (definition) and the object level (technical details). However, based on the search intention, the technical communicator might perceive it as a concept level search rather than an object level search.

Compared to the other three levels, the context level shows a remarkable discrepancy: while 65 % of respondents search for such information, 88 % (plus 23 %) would like to have this included in special language reference tools.

Due to the said discrepancy and the importance of its underlying information types for text production, the context level is particularly interesting (cf. Löckinger/Takacs-Schwarzinger 2018: 56). A closer look reveals that all data about information types at the context level follow a similar pattern. As shown in Figure 11 below, only 42 % of respondents search for word combinations,[13] while as many as 64 % wish for them. Contexts[14] and sample sentences[15] are similar (37 % vs. 67 % and 18 % vs. 34 %, respectively). Possible explanations for these differences might be that (a) respondents do not search these information types so often because of low success rates in previous searches and/or (b) the search process is perceived as cumbersome due to a (supposed)

13 Example: "press the emergency stop button".
14 Example: "… operator pressed the emergency stop button as required by …".
15 Example: "This product has been designed and tested to meet strict safety requirements."

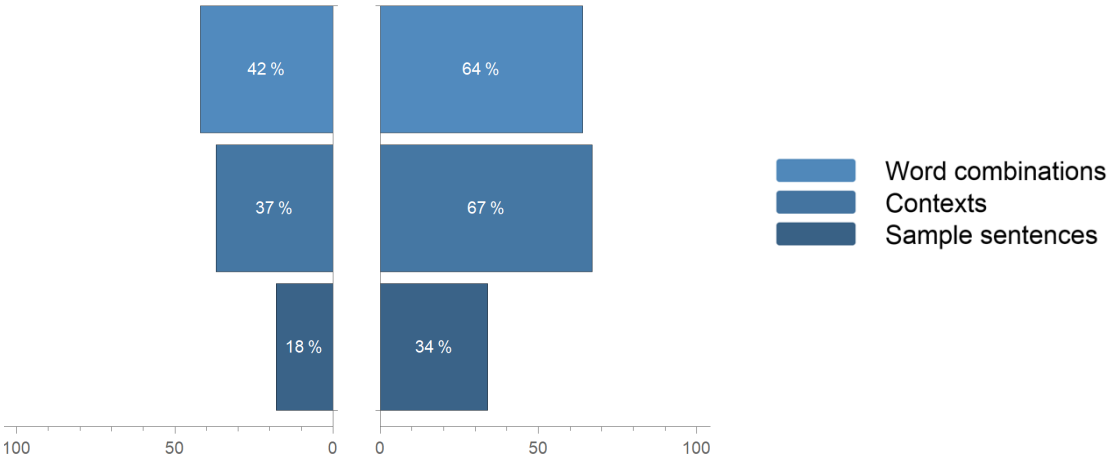

Figure 11: Information types at the context level: searched ("reality", on the left) and wished for ("dream", on the right)

lack of adequate high-quality information sources (cf. Löckinger/Takacs-Schwarzinger 2018: 56).

The values for sample sentences could be generally lower for either of two reasons. Firstly, respondents may not perceive them as a genuine type of special language information to search. Secondly, sample sentences may be less relevant as search items: sample sentences can also be delivered by software tools typical of technical communicators' workplace, such as component content management systems, authoring memory tools and the like.

5 Analysis of associations

In this section, we combine the data from section 3 and section 4 to analyse any existing associations for answering the second series of research questions: *What are the associations, if any, between [explanatory variable] and [response variable]?* To this end, we consider 'chronological age' and 'organizational age' as explanatory variables, while 'frequency of use', 'level of satisfaction', 'working time spent researching special language information' and 'types of special language information' serve as response variables. In other words, we want to examine to what extent chronological age or organizational age exert an influence on technical communicators' professional behaviour: how often they use special language reference tools, how satisfied with them they are, how much working time they spend researching special language information, and what types of special language information they search and wish for. Since no such study has yet been published in technical communication studies, the subsequent analyses are exploratory in nature.

5.1 Statistical testing and data coding

In our study, we examined associations between pairs of explanatory and response variables. For each pair of variables, the null hypothesis is that there is no association between the variables.[16] In order to investigate potential associations, we used three statistical methods:

(1) Spearman's rank correlation test (SRC). This method applies to the original ordinal data, with the exception of missing age data. It detects monotone associations and produces correlation coefficients.

(2) Analysis of variance test (ANOVA). This method needs the explanatory variables to be grouped and thus neglects some details of the data. On the other hand, missing age data form a group of their own and need not be removed. ANOVA is also able to detect non-monotone associations.

(3) Linear regression analysis (LRA). This method needs numerical data for the explanatory variables. Therefore, we formed groups of data represented by their means. A LRA model detects linear associations. Considering the slope of the regression line will also produce quantitative statements.

Combining several methods can reveal different types of association. Moreover, this approach serves as an instrument for quality assurance. The data of our study have been coded only when this was necessary for statistical calculations. In the remaining cases, we used the original ordinal or numerical data:

- For the explanatory variable 'chronological age', we used
  - age groups for SRC and ANOVA (see 3.1),
  - numerical codes for LRA: 21.5 for 'under 26 years', 30.5 for '26–35 years', 40.5 for '36–45 years', 50.5 for '46–55 years', and 60.5 for '56 years and over'.
- For the explanatory variable 'organizational age', we used age groups for ANOVA (see 3.4).
- For the response variable 'frequency of use', we used numerical codes for LRA: 0 for "never", 1 for "seldom", 2 for "sometimes", 3 for "often", and 4 for "always".
- For the response variable 'level of satisfaction', we used numerical codes for LRA: 0 for "not at all satisfied", 1 for "slightly satisfied", 2 for "moderately satisfied", 3 for "considerably satisfied", and 4 for "extremely satisfied".

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16 For sections 5.1 to 5.6, we rely on internationally agreed state-of-the-art concepts of statistics: 'null hypothesis' is defined as "hypothesis … to be tested by means of a statistical test"; 'statistical test' is defined as "procedure to decide if a null hypothesis … is to be rejected in favour of an alternative hypothesis"; 'alternative hypothesis' is described as "statement which contradicts the null hypothesis" (ISO 3534-1 2006, clauses 1.41, 1.48, and 1.42, respectively; quoted in ISO ca. 2019).

- For the response variable 'working time spent researching special language information', we used
  - percentage ranges for SRC and ANOVA (see 4.3),
  - numerical codes for LRA: 5 for '≤ 10 %', 15 for '11 %–20 %', 25 for '21 %–30 %', 35 for '31 %–40 %', 45 for '41 %–50 %', and 75 for '> 50 %'.
- For the response variable 'types of special language information', we used numerical codes for LRA: 0 when the relevant type was not selected, and 1 when the relevant type was selected.

5.2 Summary of results

Table 3, Table 4 and Table 5 below summarise the results of our statistical tests, based on the following conventions:

- We use the short forms 'SRC', 'ANOVA' and 'LRA', as discussed in 5.1.
- Each table cell shows the relevant p-value and sample size.

The results presented in the tables are to be read as follows:

- When the p-value is 0.10 or greater, the table cell is not highlighted. In these cases, the result of the statistical test indicates that the null hypothesis cannot be rejected. In other words, the variables can be considered to be more or less independent of each other.
- When the p-value is between 0.05 and less than 0.10, the table cell is highlighted in yellow. We will call this situation "notable". In these cases, the result shows that the null hypothesis can be rejected based on a significance level of 10 %, but not of 5 %. In other words, the statistical test indicates that there may be some association between the variables.
- When the p-value is less than 0.05, the table cell is highlighted in green. We will call this situation "significant". In these cases, the result shows that the null hypothesis is rejected based on a significance level of 5 %. In other words, the statistical test indicates some association between the variables.

The last two cases, i. e. notable associations and significant associations, are discussed in detail in the sections listed in the relevant table row.

Explanatory variable / Response variable	Chronological age			Organizational age			Article section
	SRC	*ANOVA*	*LRA*	*SRC*	*ANOVA*	*LRA*	
Frequency of use	p = 0.050 n = 251	p = 0.119 n = 255	p = 0.034 n = 251	p = 0.574 n = 257	p = 0.001 n = 262	p = 0.667 n = 257	5.3
Level of satisfaction	p = 0.035 n = 249	p = 0.253 n = 254	p = 0.050 n = 249	p = 0.032 n = 254	p = 0.174 n = 255	p = 0.016 n = 254	5.4
Working time spent researching special language information	p = 0.751 n = 255	p = 0.318 n = 255	p = 0.163 n = 255	p = 0.096 n = 259	p = 0.003 n = 260	p = 0.052 n = 259	5.5
Types of special language information	[See Table and Table for details.]						

Table 3: Results of statistical tests – chronological/organizational age vs. frequency of use, level of satisfaction, and working time spent researching special language information

Explanatory variable / Response variable		Chronological age			Organizational age			Article section
		SRC	*ANOVA*	*LRA*	*SRC*	*ANOVA*	*LRA*	
Types of special language information: object level	reality	p = 0.664 n = 251	p = 0.192 n = 257	p = 0.646 n = 251	p = 0.060 n = 256	p = 0.447 n = 257	p = 0.041 n = 256	5.6.1
	dream	p = 0.580 n = 251	p = 0.490 n = 257	p = 0.548 n = 251	p = 0.117 n = 256	p = 0.242 n = 257	p = 0.062 n = 256	
	reality vs. dream	p = 0.363 n = 251	p = 0.837 n = 264	p = 0.363 n = 251	p = 0.698 n = 256	p = 0.935 n = 264	p = 0.825 n = 256	
Types of special language information: concept level	reality	p = 0.948 n = 251	p = 0.988 n = 257	p = 0.986 n = 251	p = 0.306 n = 256	p = 0.526 n = 257	p = 0.428 n = 256	5.6.1
	dream	p = 0.724 n = 251	p = 0.284 n = 257	p = 0.826 n = 251	p = 0.402 n = 256	p = 0.014 n = 256	p = 0.241 n = 256	
	reality vs. dream	p = 0.741 n = 251	p = 0.420 n = 264	p = 0.848 n = 251	p = 0.792 n = 256	p = 0.222 n = 264	p = 0.811 n = 256	
Types of special language information: designation level	reality	p = 0.223 n = 251	p = 0.219 n = 257	p = 0.171 n = 251	p = 0.407 n = 256	p = 0.825 n = 257	p = 0.440 n = 256	5.6.1
	dream	p = 0.857 n = 251	p = 0.046 n = 257	p = 0.599 n = 251	p = 0.143 n = 256	p = 0.028 n = 257	p = 0.223 n = 256	
	reality vs. dream	p = 0.350 n = 251	p = 0.384 n = 264	p = 0.442 n = 251	p = 0.707 n = 256	p = 0.629 n = 264	p = 0.790 n = 256	
Types of special language information: context level	reality	p = 0.648 n = 251	p = 0.191 n = 257	p = 0.606 n = 251	p = 0.947 n = 256	p = 0.447 n = 257	p = 0.887 n = 256	5.6.1
	dream	p = 0.648 n = 251	p = 0.962 n = 257	p = 0.620 n = 251	p = 0.521 n = 256	p = 0.543 n = 257	p = 0.400 n = 256	
	reality vs. dream	p = 0.923 n = 251	p = 0.427 n = 264	p = 0.862 n = 251	p = 0.923 n = 251	p = 0.427 n = 264	p = 0.862 n = 251	

Table 4: Results of statistical tests – chronological/organizational age vs. types of special language information (overview of object, concept, designation, and context levels)

Explanatory variable / Response variable		Chronological age			Organizational age			Article section
		SRC	*ANOVA*	*LRA*	*SRC*	*ANOVA*	*LRA*	
Context level: word combinations	reality	p = 0.088 n = 251	p = 0.215 n = 257	p = 0.085 n = 251	p = 0.133 n = 256	p = 0.411 n = 257	p = 0.169 n = 256	5.6.2
	dream	p = 0.465 n = 251	p = 0.690 n = 257	p = 0.383 n = 251	p = 0.504 n = 256	p = 0.762 n = 257	p = 0.631 n = 256	
	reality vs. dream	p = 0.372 n = 251	p = 0.283 n = 264	p = 0.905 n = 251	p = 0.460 n = 256	p = 0.924 n = 264	p = 0.422 n = 256	
Context level: contexts	reality	p = 0.294 n = 251	p = 0.051 n = 257	p = 0.224 n = 251	p = 0.398 n = 256	p = 0.510 n = 257	p = 0.258 n = 256	5.6.2
	dream	p = 0.690 n = 251	p = 0.956 n = 257	p = 0.697 n = 251	p = 0.688 n = 256	p = 0.897 n = 257	p = 0.620 n = 256	
	reality vs. dream	p = 0.688 n = 251	p = 0.318 n = 264	p = 0.935 n = 251	p = 0.710 n = 256	p = 0.400 n = 264	p = 0.603 n = 265	
Context level: sample sentences	reality	p = 0.709 n = 251	p = 0.196 n = 257	p = 0.603 n = 251	p = 0.824 n = 256	p = 0.480 n = 257	p = 0.742 n = 256	5.6.2
	dream	p = 0.097 n = 251	p = 0.089 n = 257	p = 0.146 n = 251	p = 0.241 n = 256	p = 0.214 n = 257	p = 0.294 n = 256	
	reality vs. dream	p = 0.062 n = 251	p = 0.576 n = 264	p = 0.087 n = 251	p = 0.191 n = 256	p = 0.575 n = 264	p = 0.224 n = 256	

Table 5: Results of statistical tests – chronological/organizational age vs. types of special language information (context level only)

5.3 Age and frequency of use

The green cells in the corresponding row of Table 3 indicate significant associations between chronological/organizational age and frequency of use. Concerning chronological age, the yellow cell for SRC describes a notable positive correlation (rho = 0.124), while LRA yields a significant association with a positive slope of the regression line (beta = 0.011, i. e. an average increase of one frequency step in about 100 years). Thus, technical communicators who are older in chronological age use special language reference tools on average a little more often than their younger colleagues.

Concerning organizational age, the association seems to be not monotone because neither SRC nor LRA indicate an effect. However, ANOVA shows a very significant result. Having a closer look at the means per group reveals that the group of 6 respondents with missing organizational age use special language reference tools much less frequently than the technical communicators who entered their organizational age. Removing this group from the ANOVA produces a non-significant result (p = 0.220, n = 256). Thus, organizational age seems to have no association with technical communicators' frequency of use of special language reference tools.

5.4 Age and level of satisfaction

According to the corresponding row in Table 3, we can state that technical communicators on average get a little more satisfied when they grow older in chronological age or in organizational age. For both explanatory variables, SRC and LRA show significant

associations. For chronological age and level of satisfaction, the correlation coefficient is positive (rho = 0.134) and so is the slope of the regression line (beta = 0.007, i. e. an average increase of one frequency step in about 150 years). Organizational age shows the same pattern (rho = 0.143, beta = 0.012). A reason for this result could be that older technical communicators have had more time to practice using various information sources. Thus, they are more familiar with tools and options for optimizing their research. Also, they know better what to expect from special language reference tools; see the corresponding result in 5.6.2 c).

5.5 Age and working time spent researching special language information

The green and yellow cells in the corresponding row of Table 3 show the following: technical communicators' working time spent researching special language information is not significantly associated to their chronological age. It is notably, but not significantly associated to their organizational age. The significant ANOVA result is due to the group with missing data for organizational age. On average, the respondents belonging to this group report to spend a high percentage of working time researching special language information. Removing those respondents from the ANOVA produces a non-significant result (p = 0.363, n = 258). SRC and LRA show notable negative associations (rho = –0.104, beta = –0.186). Therefore, technical communicators of older organizational age on average spend less working time researching than their colleagues. A reason for this observation might be that longer professional experience results in a larger body of knowledge and thus less need for research.

5.6 Age and types of special language information

We analyse associations between chronological/organizational age and types of special language information at the object, concept, designation, and context levels (see 3.1, 3.4, and 4.3). The first group of analyses examines the four levels in general (see 5.6.1). The second group of analyses zooms in on the context level (see 5.6.2).

5.6.1 Overview: object, concept, designation, and context levels

Table 4 summarises the results for the four levels, based on three perspectives of analysis. We always compare the "reality" perspective (information actually searched) with the "dream" perspective (information wished for) and the difference between "reality" and "dream" perspective. Our tests yield only few significant results:

(a) Object level: technical communicators who are older in organizational age are somewhat less likely to search for information at object level than colleagues with less experience ("reality" perspective). SRC shows a notable association with a negative correlation coefficient (rho = –0.118) and LRA shows a significant result with a negative slope of the regression line (beta = –0.008, i. e. nobody would search for such information after about 125 years in organizational age). The "dream" perspective shows similar associations with somewhat higher p-values.

This is not surprising since more experienced technical communicators will typically know more about the relevant objects (physical devices, software, etc.). Therefore, they may be less interested in object level information.

(b) Concept level: here, we find one significant result with organizational age in the "dream" perspective: the ANOVA reveals a non-monotone development of technical communicators' wish for special language information at the concept level. This may be due to career development and increasing work experience, but it could also be a random effect. The random effect is supported by the fact that a slight change in the groups produces a non-significant result with similar means per group.

(c) Designation level: in the "dream" perspective, the ANOVA produces two significant results. The first one applies to chronological age. When we consider the means per group, we see that the 4 respondents "under 26 years" wish much less for special language information at designation level. Conversely, the 6 respondents with missing data for chronological age wish for it much more. The "dream" perspectives of the other respondents are quite the same, i. e. an ANOVA excluding the two groups mentioned shows a non-significant result ($p = 0.232$, $n = 247$).

The second significant result applies to organizational age. Based on the means per group, the ANOVA shows that technical communicators of younger and older organizational age on average wish less for special language information at the designation level than their colleagues. (At this stage, we cannot offer any specific interpretation of this result.)

No associations were found between the explanatory variables and the difference between "reality" and "dream" perspective. In other words, we cannot say that technical communicators become more realistic or more frustrated in the course of their (professional) lives.

5.6.2 A closer look: context level

Since the context level differed quite clearly from the other three levels for the entire group of respondents (see 4.3), it is analysed in greater detail. Table 5 summarises the results for the three underlying information types, again based on three perspectives of analysis: as above, we compare the "reality" perspective (information actually searched) with the "dream" perspective (information wished for). Also, we look at the difference between "reality" and "dream" perspective. Here too, our tests yield only few notable results and only with regard to chronological age:

(a) Word combinations: our results mirror notable associations with chronological age in the "reality" perspective. The correlation coefficient and the slope of the regression line are positive. In other words, technical communicators who are older in chronological age are somewhat more likely to search for word combinations than their younger colleagues. This could be due to older technical communicators being familiar with more word combinations than colleagues of younger chronological age.

(b) Contexts: here, the only notable result is in the "reality" perspective with respect to chronological age. The means per group calculated in the ANOVA reveal that the group with missing data for chronological age is quite different from the other groups. Removing this group from the ANOVA yields a non-significant result ($p = 0.252$, $n = 251$). Thus, chronological age seems to have no association with contexts as a type of special language information.

(c) Sample sentences: here, the "dream" perspective somehow changes with increasing chronological age. SRC yields a negative correlation coefficient, i. e. technical communicators who are older in chronological age somehow tend to wish less for sample sentences. The notable result of the ANOVA is again due to the group with missing data for chronological age. Removing this group from the ANOVA yields a non-significant result ($p = 0.156$, $n = 251$).

Additionally, both SRC and LRA indicate a notable negative association between chronological age and the difference between "reality" and "dream". Therefore, we can state that technical communicators who are older in chronological age tend to show a smaller difference between "reality" and "dream" than younger colleagues. This corresponds to the result presented in 5.4 (level of satisfaction increases with age).

6 Conclusion and outlook

So far, technical communicators' information needs and their use of special language reference tools have been more or less outside the research focus. The present article set out to fill this research gap by describing the results of a written online survey for technical communicators in Germany, Austria and Switzerland. A total of 265 completed questionnaires have been processed and interpreted.

The present article described comprehensive qualitative and quantitative analyses focused on the following traits of technical communicators related to reference tools: frequency of use, level of satisfaction, working time spent researching special language information, and types of special language information searched and wished for. In a number of statistical tests, these four traits were considered response variables, while technical communicators' chronological age and organizational age were considered explanatory variables.

All in all, the influence of chronological age and organizational age on the response variables is limited. Sections 3, 4 and 5 contain the relevant analyses and interpretations. On this basis, a prototypical technical communicator (PTC) may be described as follows.

PTC's personal and professional profile

PTC is almost equally likely to be female or male.

PTC is on average between 46 and 55 years old.

PTC is employed at an enterprise which has a legal obligation to produce technical documentation.

PTC has an average full-time work experience of 11 to 15 years as a technical communicator.

PTC's main job is technical documentation.

PTC's use of special language reference tools

PTC sometimes uses special language reference tools.

PTC is moderately or considerably satisfied with those tools.

PTC spends on average about 10 % of working time researching special language information.

PTC searches for special language information at concept level, designation level, and context level (and maybe object level, too).

PTC's age in relation to his or her use of special language reference tools

PTC uses special language reference tools a little more often than colleagues who are younger in chronological age.

PTC is a little more satisfied with available special language reference tools than colleagues who are younger in chronological age or organizational age.

PTC tends to spend a little less working time researching special language information than less experienced colleagues.

PTC searches and tends to wish for special language information at object level somewhat less often than colleagues who are younger in organizational age.

PTC tends to search word combinations somewhat more often than colleagues who are younger in chronological age.

PTC tends to have a more realistic expectation for special language reference tools than colleagues who are younger in chronological age when it comes to the type of special language information 'sample sentences.'

Combined with the research results published in Löckinger and Takacs-Schwarzinger (2017, 2018) and Löckinger (2019), the present article provides a detailed state-of-the-art picture of technical communicators' information needs and research preferences. Firstly, our research results support software developers' common practice not to differentiate between several sub-target groups based on chronological age or organizational age. Secondly, software developing companies can merge their product-specific user feedback with the results of our study. Thus, they will have a solid basis for developing new

or optimized reference tools for technical communicators. In this context, a result of special interest is the remarkable discrepancy between "reality" and "dream" at the context level. More specifically, future reference tools should offer features related to word combinations, contexts and sample sentences (see 4.4; cf. Löckinger/Takacs-Schwarzinger 2018: 56).

Furthermore, the results in section 4.4 suggest that both academic teaching and academic research put a stronger focus on special language information at the context level. While such types of special language information have been the object of study in corpus linguistics for a long time, technical communication degree programmes seem to have paid only little attention to them. Thus, one way forward in academic teaching could be to better integrate methods and tools for text corpus use into curricula of technical communication studies (cf. Löckinger/Takacs-Schwarzinger 2018). Another practical implementation could be to request technical communication students to use text analysis and text corpus tools for various types of assignments, e. g. in terminology work, technical documentation or for their literature research for Bachelor or Master theses. Thus, students would become familiar with the relevant methods and tools during their studies. Later, they could act as facilitators and multipliers for tools and methods in their working environments.

Our study lays the groundwork for future research into the same questions or similar ones using different methods. For example, it would be highly interesting to find out to what extent our survey-based research results are in line with empirical data collected by means of observation (cf. Löckinger 2019). In this connection, earlier research on translators' information needs and requirements for special language reference tools might provide a good yardstick for comparison (cf., for instance, Nord 2002; Löckinger 2014). Many questions still need to be addressed about technical communicators researching special language information for their challenging job.

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Appendix

Table 6 below reproduces the survey questions treated in the present article. It presents the survey questions in their original German wording, in an English version translated by the authors, and the type of question. In addition, the number of actually usable responses (sample size) is indicated. Finally, references to the relevant sections of the present article are given for ease of use.

Survey question (German)	**Survey question (English)**	**Question type**	**Sample size**	**Article section**
Verraten Sie uns Ihr Alter?	What is your age?	closed question, with option "Prefer not to say"	264	3.1
Verraten Sie uns Ihr Geschlecht?	What is your gender?	closed question, with option "Prefer not to say"	264	3.2
In welchem arbeitsrechtlichen Rahmen sind Sie derzeit überwiegend tätig?	What is your current primary employment status?	mixed question, with option "Other" for free-text answers	264	3.3
Wie lange sind Sie bereits als technische/r Redakteur/in tätig? Bitte rechnen Sie auf Basis einer Vollzeitbeschäftigung und runden Sie auf ganze Jahre auf.	How long have you been working as a technical communicator? Please express your answer in years of full-time work and round off to the next higher number.	open question	263	3.4
Welche Tätigkeit führen Sie vorrangig aus?	What is your primary task at work?	mixed question, with option "Other" for free-text answers	256	3.5
Wie häufig verwenden Sie in Ihrer Arbeit als technische/r Redakteur/in fachsprachliche Nachschlagewerke?	In your work as a technical communicator, how often do you use special language reference tools?	closed question	263	4.1
Wie zufrieden sind Sie mit diesen Nachschlagewerken?	How satisfied are you with these special language reference tools?	closed question	255	4.2

Bitte schätzen Sie, wie viel Ihrer Arbeitszeit Sie für die Recherche fachsprachlicher Informationen verwenden. Rechnen Sie sowohl die Zeit für Gespräche, z. B. mit Kolleg(inn)en, als auch die Zeit für das eigenständige Recherchieren in verschiedenen Informationsquellen ein.	Please estimate how much of your working time you spend researching special language information. Include both time for oral conversations, e. g. with colleagues, and your own individual research in various information sources.	closed question	264	4.3
Wenn Sie fachsprachliche Informationen benötigen, was suchen Sie?	When you need special language information, what do you search for?	mixed question, with option "Other" for free-text answers	256	4.4

Table 6: Overview of survey questions analysed in the present article

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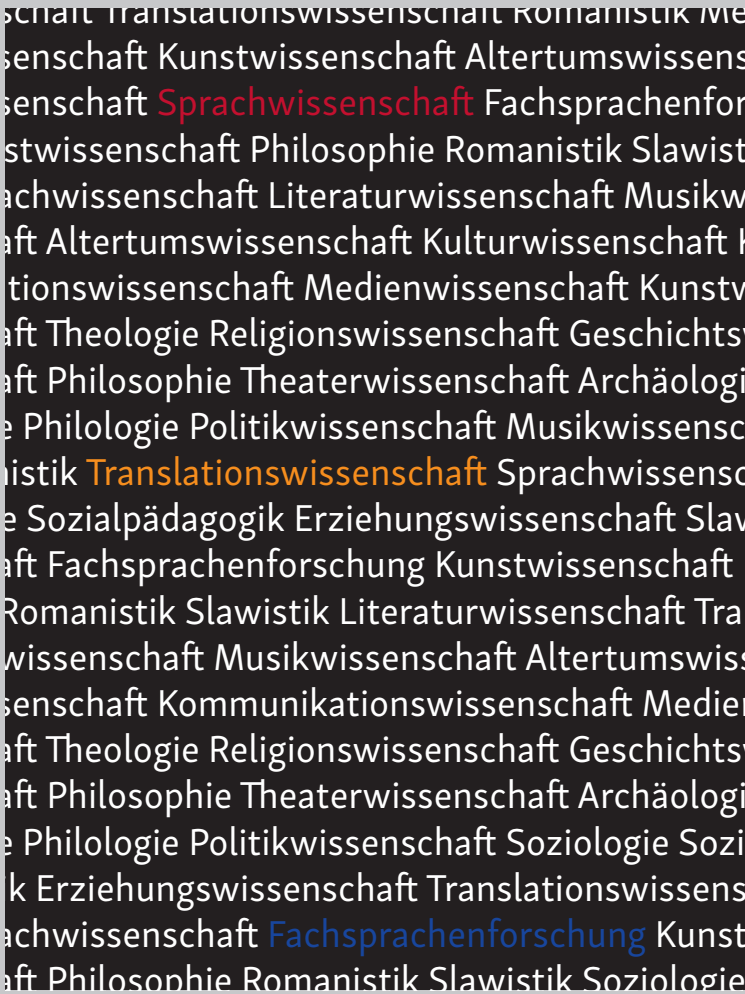

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