

Tower of Babel Bias: Is There More to Learn about Employee-Driven Digital Innovation?

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Abstract. With its origins in medical sciences, systematic literature reviews (SLRs) have gained popularity and widespread acceptance in a variety of disciplines. The systematic processes ensure an exhaustive inclusion of all relevant material and strength of conclusions. Three approaches are known to improve the comprehensiveness of SLRs: 1) extending the search with snowballing of references and citations, 2) including “grey literature” (multi-vocal reviews), and 3) verifying the list of included studies with field experts. In this paper, we explore another strategy – inclusion of studies written in languages other than English, the usefulness of which is debated. Our goal is to understand whether the Tower of Babel Bias (exclusion of articles based on language) introduces important gaps in evidence. The results of multilingual extensions an existing SLR on employee-driven innovation that included articles written in Russian language show that the extension provides unique insights and perspectives not elucidated in the research published in English, namely the employee innovativeness. We conclude that multilingual literature reviews may be time-consuming endeavors with very limited return on the invested time but may as well result in enriching the understanding of the topic of interest from a unique perspective, especially with respect to regional peculiarities. Finally, we discuss the challenges related to performing a multilingual review.

Keywords: Systematic Literature Review, Multilingual, Tower of Babel Bias, Employee-Driven Digital Innovation.

1 Introduction

Reviews of research literature provide a theoretical background for subsequent research, help to summarize the breadth of research on a topic of interest, or answer practical questions by understanding the current state-of-the-art or -practice [1]. When questions that concern a literature review aim to synthesize best quality scientific studies, in other words, represent evidence [2], systematic literature reviews are to be performed. One important quality of systematic literature reviews is its comprehensiveness – exhaustive inclusion of all relevant material. When reading through the existing guidelines on systematic reviews three main recommendations for performing an exhausting selection of studies can be identified:

1. Extending the search in electronic databases with snowballing of references (backward) and citations (forward) in order to include relevant studies that might not surface using the search string alone [1, 3].
2. Performing a multi-vocal review, i.e., such that includes “grey literature” (non-peer-reviewed sources such as preprints, books, magazines, technical and government reports, white papers, lectures, datasets, theses and dissertations, news articles, blogs, etc.), especially when targeting contemporary / emerging topics and embodying the views or voices of diverse sets of authors [4].
3. Verifying the resulting list of articles with the field experts [5, 6], especially when the subject matter is not yet strictly defined, when information may come from various fields, or if the reviewer suspects that much relevant work might not yet be publicly available [1].

Researchers performing a literature review are naturally restricted to reviewing studies written in languages they can read, or for which they have access to scholarly databases [1] and reserve themselves from including papers in various languages due to the lack of resources or prohibitive translation costs [7]. While medical standards suggest that it is important to avoid, as far as possible, exclusions based on the language of the primary study (also known as the Tower of Babel bias [8]), guidelines in other disciplines may not be so prescriptive. As a result, most literature reviews in information systems, for example, have traditionally filtered out the non-English articles. But what is the implication of setting us conveniently to using research only written in English? Curious to explore the extent of the Tower of Babel bias, we hereby summarize our lessons learned from extending an existing systematic literature review with the search and analysis of articles in one additional language: Russian. Admittedly, we were initially set to review research in Russian and Chinese but were constrained by our own language limitations. Yet, Russian language offers an interesting forum as Russia has their own academic traditions, conferences, journals and scholarly databases. Besides, scientific works in Russian language are also published by Russian speaking researchers from other (often neighboring) countries.

The rest of the paper is organized as follows. In Section 2 we outline the background and motivation for our study. Section 3 details the methodology behind the replication of the two SLRs and the approach to comparing the conclusions. In Section 4 we share the results of the SLR extension followed by the lessons learned reported in Section 5. Finally, Section 6 concludes the paper with a summary of major findings.

2 Background

Language bias or selection bias based on a language in systematic literature reviews has received considerable attention in Medical Sciences [9], with a number of comparative studies that contrast the findings of the meta-analysis of scientific studies published in English with the studies published in other languages. For example, an early study of the Tower of Babel phenomenon published in 1995 found that one meta-analysis with insignificant change in mortality of the patients would have arrived at a different conclusion if a paper written in German language in a Swiss journal had been

included in the analysis [10]. Although admitted being time consuming and costly, the standards for performing systematic literature reviews in Health Care therefore recommend avoiding language bias [9]. Technological development in machine translation is one important step in making multilingual literature reviews less time consuming and less costly [7].

The criticality of including all possible evidence in medical studies is obvious, but what about information systems research? The authors of the very guidelines for performing systematic literature reviews advise to select “practical screening criteria” based on, among other criteria, language. Perhaps therefore, multilingual or comparative meta-analysis studies of scientific evidence in these areas are not popular.

Our research study is motivated by the willingness to learn whether the exclusion of articles not written in English influences the evidence gathered during systematic literature reviews. In this paper, we have chosen to compare the findings from a systematic review of research literature in English and Russian on a selected topic. The topic selection was done by convenience, as one of the authors has recently finished a systematic literature review on employee-driven digital innovation, had deep knowledge of the topic and familiarity with the SLR procedure. Our study is thus driven by the following **Research Questions**: *What is the relationship (with respect to quantity, quality, content, topic overlap, and conclusions) between the evidence obtained from systematically reviewing research literature in English and in Russian languages?*

3 Methodology

To answer our research question, we performed multilingual extension of an existing systematic literature review on employee-driven digital innovation [11]. The original review is dedicated to a narrow topic, the interest in which has emerged in the recent decade. Our goal was to replicate the existing SLR processes to cover research in a language distinct to English. The protocol for conducting the extension was based on the original review and followed the seminal advice for performing SLRs [2, 12, 13].

3.1 Search strategies

We started by translating the search strings and performing additional searches in digital scholarly databases, following the time frame and the search strategy of the original studies (Step 1). The original review reporting the-state-of-the-art on employee-driven digital innovation [11], followed the guidelines by Webster and Watson [12], Kitchenham [2] and Rowe [13]. The search strategy aimed at high-quality data by using the international online scholarly database Scopus. The authors searched for journal articles or conference proceedings reporting empirical research published between 1 January 2010 and 11 March 2021 and included publications that were peer-reviewed and written in English based on the search strings applied (see Table 1).

Our replication started with the translation of the search strings into the Russian language. We have decided on a pragmatic approach to narrow down the search strings to the one that contains the other strings (3. “Employee” AND “Innovation”), which was

then translated using two different synonyms for the word “Employee” – “Работники” and “Сотрудники”. We chose eLibrary.ru¹ to replicate the search, as one of the key scholarly databases indexing the scientific literature in Russian language. The other alternative, Cyberleninka², was excluded as rather small. Since we could not select a concrete date to limit our search, we decided to follow the authors approach and search until the current date of search. In the replication, we also limited the search to the articles available in full text. The original search returned 10,436 hits, while the replication returned 4,332 hits (see Figure 1).

Table 1. Details of the original review and its extension.

Original study	
Topic	Employee-driven digital innovation
Search string	1. “Digital AND Employee-Driven AND Innovation” 2. “Employee-Driven AND Innovation” 3. “Employee” AND “Innovation” 4. “Digital” AND “Employee” AND “Innovation”
Search strategy	Titles, abstracts and keywords. Journal articles and conference proceedings
Databases	Scopus. Additionally performed snowballing
Time frame	2010-01-01 – 2021-03-11
Replication in Russian	
Search string	3.(Работники AND Инновации) OR (Сотрудники AND Инновации)
Search strategy	Titles, abstracts and keywords. Journal articles and conference proceedings. Full text available. Search based on morphology
Databases	eLibrary.ru. Additionally performed snowballing
Time frame	2010-01-01 – 2021-10-19

3.2 Study selection (inclusion and exclusion)

Study selection started by excluding duplicates and studies which did not have an abstract (Step 2), followed by the relevance assessment based on the title and publication channel (Step 3). The remaining papers were then evaluated based on the abstract (Step 4), or subsequently a full read through (Step 5). Studies were included if they focused on employee-driven digital innovation, appeared in a peer-reviewed journal or conference, and were written in English. To reduce the possibility of omitting relevant publications, the authors performed snowballing of the references for papers published in or after 2020 (Step 6).

Our replication followed the procedure adapted from the original review. Study inclusion and exclusion was performed by the first author in regular consultation with the

¹ eLibrary is the largest Russian scientific portal established in 1999 to provide access to foreign scientific works, and since 2005 including works in Russian language. The database currently indexes over 39 million of published works from over 74,000 scientific journals, ¼ of which are from Russia.

² Cyberleninka indexes 2,7 million scientific works and focuses on dissertations and open access.

first author of the original SLR, and evidently differed with respect to the targeted language. Further, because we were not familiar with the publication channels, our screening in Step 3 was limited to judging the relevance of the papers based on their titles. Snowballing was repeated after the same procedure as in the original study by pulling the references of the papers published in 2020 but did not result in any additional papers to include.

The original study selection resulted in including 58 papers, while the replication resulted in including just 1 paper.

3.3 Quality assessment

The original SLR performed a quality assessment of the included papers (Step 7), following the established recommendations [14], and judged whether the publication was a research paper, the aims of the research, its context, research design, recruitment strategy, data collection, data analysis, relationship between researcher and participants, statement of findings, and value for research or practice. The scoring was binary: 0 if the criterion is not fulfilled and 1 otherwise.

Our replication followed the procedure from the original SLR. All papers included in the original review and the replication passed the quality assessment. The filtering of papers based on quality assessment is displayed in Figure 1, while the assessment results in the original SLR and the replication are presented in Figure 2.

3.4 Analysis procedures

In the replication, we followed a similar approach and replicated the mapping process employed by the original SLR. We followed the original data extraction form to map key results from the original review and the replication. To answer our RQ and understand whether multilingual replication is useful, we judged the quantity, the quality, and the content of the paper in Russian language. In other words, we were interested to see whether there is additional evidence 1) to support already covered findings or 2) adding unique findings. This was done by looking at the relationship between the results from original SLR and the replication and revisiting the key conclusions.

3.5 Limitations

Our study has several important limitations. Our review cannot qualify as full-standing systematic literature review and should not be treated as such, because the search strings and strategy were designed to replicate the original review and not to include all possible evidence on the topic. Due to this, there is a risk of omitting relevant studies. We might have also missed some relevant work by selecting limited bibliographic databases and applying pragmatic strategies when narrowing down the scope by choosing most popular synonyms to terms.



Fig. 1. Study selection through the different phases of the original reviews and replications.

	Q1 Research (not "lessons learned" or expert opinion)	Q2 Clear statement of the aim	Q3 Adequate description of the context	Q4 Justified research design	Q5 Appropriate data collection	Q6 Rigorous data analysis	Q7 Minimized researcher bias	Q8 Clear statement of findings	Q9 Value of the research or practice
Original	100%	100%	100%	100%	93%	93%	72%	100%	100%
Replication	100%	100%	100%	100%	100%	100%	0%	100%	100%

Fig. 2. Fulfillment of the quality assessment criteria.

4 Results

In this paper, we report our findings from performing a multilingual replication of an SLR on employee-driven digital innovation motivated by the willingness to learn whether the Tower of Babel bias influences the evidence gathered during SLR. In this section, we provide the quantitative findings with respect to the papers found during the SLR extension, we then present the findings regarding the quality assessment, followed by the findings from content-related comparison diving into the overlap of the topics, content and conclusions.

4.1 Quantity of multilingual additions

Our replication of the review of employee-driven digital innovation has resulted in one additional paper. This was surprising, given that the search replication returned only 2,4 times fewer papers, while the final inclusion resulted in 58 times difference. Key reasons for study exclusion were related to the general perspective of innovation (not innovation of digital products and services, not innovation enabled by digital tools, or not employee-driven innovation), and the chosen perspective, i.e., general studies of national or regional strategies of innovative development and thus the lack of concrete empirical cases. Limited attention to the topic of digital innovation is also highlighted by the authors of the included paper [P1] who explains it by the limited availability of digital technologies, and subsequently their use (both unwillingness and inability to use digital technologies).

4.2 Quality of the multilingual addition

The only paper included in the review [P1] was well written and passed all the quality assessment criteria but one – the discussion of the relationship between researchers and

participants. The comparison of the results of this assessment between the replication and the original review is inadequate, due to the single data point in the replication.

4.3 Content, topic and conclusions overlap

Comparing the content of a single article against the collection of 58 articles in the original literature study is an unfair endeavor. However, there are some interesting reflections that can be linked to this single study. The authors [P1] seek to provide an understanding of employee-driven digital innovation at the individual level, which contrasts with the original SLR, in which the vast majority of studies were performed on the organizational level. This also applies to the quantitative approach that the study methodologically uses. Most of the studies in the original literature review sought to shed light on employee-driven digital innovation through qualitative research. The combination of these two factors provided in this one publication creates a lens for insight that is not elucidated in the 58 publications included in the original literature study, namely the employees' innovativeness. This is insightful as we currently know little about the mechanisms that involve employees in innovation. The theory used in [P1] is not used in any of the 58 original studies. This can provide a theoretical approach that other researchers can be inspired by and provide a basis for new studies that can provide further insight into the field when applied in other contexts. In the publication, the authors also highlight the need for further research in the field, based on the fact that there are still connections that cannot be explained through their study.

A deeper analysis of excluded papers revealed other papers dealing with innovative capabilities of the employees. These were the papers that were excluded from the final set since they did not specifically study digital innovation. Examples include a broad study of individual motivation and its links to innovation [15], a focused study of motivation in connection to participation in innovation contests [16], and a study of employee creative capabilities that stimulate innovation [17], to name a few.

5 Discussion

In the following, we discuss our lessons learned about performing multilingual reviews.

5.1 Translating the search strings

The first challenge we faced when replicating the SLR in Russian was the translation of the search strings. The challenges of correct translation caused by the differences in terms, phrasal lexical units and grammatical features of scientific style are not new [18]. In the following we list four lessons learned in this regard.

Difficulty to find equivalent terms: The original study included such keywords as Employee-driven, Digital and Innovation. Translating the first keyword introduced major challenges. First, the combination of the words "employee-driven" does not have a direct translation in Russian. To find out how Russian authors translate the term, we

used the English keyword in a search in the Russian scholarly database, since publications in Russian typically include a translation of the metadata (authors, title and abstract). The search returned one hit, and we found that the authors translated “employee-driven innovation” as “Иновации на рабочем месте”, the direct translation of which is “innovations in the workplace” or “Компании, в которых сотрудники запускают иновации”, the direct translation of which is “Companies, in which employees launch innovations”. However, such translations are very imprecise and likely to return noisy hits. We thus opted to omit this keyword and go for a broader search string, while using the employee-driven innovation as an inclusion/exclusion criterion.

Interlingua interferences: When further piloting the search strings, we tried to translate the term “digital innovation” and noticed that the direct interlingua interference (Дигитальные иновации) is not widely used (returned 0 hits on eLibrary and Google Scholar), and we would risk to fall into the trap of “false translator friends” [19]. Instead, we used another translation (Цифровые иновации), which turned out to be more promising.

At the end, we decided to use a broader string (No. 3 in Table 1), because the combination of the terms Digital, Employee and Innovation together (Цифровые AND Работники AND Иновации) returned only six hits in eLibrary and 15 hits on Google Scholar.

Distinction between singular and plural forms: In English, it is typically sufficient to abbreviate the keywords in the form “Keyword*” to find both singular and plural forms (with few exceptions). In contrast, in Russian the * is placed after the root of a word. Besides, the singular/plural distinction for nouns, all adjectives in Russian also change their ending for these two forms. As such, the combination of keywords Digital innovation* would translate from English into Russian as Цифров* иноваци*.

Translation of synonyms: Russian language is rich with synonyms (and homonyms), which complicates the translation [18]. For example, the word Innovation has four equivalent synonyms in Russian – новшество, новация, нововведение, иновация, while the word Employee in Russian translates as сотрудники, работники, and персонал. Evidently, this may significantly increase the length of the search string and the difficulty of search execution, when long logical expressions cannot be accommodated with the same search. For simplicity reasons, we only used the most common synonyms, one synonym for innovation (иновация) and two synonyms for employees (сотрудники and работники). When making these decisions, we piloted the search using different synonyms to see the amount of hits returned and randomly comparing whether the same papers appear when using the different search strings.

5.2 Selecting scholarly databases

Discipline-specificity: The topic of employee-driven innovation is cross-disciplinary and thus potentially relevant papers could be found in very diverse publication channels. Yet, synthesizing study findings covering different research fields might not always be a wanted strategy. The original SLR was performed by researchers working in the field of Information Systems and targeted one discipline-agnostic scholarly database (Scopus). When performing the replication, we opted for including eLibrary, the

most popular discipline-agnostic scholarly database that indexes research published in Russian language. This has resulted in finding studies published in very diverse publication channels. The included paper [P1] was published in the field of Innovation economics, while the original review screened out papers not published in channels not related to Information Systems or Innovation Management during the study selection process (with one exception of a study in Psychology, which was classified as Innovation Management).

5.3 Necessity for the language skills

Final, but perhaps most critical question relates to the skills needed to perform a multilingual review. In our case, two of the authors were fluent in Russian, while the author of the original SLR was not familiar with Russian at all. Noteworthy, none of the authors are from Russia or have been a part of the Russian scientific life. Our knowledge limits to the language familiarity, and thus one can say that we acted as outsiders for the Russian scientific arena. In the following, we reflect on the distribution of roles and the importance of the language skills during the different steps when executing the SLR.

Data sources and search strategy: We started our multilingual replication with the translation of the search strings. Our experiences described above (see Section 5.1) clearly show that machine translation would have been insufficient, as this task required not just a direct translation, but an understanding of the scientific context in each of the topics and piloting.

Our next task was to identify scientific databases to be included. We found that this can be done by executing a random search with the search string formulated in the targeted language in Google Scholar and thus does not require the language skills. To do so, we browsed through the venues represented in the hit list returned by Google Scholar and identified two scientific databases, eLibrary and Cyberleninka, which were considered for inclusion. To understand what these databases represent, we had to read the “About” descriptions in both portals. This information was available only in Russian but could have been also understood with the help of machine translation.

When it comes to the search execution, in our case, the user interface of the chosen Russian scientific database, eLibrary, was available in Russian only, while Google Scholar was available in English. Although, we believe that configuring and executing the search could have been done by someone without the language skills, one important task in this process was to screen the search results and assess the appropriateness of the hits returned. Thus, we suggest that search execution is ideally performed by someone who is familiar with the language.

Study Selection: In our experience, we had around 4,000 papers to screen, which required excluding papers that were not available, as well as not papers. This task could have been done without knowing the targeted language. In Steps 3 and 4 during the study selection, we read the titles and abstracts to assess the relevance for our research. Most publications in eLibrary contained abstracts and titles in English, which means that someone without the language skills could have performed the study selection, in rare cases of unavailable translations using machine translation. The final step of study selection was inclusion/ exclusion based on the full text, which would have required

translating 72 papers, because many titles and abstracts contained insufficient details to decide whether the paper was relevant or not. Such translation might be tedious or even expensive and thus this screening step is better performed by the language speakers. Notably, mere language skills, in our experience, were also insufficient to perform the study selection, since it required a good understanding of the topic. Thus, the language speakers who performed the replications were chosen for being informed (although not deeply) about both topics and continuously consulted with the author of the original SLR.

Study quality assessment: To assess the quality of the included papers, we extracted the data according to the checklists used in the original SLR, which often required reading through the whole paper. Verified machine translation or a professional translation could be an alternative at this stage, especially when the number of included papers is not large. Otherwise, it might be an expensive process in terms of time and/or costs.

Data extraction: In our case, data was extracted by the language speakers, but could have been as well extracted using verified machine translation as suggested in related work like [7] or professional translations of the papers.

Data synthesis: We have machine translated the included paper for the author of the original SLR to be able to read it, as we understood that data synthesis would require a deeper knowledge of the topic than that of the language speakers, as well as the deeper understanding of the paper than the mere data extracted from the paper. Our qualitative assessment of the accuracy of translation is partially consonant with the prior work by Balk et al. [7] who found that machine translation is not always accurate and sufficient for high quality data extraction. We found occasions of awkward translations with grammatical errors, but overall felt that the quality of the text was sufficient to understand it. We thus suggest that machine translation requires a verification by a language speaker.

6 Conclusions

In this paper, we have performed multilingual extensions of a recently conducted SLR on employee-driven digital innovation in the Russian language to assess the Tower of Babel bias. Our results show that executing multilingual SLR can be challenging and time consuming. In response to our research question, we found that the usefulness of region-specific evidence is debatable. Our replication returned very scarce additional evidence due to the topic unpopularity after a very time-consuming screening (reviewing 4,332 publications to include just one at the end). Yet, the included paper has provided unique insights into the topic in terms of theories used, and aspects and perspectives studied, and is thus seen as useful. Thus, whether gained insights were worth the effort, can be debated.

With respect to the new insights about employee-driven digital innovation, our SLR extension brought evidence of employee-driven digital innovation at the individual level [P1], namely employees' innovativeness, which contrasts most studies performed on the organizational level [11]. This is insightful as we currently know little about the mechanisms that involve employees in innovation. Besides, it suggests an additional

theoretical basis and a quantitative approach for exploration, as opposed to the traditionally employed qualitative approaches [11].

Finally, we discuss lessons learned about performing multilingual literature reviews, which offer important considerations with respect to translating the search strings, selecting of scholarly databases, searching in different search engines, evaluating papers written with likely distinct academic traditions and the necessity of the language skills.

As future research, we recommend performing further replications of the existing SLR in languages such as Chinese, German, Portuguese, and Spanish to deepen our understanding of the Tower of Babel bias and shed the light on the uniqueness and completeness of the research results published in English.

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