

Connecting Wikifunctions to Wikipedia: Opportunities and Challenges

Research report

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Executive summary

Wikifunctions is a new Wikimedia Foundation (WMF) wiki of code that is part of the Abstract Wikipedia project. It will soon integrate with Wikipedia and sister projects. This will allow code hosted on Wikifunctions to generate content inside Wikipedia articles. In this study, we interviewed Wikipedia contributors and analyzed server data to help determine the details of how Wikifunctions should integrate with Wikipedia. We recommend using Wikifunctions to address technical issues faced by editors. Especially, we suggest using Wikifunctions to support template-like features across wikis and to replicate the functionality of some templates from larger Wikipedias.

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1. Overview

This study aims to support the integration of Wikifunctions (WF) with Wikipedia (WP) and other Wikimedia projects. This integration will allow contributors to use centrally hosted code from WF to generate localized content inside articles.

Specifically, we seek to uncover insights into (A) how WF could improve the workflows and effectiveness of WP contributors, and (B) what barriers to a successful WF integration might exist.

We hope these insights can inform the design of the WF integration, and help the WF team determine which WF use cases and features should be prioritized. They may also inform decisions about community processes and communication related to the integration.

We spoke with 25 contributors who edit WPs in a total of 10 languages. We focused on small- and medium-sized language WPs that were selected as priorities for WF, Abstract Wikipedia and Wikidata. In addition, we interviewed 2 WF editors. Where feasible, we followed up qualitative findings with quantitative analysis. The WPs of the selected participants vary in age, size, technical complexity, number of contributors, and number of speakers of the languages in question.

Since WF will provide technical facilities to WP, we asked editors about technical issues in their workflows. WF may provide functionality similar to templates, so we also asked participants about issues with templates.

The workflow that study participants described most often is the translation of articles using the Content Translation Tool (CX). In this workflow, contributors face issues with templates that exist in the source language (often English) but not in the target language. This creates frustration, slows down work, and leads to errors and the omission of important content from articles in the target language. Here, WF has a unique potential to provide effective solutions.

In a follow-up quantitative analysis, we learned that some of the WPs selected for this study are outliers and that content translation is less common than we would have expected based on the interviews alone. Nonetheless, we still recommend using WF to address the issue of mismatches in template-provided functionality across wikis.

The most general learning we report is that as wikis age and grow, their independent template systems also grow and become more complex and differentiated, in tandem with editorial policies. As part of this process, template systems also become more socially entrenched. We suggest taking this dynamic into account in designing the WF integration.

It would be hard to overstate how complex many WPs' template systems and associated community practices are. Across all WPs, there are millions of templates, help pages and related policy directives, developed over years or decades. Templates are deeply intertwined with how knowledge is organized and presented on WPs.

In this unique, complex setting, the recommendations we offer should not be taken as definitive, much less as firm predictions, and should not be a deterrent to the study of

new, creative, yet-unimagined, or simply different, solutions. (While this caveat applies to all generative research, it is especially important here.)

This study was carried out for the Abstract Wikipedia Team.

2. Background

2.1 Templates

Large Wikipedias have access to a range of well-maintained functions, known as templates and modules. Contributors use these functions to add a wide variety of types of content to articles, including references, sidebars with summary information (“infoboxes”), tables of statistics, lists of related articles, pronunciation guides, notices about issues with articles, and even clickable buttons. Templates and modules save contributors time by automating repetitive tasks. They also help standardize content and design in articles.

(Templates and modules can be used for similar purposes. For simplicity, in this text, we will mostly refer only to templates, though nearly all the statements we make about templates apply equally to modules.)

Each wiki community is tasked with creating and managing its own templates, which normally output content only in the language of the wiki on which they are hosted. While larger wikis often have comparable sets of templates, many templates are missing on smaller wikis, leading contributors to copy and paste templates onto these wikis, and then localize natural language in the template code.

This decentralized approach creates inefficiencies, requiring a significant duplication of effort and preventing smaller wikis from benefiting from the expertise and best practices of large communities. This makes it challenging for smaller wikis to keep pace with larger counterparts in terms of content quality and maintenance.

At the same time, the decentralized nature of templates supports the autonomous development of each wiki community’s editorial policies; as a means of content

standardization, templates implement policies that communities have agreed upon and that may be unique to those communities.

The inefficiencies and other issues related to the current per-wiki implementation of templates have given rise to proposals to create a global, multilingual repository of templates. In the Community Wishlist Survey, proposals for such a feature came in third and first in 2015 and 2021, respectively [\[11\]](#)[\[12\]](#).

Given the NLP facilities planned or already implemented in WF, it appears WF may be a good candidate for a global repository of template-like functions to generate content for wiki articles in multiple languages.

However, WF does not seek to provide a global, “drop-in replacement” for templates. Some features that contributors would expect from a dedicated global template system may not be included in WF.

2.2 Wikidata

WF will be able to obtain data from Wikidata. The existing per-wiki template system already provides this functionality (though not all existing templates use data from Wikidata). As a global, language-neutral knowledge repository, Wikidata is updated frequently. Any articles that include information from Wikidata are also automatically updated when this occurs. The inclusion of data from Wikidata in articles facilitates keeping them up-to-date.

2.3 Wikifunctions

WF is a wiki of freely usable functions. These functions are distinct pieces of code that can be linked together. They may perform a variety of tasks, including simple calculations and, eventually, complex language operations. WF currently lets anyone create and share these functions, and in the future it will allow anyone to use them in diverse applications, including WP and other Wikimedia projects.

One of the goals of WF is to support Abstract Wikipedia, a yet-incomplete Wikimedia project to generate encyclopedic content in any language, based on structured data from Wikidata. Abstract Wikipedia will use code stored on WF to transform structured data

into prose. In anticipation of this application, WF contributors have created a number of basic natural language processing (NLP) functions on WF.

When integrated into WP and other wikis, WF will also have the ability to generate content in articles in a manner (at least to some extent) similar to templates.

Templates, modules and WF (once integrated with WP) will all be “inclusion systems”, in that they generate, or will generate, content for inclusion in articles.

2.4 Roadmap

The WF roadmap establishes that WF should be integrated into WP and other wikis. This will allow the output of functions hosted on WF to be included in article content.

However, beyond this general idea, numerous aspects of the WF integration remain undecided. Areas where decisions have yet to be taken include: UI design, which use cases and features should be prioritized, and how spaces for community discussion will function.

3. Research questions

Main questions:

- A. What opportunities exist for improving the workflows and effectiveness of WP contributors through WF?
- B. What possible barriers to successfully integrating WF might exist?

To help answer (A) and (B), we investigated the following more specific questions:

1. What are typical contribution workflows on participants’ wikis?
2. In those workflows, what technical issues do contributors typically face?
3. What issues do contributors typically face in relation to templates and modules?
4. What community dynamics and practices exist in relation to technical difficulties and technical knowledge?
5. What community dynamics and practices exist in relation to templates and modules?
6. What processes do communities typically follow to keep articles up-to-date?

7. What processes do communities typically follow to maintain code in templates and modules?
8. Have participants heard of Abstract Wikipedia and Wikifunctions, and what do they think of these projects?
9. After viewing a video demonstration of (a mockup of) the WF integration, what are participants' reactions to the functionality shown?
10. What parts of the demonstration video seem difficult to understand to the participant?
11. What community spaces seem best to the participant for discussing issues with WF related to text generation in their language?

4. Approach

This study is exploratory, since the main research questions are open-ended. It is generative, in that it generates recommendations for product development.

The main object of study is wiki communities, understood as online communities and as sociotechnical systems. Under this view, the Wikimedia movement forms a large network or system of overlapping systems. (For more on this view, see [Appendix A](#).)

We focused mostly on five WP communities that were selected as priorities for WF, Abstract Wikipedia and Wikidata. The criteria used to select these WPs related mainly to movement and technical concerns (such as the prioritization of underrepresented languages and the need to test features with latin and non-latin scripts) [34][1]. In addition to contributors to this core group of WPs, we also spoke with contributors to five more WPs (details below).

The main research technique was semi-structured interviews with WP contributors. We sought interview participants with various levels of knowledge about technical aspects of wikis. We also prioritized editors who had a high edit count on their respective WPs; we expected that such editors would be highly engaged with their communities, and would thus be able to describe not only their own experiences, but also community dynamics and the experiences of other contributors.

We analyzed interviews using thematic analysis, and followed up with quantitative analyses of trace data from WMF servers. We also considered documentary sources,

including on-wiki templates, help and policy pages, volunteer proposals, Community Wishlist Survey results, and Phabricator tasks.

4.1 Participants

In total, we conducted 27 interviews: 2 exploratory interviews with WP contributors; 23 semi-structured interviews with WP contributors; and 2 exploratory interviews with WF contributors.

Most participants were recruited through announcements in community forums (Village Pumps and Telegram channels). Others were known to researchers and were invited directly. We asked prospective participants to fill out a brief questionnaire to determine their eligibility.

To select participants from the pool of survey respondents, we viewed respondents' edit counts, and reached out to the contributors with the highest counts.

To find contributors with various levels of technical knowledge, we also viewed survey respondents' contributions to Template and Module namespaces on their WPs.

Participants received a thank-you gift worth \$50 USD.

See [Appendix B](#) for participant codes, locations and WP communities.

4.2 Wikipedias

Most interview participants contribute to one of the five language WPs selected previously as priorities for WF, Abstract Wikipedia and Wikidata. Those WPs are: Bengali, Malayalam, Hausa, Igbo and Dagbani.

In addition, to obtain perspectives on larger WPs, we interviewed contributors to Arabic and Italian WPs.

Finally, for initial, exploratory discussions and pilot interviews, we reached out to editors known to researchers. These editors contribute to English, Polish and Telugu WPs.

The WPs of participants vary across several core measures (such as age, size, and number of contributors). See [Appendix C](#) for details.

4.3 Interviews

Interviews were conducted remotely over Google Meet, and lasted approximately 60-100 minutes. All but two were recorded. Three interviews were held in the participant's language with the assistance of an interpreter; the remainder took place in English.

For the semi-structured interviews, two interview guides were designed. One included technical topics, and the other focused more on non-technical aspects of editing.

Interviews centered on the specific research questions outlined above. Participants were also shown a video demonstrating a possible UI for the WF integration with WP (see [Appendix G](#)). Towards the end of each interview, we explained to participants the detailed goals of the research, and asked them directly for feedback on how to integrate WF with WP.

4.4 Trace data

Quantitative analyses were performed using trace data (digital traces of user activity) from WMF servers. Most such data is stored on the WMF's Analytics Cluster and was queried from Jupyter notebooks; the WMF's public dataset of core metrics was also used in some analyses [22]. For details on how quantitative analyses were carried out, see the corresponding Appendix for each analysis.

5. Results

5.1 Workflows

Most of the articles [...] in Bengali Wikipedia are very small. So, I actually translate them, and expand from the English article to the Bengali article.

– P7, Bengali Wikipedia contributor, Bangladesh

I translate from Spanish or English to Arabic. Sometimes, I write directly [in] Arabic [...] but mainly, I translate.

– P1, Arabic Wikipedia contributor, Egypt

In interviews, we heard repeatedly that participants translate articles from larger WPs, especially English WP, to WP in their language. Often contributors use the Content Translation Tool (CX) to translate, though sometimes they translate without using it.

Other workflows that participants described include: expanding article content, fixing spelling or punctuation errors, improving copy, fixing technical issues in articles (such as reference errors), and creating and improving templates.

It would be challenging to use trace data to measure the prevalence of most of the workflows we heard about; however, in the case of CX, every edit performed with the tool is tagged in the MediaWiki database, so measurement is relatively straightforward. We analyzed data about CX usage, and obtained the following takeaways:

- The rates of CX usage on participants' wikis coincided with what we expected based on interviews, that is: high CX usage on smaller WPs, moderate usage on larger WPs, and very low usage on WPs that limit it (English and Polish) or where machine translation is not supported (Dagbani). (See [Figure 1](#).)
- However, an analysis of CX usage across all WPs showed that several of the WPs of interview participants are outliers, and overall CX usage is lower than we expected based only on interviews. (See [Figure 2](#).)
- Surprisingly, across all WPs, CX usage does not appear to significantly correlate with wiki size. However, it is likely that there are confounding factors at play here (such as the unavailability or poor quality of machine translation for certain languages, the existence of community campaigns to promote CX only on some WPs, or contributors' fluency in the languages of large WPs). It is conceivable that we would see a correlation if such factors were taken into account.

As mentioned, participants also recounted translating without using CX. So, the actual global rate of editing by translating from another wiki is likely higher than the rates of CX usage seen here. Also, our analysis examined CX usage per edit, however, it is possible that we would see different results if we focused instead on editors who use CX (for

example, by comparing across wikis the percentage of active editors who used CX at least once in the last month). (See [Appendix D](#) for more details and the methodology used in this analysis.)

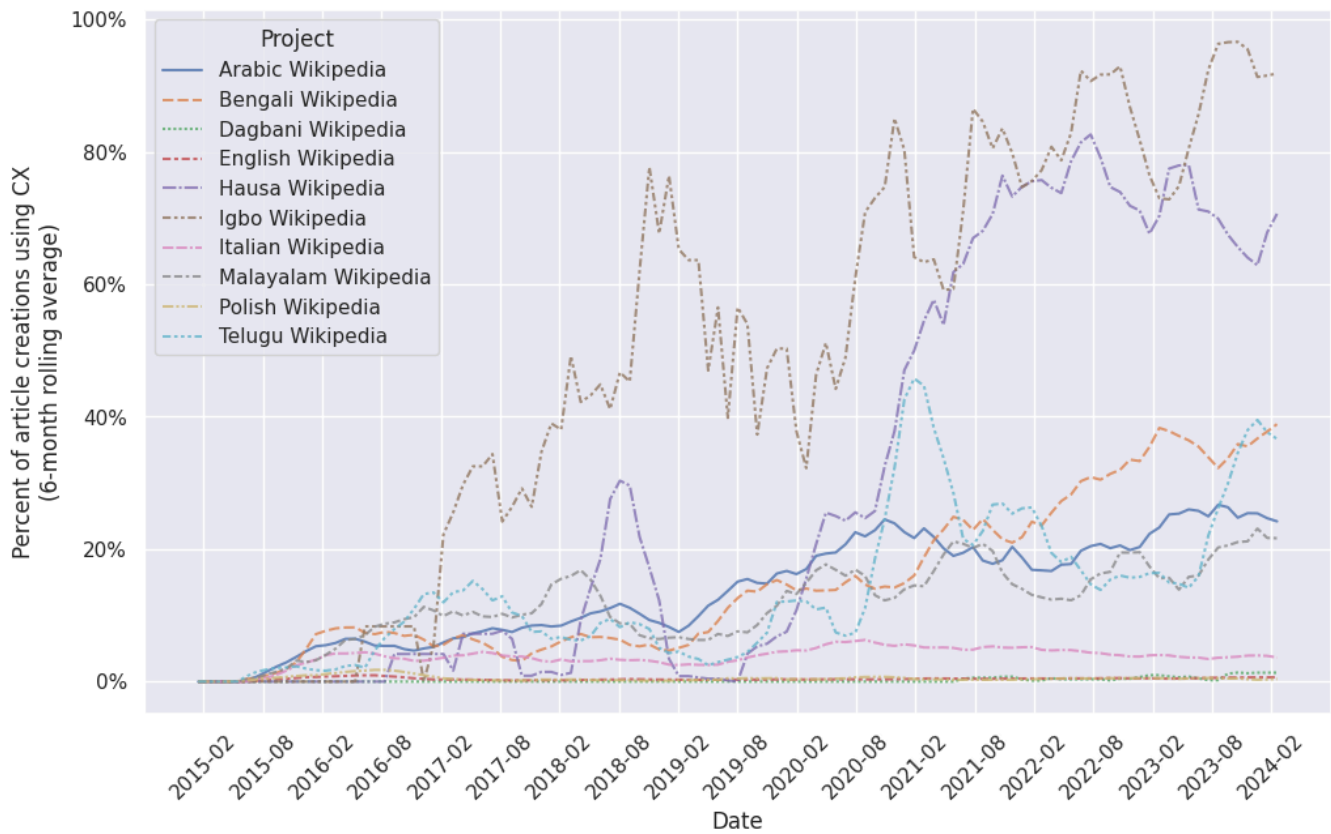


Figure 1. Monthly percentage of article creations using CX, 6-month rolling average, for participant WPs.

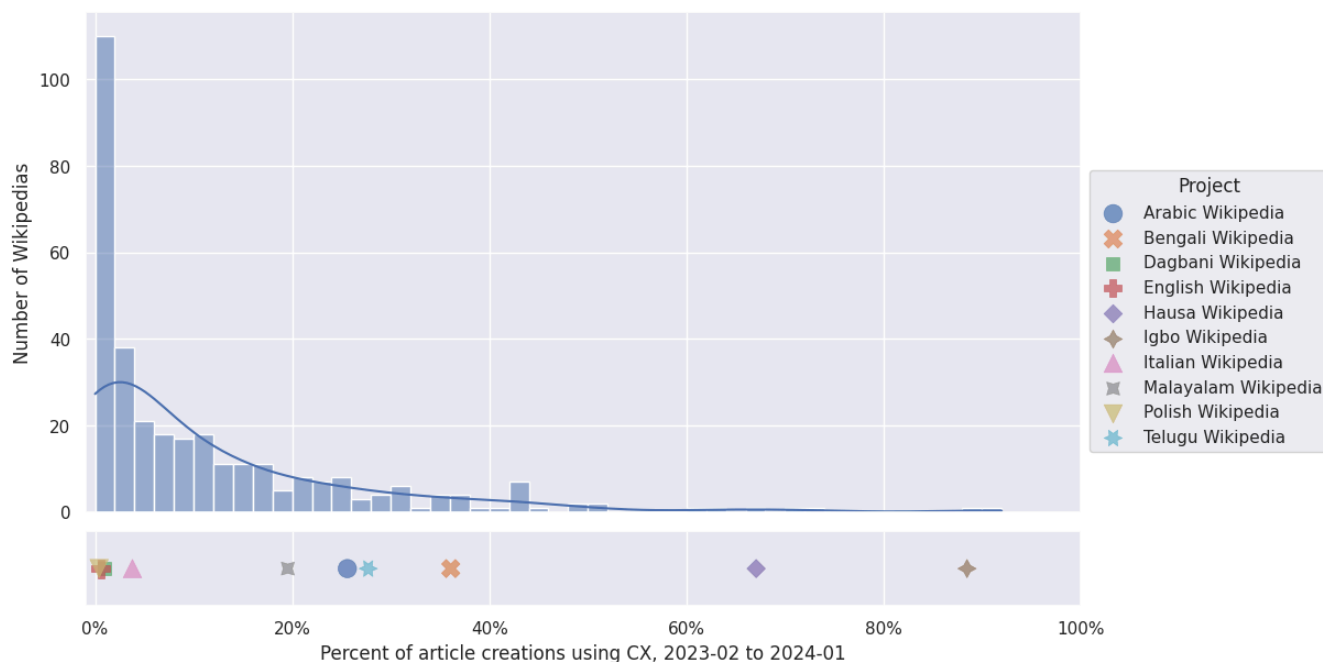


Figure 2. Comparing the percentage of article creations that used CX, 2023-02-01 to 2024-01-31: distribution of values for this measure across all WPs (top chart), compared with the same measure for participant WPs (bottom chart).

5.2 Issues

Missing templates

The most common and most frustrating issue we heard about from participants is the mismatch of templates across WPs. Contributors often face this issue when translating using CX. (Since translation was the workflow they discussed most, it is not surprising that they also highlighted this problem.)

The problem occurs when contributors translate articles (again, often from English) and the source article contains a template that does not exist on their wiki.

The gravity of the issue depends on the type of template that is missing, where it appears in the article, and the technical abilities of the contributor. Often it leads to omission of content or errors in the article in the target language.

When the missing template is in a reference (seemingly a frequent occurrence) the target article can end up with reference errors. Sometimes contributors simply delete references to avoid creating an article with errors.

One of the problems, I realize, is the references. If I copy and paste the reference into the Hausa article, it appears red, “The template is not in your language.” So, I’m forced to discard the reference and just publish it without adding references. So that’s a major problem for me.

– P16, Igbo Wikipedia contributor, Nigeria

When translating, in the reference segment, there’s always what we call reference errors. Sometimes in our community, projects are undertaken by volunteers to correct and remove these reference errors.

– P11, Hausa Wikipedia contributor, Ghana

Other types of content may also be removed for the same reason. For example, in one case we saw, statistics tables generated via a template were omitted from an article about an athlete.

In addition to evidence from interviews, there is documentary evidence of this problem, in the form of dozens of tickets in the WMF’s Phabricator system, as well as volunteer and staff projects to address the issue. (See subtasks listed here [\[14\]](#) and here [\[6\]](#), this proposal [\[15\]](#), and this discussion [\[16\]](#)).

Problems creating equivalent templates

Sometimes, contributors copy and paste template code from the source language WP to their WP. Here are some issues with this process:

- Templates can end up in a partly translated state. Template code often contains natural language strings in the source language. In some cases, contributors only translate the strings displayed by the template in the article they're working on.
- Chains of embedded templates require extra work to recreate. Often, templates contain other templates, which in turn contain still more templates. In such cases, editors need to copy the entire chain of templates over to their WP just to get one template to work.

Once templates have been copied over, it seems there is little concern for keeping the copied template code synchronized with the original from the source language.

Template discoverability

Several participants on larger WPs mentioned difficulties finding templates. The problem is so significant that sometimes editors will create a new template without realizing that one already exists for exactly the same purpose.

When I'm asked, "What templates should I use?", my answer is always: go look at an article that is well made, about the topic, and see which templates are used.

– P19, Italian Wikipedia contributor, Italy

5.3 Updating facts

Ahead of this research, the WF team anticipated that WF might improve editor workflows for keeping articles up-to-date.

However, no participants could recall a time they edited an article to bring a fact up-to-date.

Nonetheless, two participants discussed creating automated mechanisms for updating facts in infoboxes (in both cases, from census data). Also, one participant described a flurry of updating activity by many contributors on English WP, following the release of

census results for their region. All participants reacted favorably to the idea of using WF to keep facts up-to-date based on content from Wikidata.

It appears that updating facts in articles is not a common workflow, and is not top-of-mind for most contributors, despite it being favorably viewed by all interview participants, and a focus for at least some technical contributors.

Actually, I just translate articles from English to Hausa. I don't normally improve on them.

– P11, Hausa Wikipedia contributor, Ghana

In my community, making of new articles has been prioritized over improving or fixing already existing articles.

– P16, Igbo Wikipedia contributor, Nigeria

5.4 Technical knowledge and support

Another learning relates to community technical knowledge and technical contributors: we heard from many participants that technical knowledge is in short supply in their communities.

Also, technical editors play a key role in supporting editors with less technical knowledge, and as a result may be highly socially connected in their communities.

Finally, several participants recounted a process of gradually becoming technically proficient with templates and wikitext, starting with minor tinkering to achieve a specific editing goal.

If there is [...] some technical change which is causing templates not to work, we can kind of count on [experienced editors] [...] which is obviously a bottleneck. The ones that are fully familiar with all the caveats of making templates [...] it's less than five.

– P23, Polish Wikipedia contributor, Poland

Yesterday, some people were asking me, “Is this possible with a bot?” “How do I do this?” [...] So, yeah, I actually do get many help requests.

– P18, Italian Wikipedia contributor, Italy

Editing templates is a communal sort of thing.

– P27, English Wikipedia contributor, United States

5.5 Community and template dynamics

It appears that template systems on WPs tend to follow similar trajectories of growth, increasing complexity and differentiation. This evolution of templates seems to accompany growth in wiki content, number of contributors and wiki-specific policies.

Participants recounted that, on smaller WPs, templates are often copied from English WP; they also stated that, on larger WPs, many templates were originally copied from English WP, and have since developed autonomously.

On smaller wikis, we heard about the creation of a few wiki-specific templates, and on larger WPs, we saw large, intricate, unique template systems that were associated with wiki-specific social practices. For example, on Italian WP, participants demonstrated wiki-specific templates for generating the first paragraph of a biography, listing protected monuments and indicating content licenses; there were even templates for generating template documentation. Italian WP contributors also pointed out an apparently unique

community project, called “Coordination” [24], which promotes discussion and collaboration on various topics, including templates and editorial policy.

For a cursory analysis of the coordinated growth of content, policy and templates across WPs, see [Appendix E](#).

Also, templates can constitute editorial policy in and of themselves. That is, templates can express a standardized, repeated way of presenting information on a given topic, equivalent to a wiki’s editorial policy for that topic. Discussions about such templates, while seemingly technical, can in fact be editorial in nature. See [Appendix F](#) for an example of such a template and a related discussion.

The tendency towards differentiation of wiki template systems appears to be part of a broader back-and-forth between differentiating and unifying trends in the Wikimedia movement overall. In the global ecosystem of wiki communities, the content and policies of WPs can, like templates, become differentiated, while global, multilingual projects such as Wikidata, Wikimedia Commons, and Meta-Wiki seem to act as unifying forces. A detailed analysis of this dynamic is beyond the scope of this research. Nonetheless, we should point out that the WF integration seems poised to become a unifier of currently dispersed technical facilities. (In the [Recommendations section](#), below, we discuss how WF can respect wiki-specific editorial policy while at the same time helping communities benefit from the pooling of technical efforts.)

When we write articles, and we use some books, we will always add [...] a bibliography section that uses the {{Cite_book}} template [...] I guess this is kind of unique to our Wiki.

– P18, Italian Wikipedia contributor, Italy

Some of the Arabic templates were created by the Arabic community. They are not translated from the English language.

– P3, Arabic Wikipedia contributor, Germany

5.6 Wikidata, WF and Abstract WP

Interview participants were familiar with Wikidata, understood how it worked, and viewed the project in a positive light.

Participants on several WPs described using the `{{databox}}` template, which generates a generic, Wikidata-based infobox. To enable this, at least one community undertook a project specifically to translate Wikidata properties. On another WP, however, databoxes were not used, precisely due to the lack of Wikidata translations.

Most participants had heard of Abstract Wikipedia or WF, though few had a detailed understanding of the former. Knowledge of WF was somewhat more widespread, and several participants mentioned having watched WF events online or even participated in in-person WF edit-a-thons.

While translating, we do not use the English `{{infobox}}`. We add the `{{databox}}` template.

– P13, Igbo Wikipedia contributor, Nigeria

5.7 WF demonstration

Nearly all participants watched a video demonstration of a WF mock-up (see [Appendix G](#)).

When it was explained to them, participants understood the WF value proposition quickly and easily. We learned of no major objections to integrating WF with WP. Based on reactions to the video, we would expect a favorable or even very favorable reception from editor communities.

In addition, we saw a few repeated minor points of confusion and areas where extra explanations were needed:

- Several participants assumed the text produced by functions was machine-translated from English.

- It was sometimes difficult to explain the difference between machine translation and the generation of prose based on structured data.
- A few participants initially did not understand that functions would not be hosted on their language WP.
- Some participants assumed that functions would only be for mathematical calculations.
- Additional explanations were needed regarding the applicability of functions in template-like use cases.

I think this is a very good idea. This initiative is very, very nice. If the Wikifunctions can actually do this, I think it's very nice.

– P14, Igbo Wikipedia contributor, Nigeria

6. Recommendations

6.1 General approach

Wikifunctions is a radical, new project without clear antecedents, other than perhaps Wikidata, on-wiki template systems, and Wikipedia itself. Though conceived for Abstract Wikipedia, and likely useful as a global repository of functions or template-like facilities for Wikimedia wikis, WF has possible applications that are much broader. One WF editor described it as a “programming-language-independent programming language” (P24). It may well open the door to radically new, collaborative, distributed code creation practices.

Given this innovative bent, it may seem out-of-place to recommend integrating WF with WP in a way that targets support for existing practices and workflows.

However, in our conversations with WP contributors, what stood out was not contributors’ interest in doing something radically new technically, but rather their struggles to replicate and adapt the experience of the successful and now-established

project that is Wikipedia. The work of contributors seems more geared to bringing something known and useful to new settings, than to creating something new from whole cloth.

So, it seems reasonable to suggest that the most constructive way to integrate WF into WP would be to use WF to support contributors' existing goals, practices and needs. At least in the technical sphere, WP contributors appear to wish to streamline and simplify their labor. They face technical barriers that reduce their effectiveness in the work they wish to do, and WF seems well placed to help remove these barriers.

(It seems likely that whatever innovations contributors to WPs do produce would be in the sphere of epistemic criteria or formats for knowledge dissemination, more than software development processes or natural language processing.)

The general approach we recommend for integrating WF is as follows:

- Integrate WF into common activities that editors are motivated to perform and are already familiar with.
- Adapt WF to solve existing technical challenges, to achieve a net reduction in the overall technical burden facing editors.

No matter what, editors will have to spend some time learning WF in order to use it. If, in doing so, they are able to solve other technical challenges that drag them down, then the WF integration will be a net win.

So, again, our main recommendation is: find typical workflows, and use WF to solve technical problems in those workflows.

Most of the time editors want to continue what they're doing, and not get sidetracked with something else. [...] [Editors] might be concerned about learning something very different, so they'd have to stop what they're doing, which is editing, which is the thing they enjoy.

– P26, Telugu contributor, India

6.2 Workflow and use cases

Based on the interviews we conducted, we would suggest, first and foremost:

- Create WF functions that replicate the functionality of some commonly used, existing templates on larger Wikipedias.
- Make them available for contributors to use on other wikis with little or no effort.
- Integrate them with the Content Translation Tool (CX).
- Facilitate discoverability.
- Provide copious, localized documentation, tutorials and trainings.

These are our main, specific recommendations, especially if the WF team seeks to continue to collaborate most closely with the WPs they have already prioritized (Bengali, Malayalam, Hausa, Igbo and Dagbani).

As mentioned above, CX usage is higher than average on these WPs. If the WF team seeks to target the most common workflows across-the-board, then integration with CX may be less important, and further research may be warranted to identify the most common workflows in this broader context (see [7. Further research](#) for more on this).

If, for technical reasons, it proves impossible to replicate the functionality of common templates ahead of the WF integration (for example, if the WF integration will proceed before functions are able to produce output in a required format) one option might be to delay outreach efforts to promote WF adoption. That is, if the initial WF integration only allows functions to output plain text, consider waiting to promote broad WF adoption until needed output formats become available and replication of templates from larger Wikipedias becomes feasible.

We also recommend considering how different technical options for implementing the WF integration may impact (1) which features and rollout plans will be possible, and (2) what additional learnings or new mental models will be required for technical editors.

6.3 Possible templates to replicate

Here we briefly review general categories of templates whose functionality WF might replicate. Note that a thorough review of which categories of template are most sorely missed on smaller and medium-sized WPs is outside the scope of this research. (However,

related work on this has already been undertaken by volunteers and other WMF teams; see [7. Further Research.](#))

Citation templates

Replicating templates of this sort would help prevent reference errors in translations and stop editors from removing references when translating (an issue we witnessed directly in interviews).

In most cases, citation templates are not tied to wiki-specific editorial policies. Citations are a key part of the Wikimedia movement's approach to knowledge.

Infobox templates

Replicating infoboxes could help showcase Wikidata. A direct antecedent, the generic `{{databox}}` template, has been successful on many wikis. Providing functions that replicate infoboxes would help small wikis add clearer, topic-specific infoboxes to articles.

Infoboxes are a signature element of WP articles across languages.

Other options

Other types of templates that could be replicated include tables of statistics, Main Page templates, or templates for inline content (such as pronunciation guides). See also this taxonomy [\[17\]](#).

6.4 Community process and discussion

Regarding community process, we offer three key recommendations:

- Ensure the WF integration supports diverse, wiki-specific editorial policies.
- Provide spaces for localized and multilingual discussions about WF.
- Foster horizontal community process.

On the first point, we expect there will be no technical impediments to WF providing functions adapted to each and every per-wiki editorial policy. If two WPs decide to present information on a given topic in different ways, WF can offer functions with

configuration options (or, if necessary, multiple functions) to accommodate this difference.

In this way, WF can support per-wiki editorial policy while retaining the benefits of sharing technical resources and effort across wikis. In terms of the dynamic between globally unifying and diversifying tendencies, WF can unify templates that are not tied to the unique policies of any community (likely the case for the majority of templates), thus freeing up contributor resources for other activities, including the elaboration of wiki-specific policies.

Put another way: for many smaller language communities, building entire template systems from scratch is not a realistic proposition. For such communities, the wiki-specific nature of templates, far from supporting community autonomy, wastes contributors' time with repetitive labor, thus reducing time they could spend on tasks more relevant to their communities.

The second recommendation above, that WF offer spaces for localized and multilingual discussions, seems important for the effective use of pooled technical resources. It also seems challenging to implement effectively; experiences from other global projects (Commons, Wikidata, Meta-Wiki), though imperfect, could inform the approach taken.

In interviews, we asked participants where they would expect to go to discuss issues with WF that were specific to their language. We saw no clear pattern in their replies.

Respect for diverse policies and the existence of appropriate discussion spaces are both requirements for fostering horizontal community process (the third recommendation above). (On the benefits of such process for content production, see [\[28\]](#).)

Finally, regarding the selection of WP communities to target for the initial WF rollout, we note that, while focusing on larger wikis might be more impactful in terms of the total number of contributors involved, the focus on smaller wikis has the advantage that the template systems of such wikis are probably less socially entrenched. Smaller WP communities may be more willing to try out the WF integration and may see it as less disruptive.

6.5 Miscellaneous

Here are a few final, brief recommendations:

- Coordinate with the myriad of related projects. Multiple WMF teams and volunteer projects have dedicated huge amounts of work to editing workflows, template proposals, the study of cross-wiki template mismatches, and other related topics.
- Several interview participants emphasized that they prefer to contribute using source editing mode. We suggest taking this into account in the WF design.
- Several participants described the importance of testing changes to heavily used templates in a sandbox before publishing those changes. Providing such an option for WF seems important to support widespread adoption.

7. Further research

7.1 Workflows and edits

Workflows are a central concept for understanding editors and their needs. A related concept that has been the subject of substantial research is the edit itself: what content changed in an edit, what was the editor's intent in making the change, and how should we classify edits and the intentions behind them [\[36\]](#) [\[27\]](#).

Workflows and edits are distinct but related concepts. A workflow can involve multiple edits (for example, a single workflow might involve translating an article using CX, then adding missing templates). Also, many types of edit can be performed using more than one workflow (for example, an editor can fix punctuation on mobile or desktop, in Visual Editor or source editing mode, or using a bot). At the same time, some types of edit are mostly performed only in certain workflows. In much discussion of contributor activity, the two concepts are conflated, and the distinction is often not important.

Both workflows and edits can potentially be analyzed using trace data (though analysis at scale may require specially trained AI models and dedicated infrastructure).

It seems reasonable to investigate edits and workflows together when possible, and that studies of these two related phenomena should build off each other.

Here are two possible orientations for future research on both workflows and edits:

- **Consider in relation to contributors.** Studies of edits and workflows might focus on how they are performed/used by editors. Questions here could include: what percentage of editors never follow certain workflows or never perform certain types of edit? Or, what percentage of editors use certain workflows (for example, translating with CX) at least once a month?

Such questions could be relevant for evaluating the potential impact of work on products and features. For example, consider the hypothetical situation in which a given type of edit only constitutes a small percentage of total edits on a WP. The impact of improving the tools needed for that type of edit could still be significant if a large percentage of editors perform such edits at least every now and then.

Editors could also be segmented (divided into groups) based on types of edit they perform or the workflows they use. This approach could shed light on relationships between roles and social dynamics within WP communities. (In this study, we saw such a relationship in the apparent greater social connectedness of technical contributors.)

- **Consider differences between communities.** In this study, we learned that CX usage varies greatly between WPs in different languages. What other differences might exist in how editors contribute across different WPs? What do these differences imply for community dynamics, growth and WP content in each language?

Finally, we suggest continuing to study the workflows of WF editors, on WF itself. As a project, WF is in the early stages of its development, and, due to the unique nature of its content, we would expect workflows and edit types on WF to be substantially different from those on other wikis. However, in general, in other contexts, software development processes have been studied extensively. How will coding on WF differ from coding elsewhere? What new tools, processes or discussion spaces will be needed to support WF's radical approach to software development?

7.2 WF and templates

[Above](#), we recommended using WF to replicate the functionality of some templates from larger WPs, as part of the integration of WF with WP. We also made some initial suggestions regarding which templates to target. However, given that English WP, for example, has over 600,000 templates, actually deciding which templates to replicate might not be straightforward. Indeed, this could be the subject of future in-depth research.

Trace data can be used to measure which templates are most commonly missing from translated articles, and the WMF Language Team has previously recommended studying this [\[20\]](#). Another topic to investigate could be error states (such as reference errors) in translations and how they relate to the absence of certain templates in target languages. Further considerations include: relevance to target users, alignment with WF and Abstract WP goals, and whether it is technically more feasible to replicate certain types of templates than others. This volunteer-created template taxonomy [\[17\]](#) could be a useful starting point.

7.3 Wiki representativeness and segmentation

Going into this study, we expected that by interviewing contributors to WPs of a variety of sizes, we would likely obtain generalizable results. However, at least in CX usage, it turned out that several of the WPs selected for this study were outliers, and that CX usage does not track with WP size or other standard metrics.

For future research, we would suggest paying closer attention, from the outset, to the representativeness of the WPs included in a study. Note this is not a straightforward problem. One possible way to solve it could be to continue the work, begun several years ago, to segment wikis, grouping them based on similarity of characteristics and processes. The previous research that we found on this topic either did not yield interpretable groupings [\[23\]](#) or was limited in scope [\[21\]](#). Further work is certainly feasible. If it were possible to reliably assign each WP to a group of similar wikis, researchers could increase the chances that the results obtained from the study of a limited selection of WPs would be generalizable. (See also [\[19\]](#).)

7.4 General reflections

In this research, we came across a few topics of general significance for the Wikimedia movement—most notably, opposing tendencies of unification versus diversification of resources, content and policy. WF interacts with these tendencies, though it seems that other projects and activities—specifically, Wikidata and content translation—are even more deeply intertwined with this dynamic. What would it mean for the diversity of epistemic criteria if most facts are held in a central repository (Wikidata) rather than evaluated independently by each WP community? And what does it mean for a substantial portion of a WP’s content to be created via translation from English or from a large WP in another language? Though undoubtedly contentious, discussions of these topics are deeply meaningful for the movement. It seems likely that it would be worthwhile to dedicate time and resources to reflecting on them.

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Appendices

A. Systems framework

Countless social theorists have applied systems theory, or similar perspectives, to the study of social and cultural phenomena, in countless ways. Here we provide only a few brief notes and references on this topic, which, we hope, may be useful in framing the results of this study.

Hu, Mostashari and Xie define *sociotechnical system* as “a dynamic entity comprised of inter-dependent and interacting social/institutional and physical/technological parts, characterized by inputs, processes/actions, and outputs/products” [18: 2]. This seems like an appropriate way to describe WP communities.

English Wikipedia describes complex systems as “systems whose behavior is intrinsically difficult to model due to the dependencies, competitions, relationships, or other types of interactions between their parts or between a given system and its environment” [13].

In this study, we observed what seems to be a tendency of WP communities to become more complex and differentiated as they grow. We also saw an apparent coordinated

evolution of templates and editorial policy. The concepts of complexification, differentiation and coordinated evolution all have definitions within systems theory.

See also [7], [33] and [37].

B. Interview participants

Code	Interview type	Wiki	Country
P1	Semi-structured, technical focus	Arabic Wikipedia	Egypt
P2	Semi-structured, non-technical focus	Arabic Wikipedia	Egypt
P3	Semi-structured, non-technical focus	Arabic Wikipedia	Palestine
P4	Semi-structured, non-technical focus	Arabic Wikipedia	Germany
P5	Semi-structured, technical focus	Bengali Wikipedia	Bangladesh
P6	Semi-structured, technical focus	Bengali Wikipedia	Bangladesh
P7	Semi-structured, non-technical focus	Bengali Wikipedia	Bangladesh
P8	Semi-structured, technical focus	Dagbani Wikipedia	Ghana
P9	Semi-structured, technical focus	Dagbani Wikipedia	Ghana
P10	Semi-structured, technical focus	Hausa Wikipedia	Nigeria
P11	Semi-structured, non-technical focus	Hausa Wikipedia	Ghana
P12	Semi-structured, non-technical focus	Hausa Wikipedia	Nigeria
P13	Semi-structured, technical focus	Igbo Wikipedia	Nigeria
P14	Semi-structured, non-technical focus	Igbo Wikipedia	Nigeria
P15	Semi-structured, non-technical focus	Igbo Wikipedia	Nigeria
P16	Semi-structured, non-technical focus	Igbo Wikipedia	Nigeria
P17	Semi-structured, technical focus	Italian Wikipedia	France
P18	Semi-structured, technical focus	Italian Wikipedia	Italy
P19	Semi-structured, non-technical focus	Italian Wikipedia	Italy
P20	Semi-structured, technical focus	Malayalam Wikipedia	India
P21	Semi-structured, non-technical focus	Malayalam Wikipedia	UAE
P22	Semi-structured, technical focus	English Wikipedia	Canada
P23	Semi-structured, technical focus	Polish Wikipedia	Poland
P24	Unstructured	Wikifunctions	Australia
P25	Unstructured	Wikifunctions	Poland
P26	Unstructured	Telugu Wikipedia	India
P27	Unstructured	English Wikipedia	United States

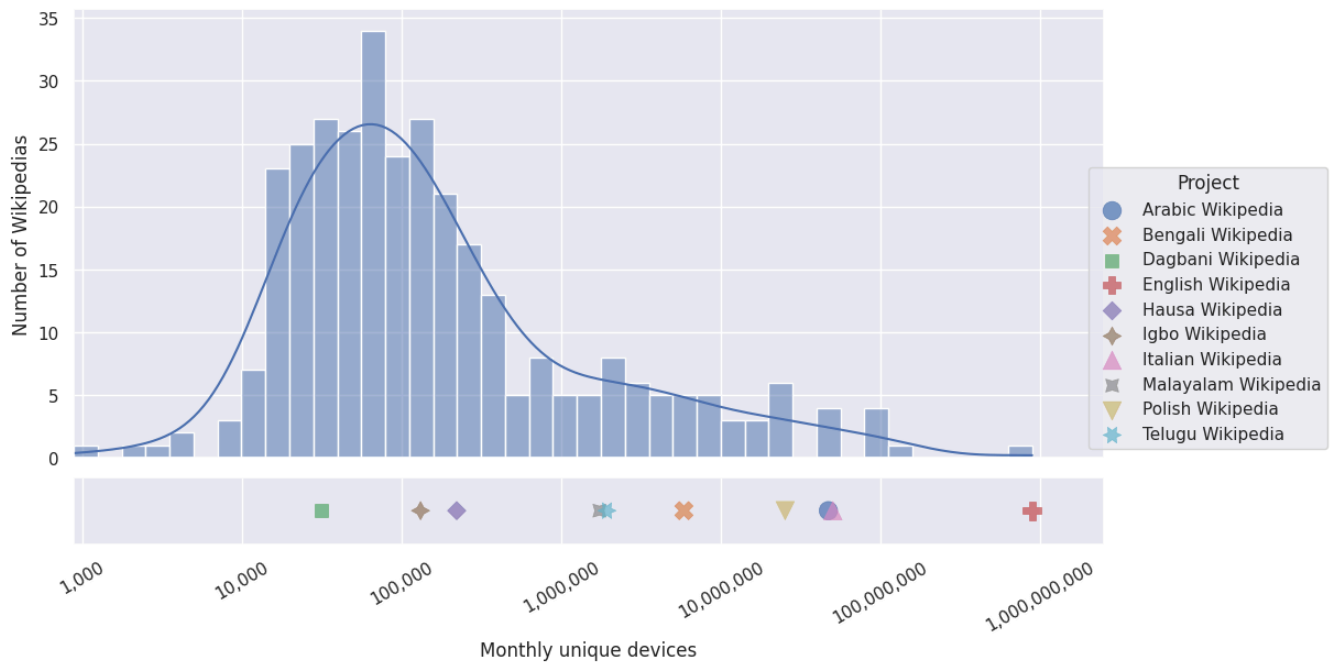
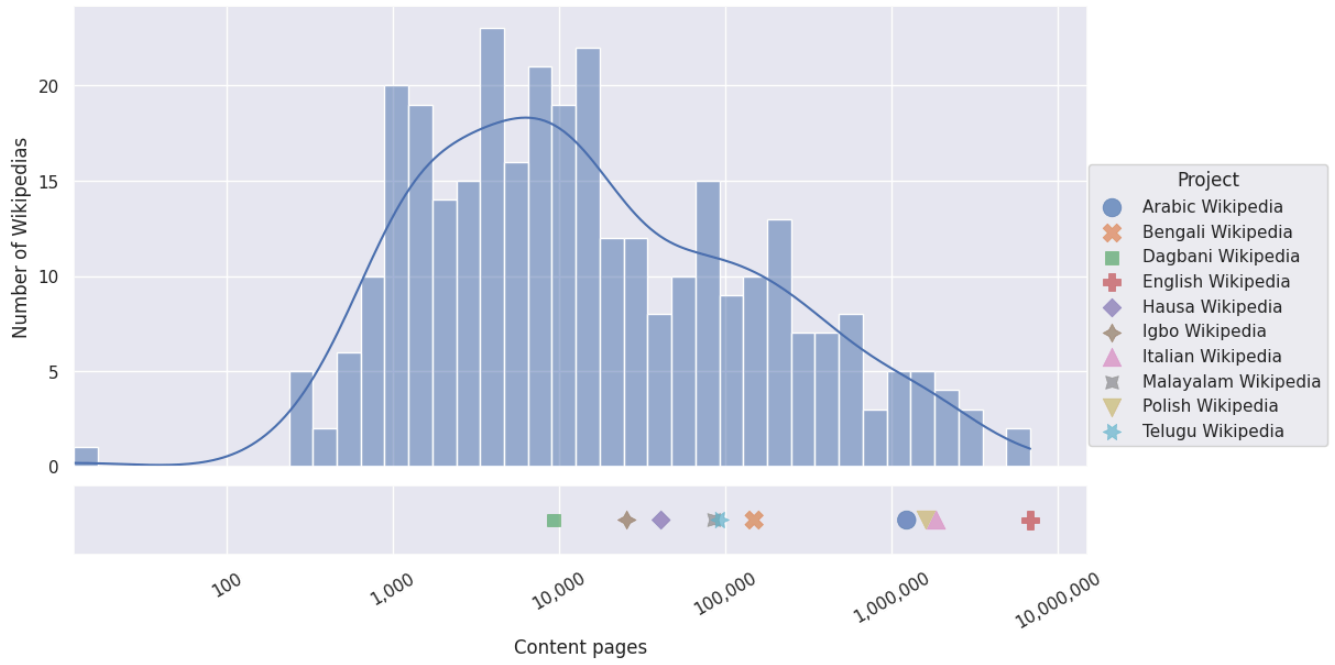
Table 1. WP and WF contributors who participated in interviews for this study.

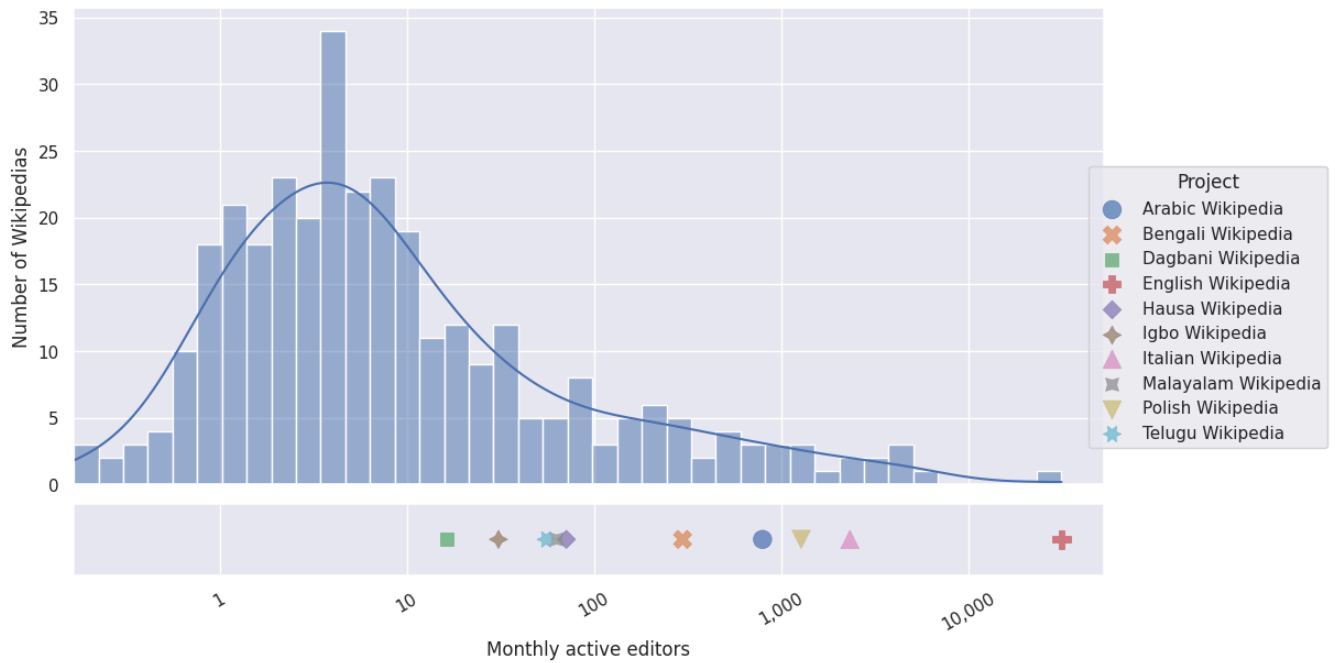
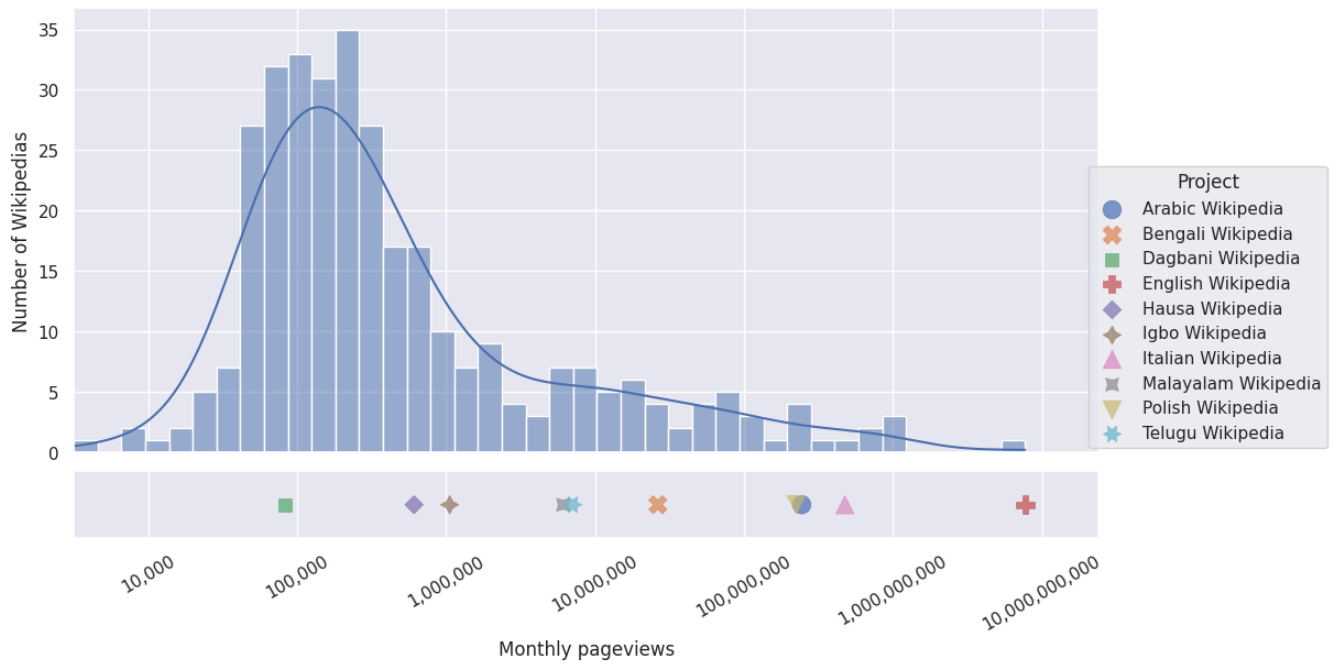
C. Wikipedias

Below are a table and charts showing key measures for the WPs of participants. Data is from the WMF’s public Wiki comparison dataset [22]. Percentile scores are with respect to the population of all WPs (not all WMF wikis).

Project	Content pages	Content pages perc.	Month. unique devices	Month. unique devices perc.	Month. page-views	Month. page-views perc.	Month. active editors	Month. active editors perc.	Month. active admin.	Month. active admin. perc.	Age (days)	Age perc.
Dagbani WP	9,228	46.9%	31,323	21.8%	83,048	22.7%	16	71.2%	1	6.9%	1,006	3.6%
Igbo WP	25,524	63.5%	130,995	58.9%	1,057,712	75.8%	31	78.5%	4	68.1%	7,156	46.6%
Hausa WP	40,973	67.5%	220,692	68.1%	609,620	69.0%	71	83.7%	7	85.4%	7,973	87.8%
Malayalam WP	85,360	75.8%	1,729,138	84.4%	6,090,017	84.4%	63	83.3%	7	85.9%	8,477	99.5%
Telugu WP	92,630	77.0%	1,928,477	85.6%	7,100,498	85.0%	55	82.8%	5	78.7%	8,071	92.8%
Bengali WP	148,519	81.0%	5,850,779	91.4%	26,396,973	91.1%	296	92.0%	12	89.6%	7,402	60.6%
Arabic WP	1,228,102	95.1%	46,995,897	97.2%	244,058,978	97.2%	791	95.1%	21	94.5%	8,477	99.5%
Polish WP	1,606,071	96.9%	25,198,164	96.0%	223,555,738	96.6%	1,272	96.9%	72	98.5%	8,223	94.7%
Italian WP	1,852,002	97.5%	50,163,524	98.2%	475,154,182	98.2%	2,316	97.9%	109	99.4%	8,256	95.0%
English WP	6,792,544	100.0%	888,600,046	100.0%	7,689,967,367	100.0%	31,196	100.0%	398	100.0%	8,477	99.5%

Table 2. WPs of participants across key metrics, with percentile score for each metric.





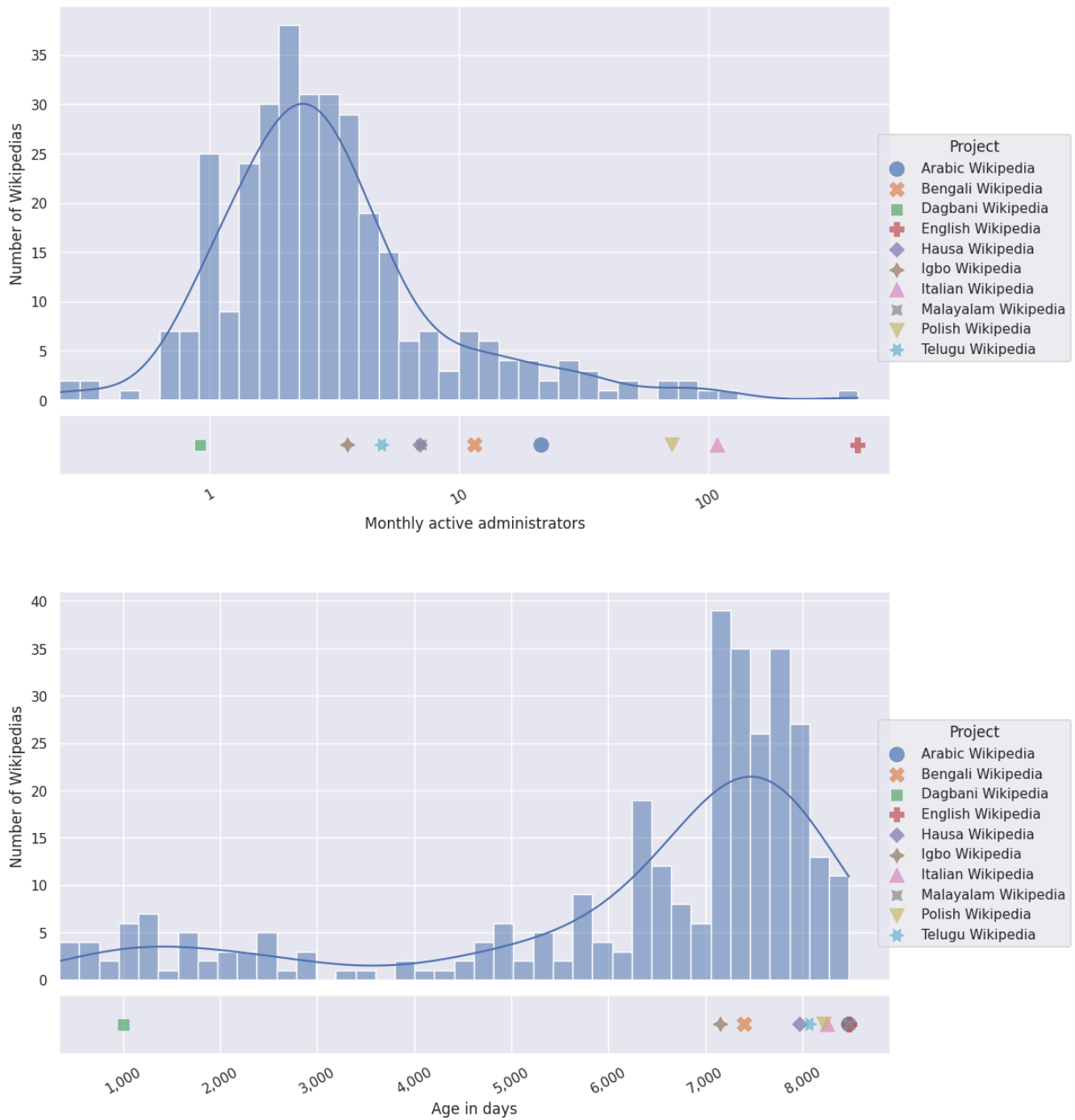


Figure 3. WPs of participants on key metrics (lower charts), with the distributions of all WPs over the same metrics (upper charts). See [22] for definitions of metrics.

The Jupyter notebook used to query and process data, and generate plots, is available here:

<https://gitlab.wikimedia.org/andyrussg/jupyter_notebooks/-/blob/deb8ba7341f415398d9f98dee566a91f7d03b4fa/wiki_comparison.ipynb>. WP age data obtained from: <https://github.com/wikimedia-research/wikimedia_project_creation_closure_dts/blob/master/data.tsv>.

D. Analysis: CX usage

As noted ([Figure 2](#)), several WPs of interview participants are outliers, in that the rate of CX usage on those WPs is much higher than average.

For this analysis, we examined the edit history of WPs in all languages over the one-year period from 2023-02-01 to 2024-01-31. For each WP, we counted edits that created new articles, and that had not been flagged as deleted, reverted, or performed by a bot.

For all such edits (which we refer to here as “article creations”) we then counted those flagged as performed with CX, to obtain the percentage of article creations with CX, for each WP.

[Table 3](#) shows (A) the percentage of article creations with CX for all participant WPs, and (B) the percentile score of each WP for that measure, in the population of all WPs.

Project	(A) Percentage of article creations with CX	(B) Percentile score of (A) in the population of all WPs
Polish Wikipedia	0.4%	22.4%
English Wikipedia	0.6%	23.3%
Dagbani Wikipedia	0.9%	26.1%
Italian Wikipedia	3.8%	43.6%
Malayalam Wikipedia	19.6%	79.4%
Arabic Wikipedia	25.6%	85.9%
Telugu Wikipedia	27.7%	87.7%
Bengali Wikipedia	36.1%	92.6%
Hausa Wikipedia	67.1%	98.8%
Igbo Wikipedia	88.5%	99.7%

Table 3. Percentages of article creations with CX, for the one-year period from 2023-02-01 to 2024-01-31, participant WPs.

The median percentage of article creations with CX across the entire population of WPs (taking each language WP as a unit of observation) is 5.60%. The average value of this measure for the population of WPs is 11.34%.

However, these values give equal weight to each WP, ignoring differences in size. To evaluate the overall tendency of editors to use CX across all WPs, and also across subsets of WPs, it seems preferable to aggregate article creations on all the WPs in each set, and calculate the percentage of articles created with CX in each set. Following this approach, we found the percentage of articles created using CX across all WPs, over the same one-year period mentioned above, is 10.05%. For all articles created only on WF focus WPs during this period, the percentage is 45.98%.

Figure 4 shows these percentages, together with total article creations, during the same period, for different sets of WPs. This figure highlights the non-negligible raw number of articles created using CX across all WPs, despite the global rate being much lower than in participant WPs.

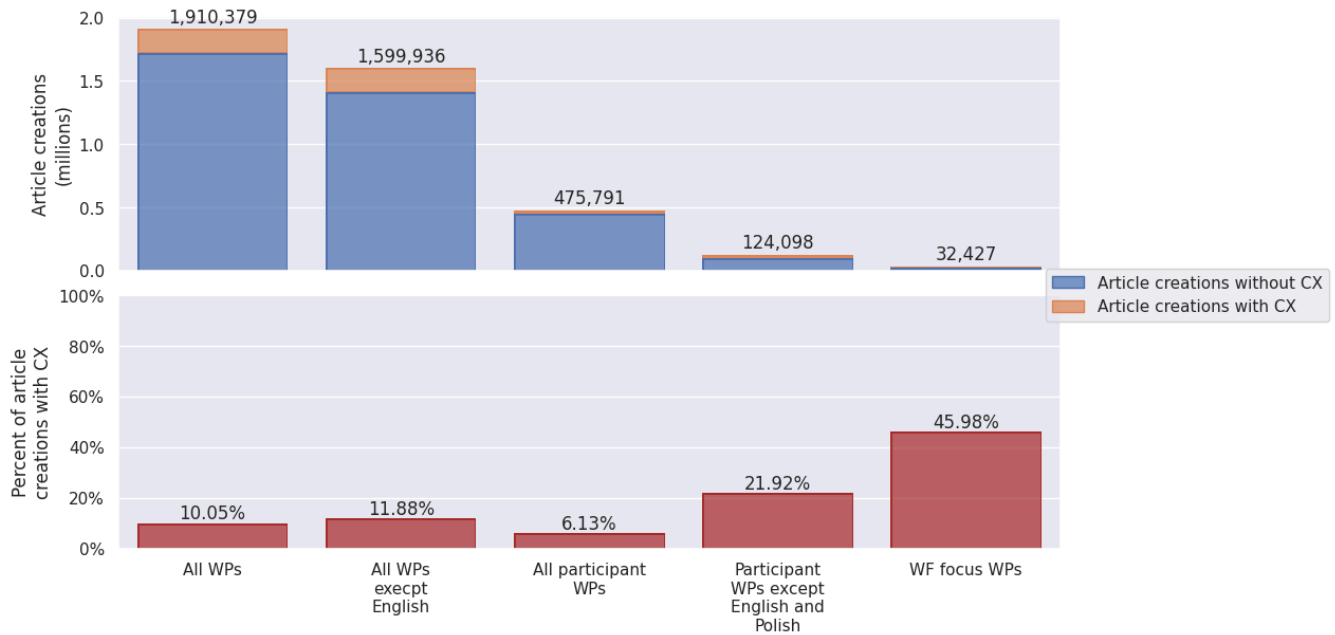


Figure 4. Aggregate article creations and percentages of article creations with CX for different sets of WPs, 2023-02-01 to 2024-01-31.

We also looked for correlations between the percent of articles created with CX on each WP and a few standard metrics used to compare wikis. These metrics appear in the WMF’s public wiki dataset [22]. The metrics we considered are: total content pages, monthly editors, and monthly non-bot edits. In each case, we saw slight positive correlations; Kendall’s τ correlations of these metrics with the percentage of articles created with CX are 0.142, 0.233 and 0.172, respectively. See figures 4, 5 and 6.

(Correlations were weaker if we removed the smallest WPs from the mix. This may be a reasonable step, since machine translation is likely not available for many of those wikis. However, further investigation would be needed to determine an appropriate approach.)

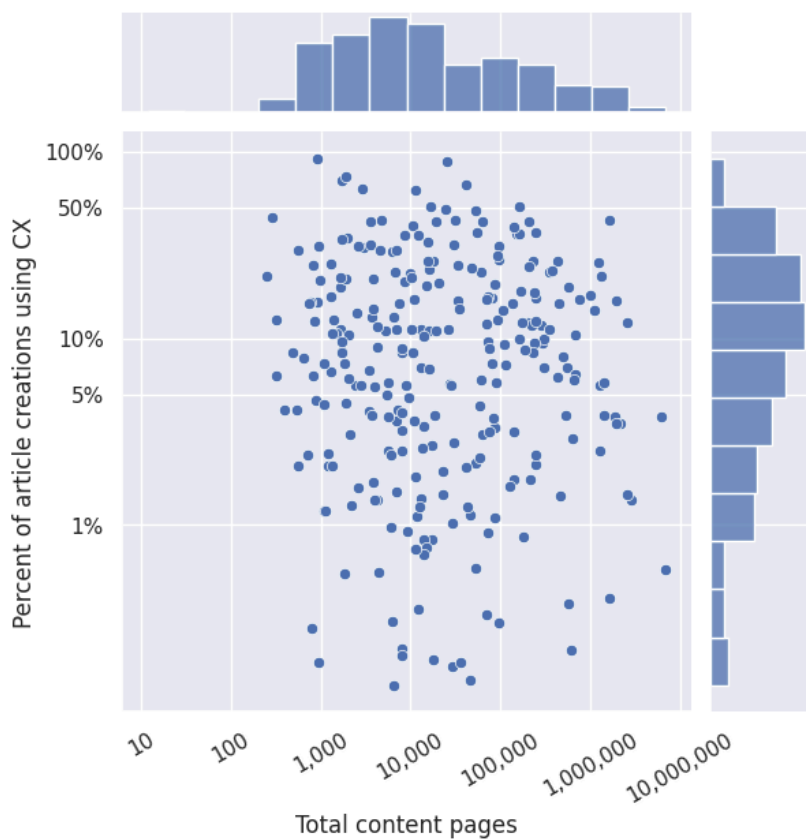


Figure 5. Percentage of article creations with CX, 2023-02-01 to 2024-01-31, and total content pages (log scales). Each point represents a single language WP.

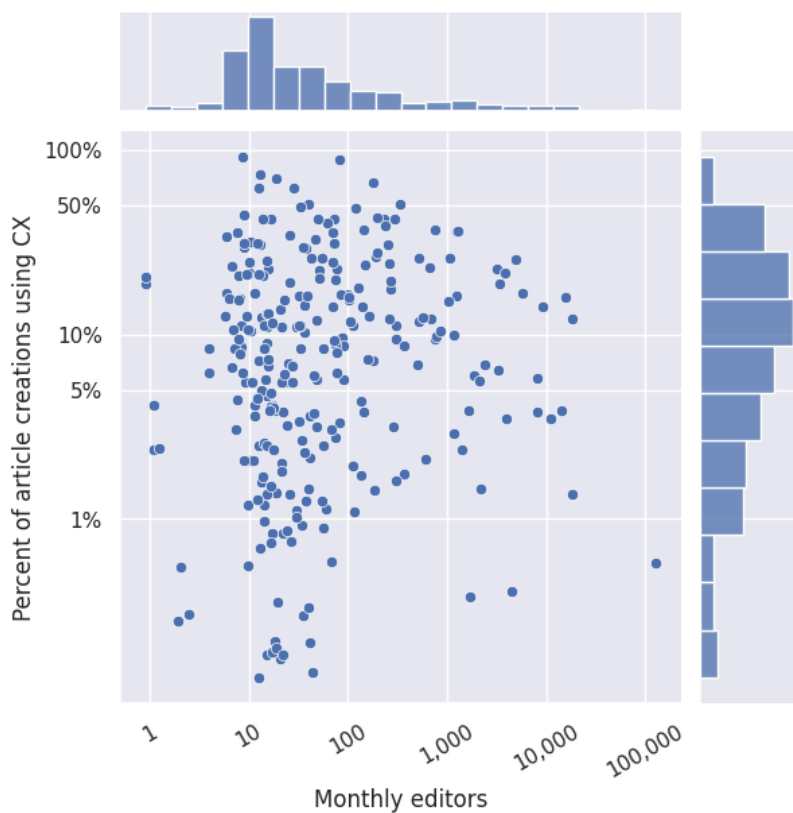


Figure 6. Percentage of article creations with CX and monthly editors, 2023-02-01 to 2024-01-31 (log scales). Each point represents a single language WP.

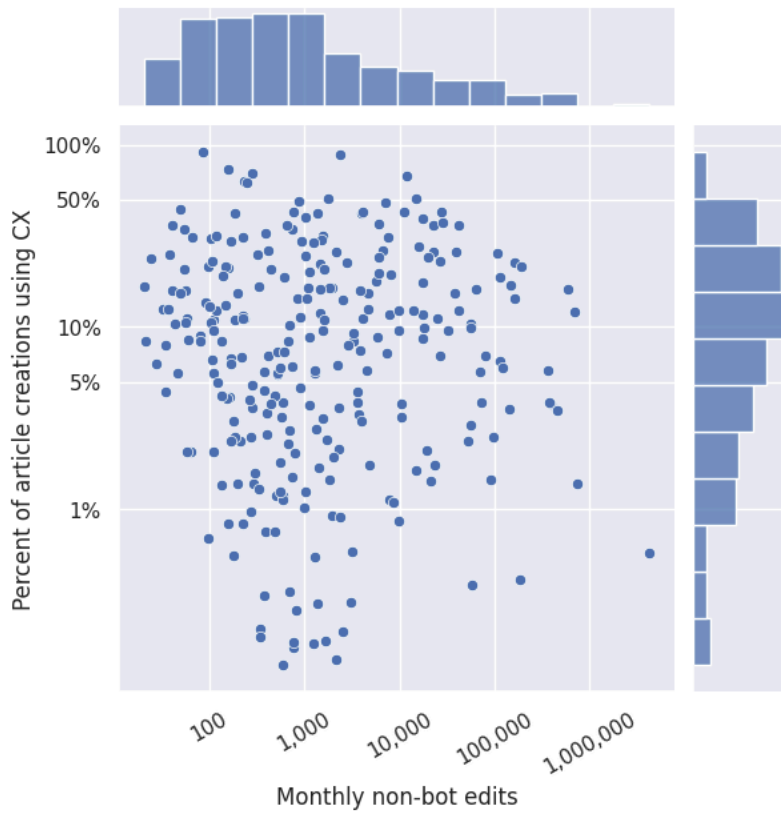


Figure 7. Percentage of article creations with CX and monthly editors, 2023-02-01 to 2024-01-31 (log scales). Each point represents a single language WP.

Finally, [Figure 8](#) shows the evolution of the percentage of article creations with CX over time, for all WPs that had more than 50 new articles created each month since CX was first deployed. This figure is relevant in that it highlights the chaotic, community-specific ups-and-downs that underlie the overall trend of growth in CX usage.

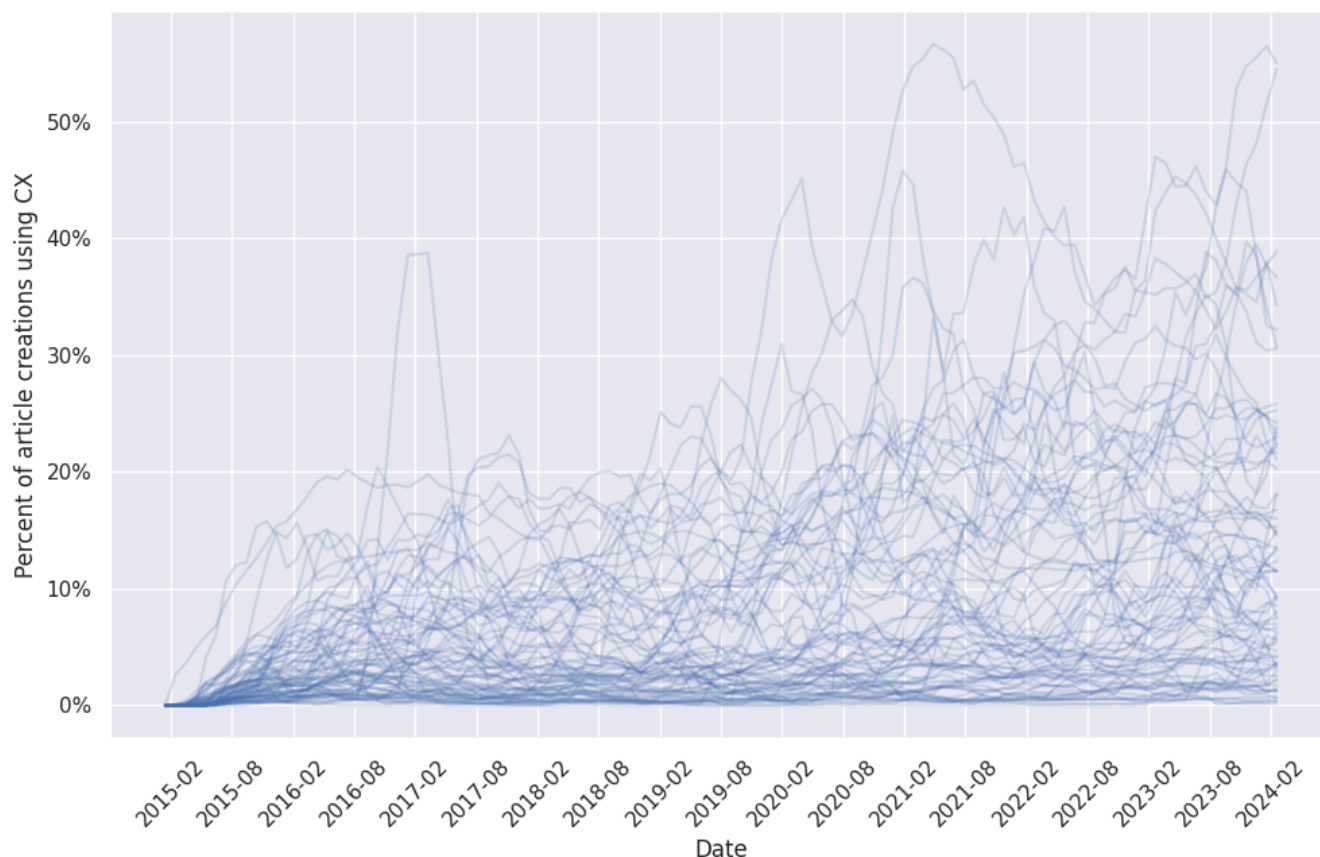


Figure 8. Rolling 6-month (monthly) average of the per-wiki percentage of article creations using CX, for all WPs that had more than 50 new articles created each month since 2014-03.

For details on the private WMF dataset queried for CX usage, see [4]. The Jupyter notebook used to query and process data, and generate plots, is available here: https://gitlab.wikimedia.org/andyrussg/jupyter_notebooks/-/blob/1fc22f258ca9652618cc12705a885b8aabffc79/cx_usage.ipynb.

E. Analysis: WP trends

Here we present a cursory review of the apparent coordinated growth of content, policy and templates in WPs.

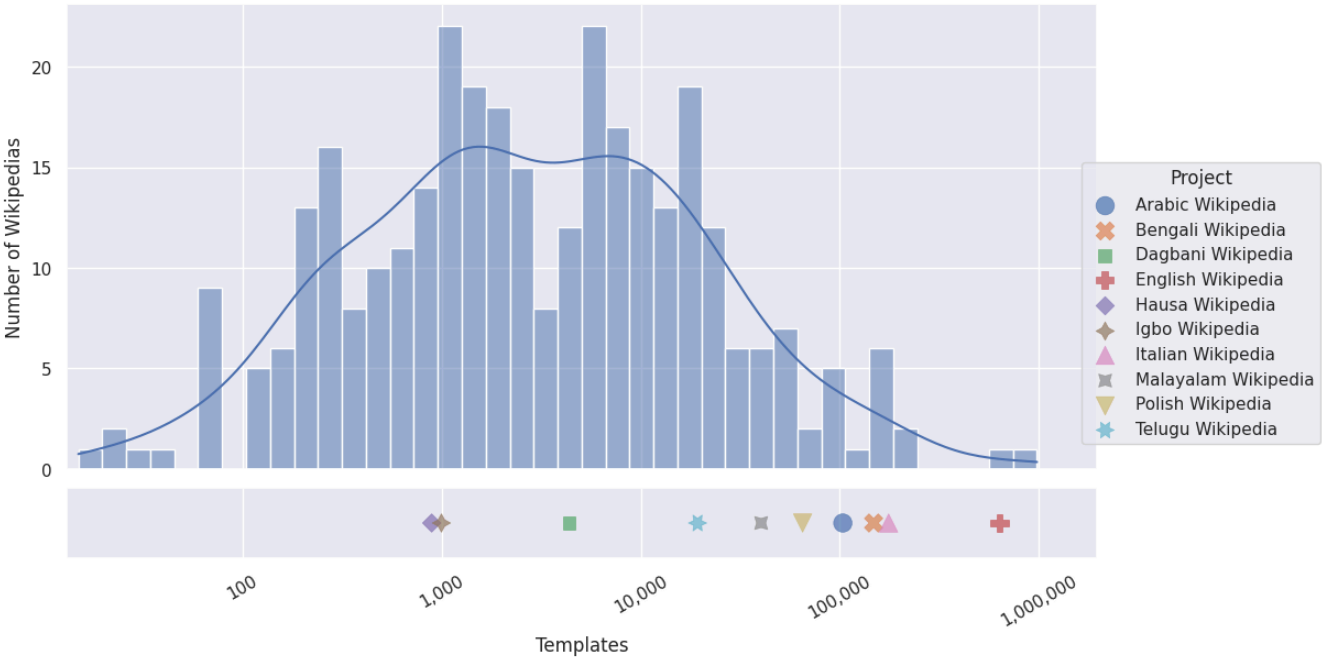


Figure 9. Number of templates on WPs of participants (lower chart), with the distribution of the number of templates per WP, across all WPs (upper chart). Measured by counting pages in the Template: namespace on each WP.

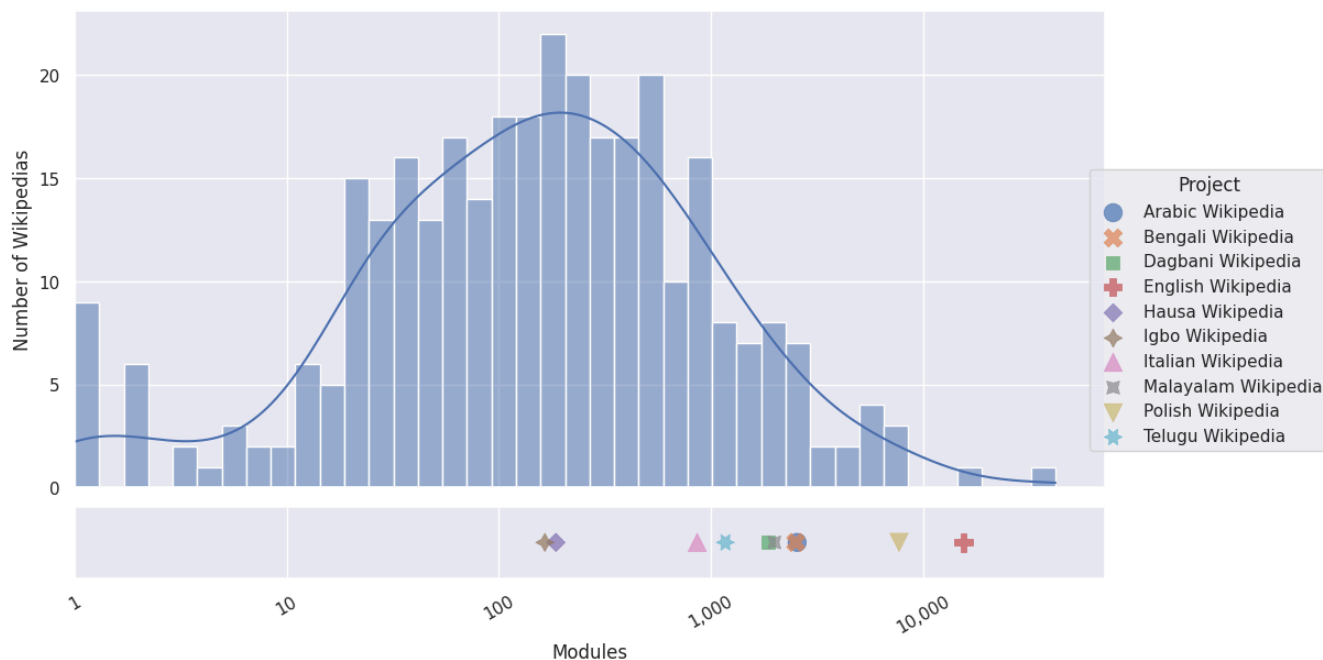


Figure 10. Number of modules on WPs of participants (lower chart), with the distribution of the number of modules per WP, across all WPs (upper chart). Measured by counting pages in the Module: namespace on each WP.

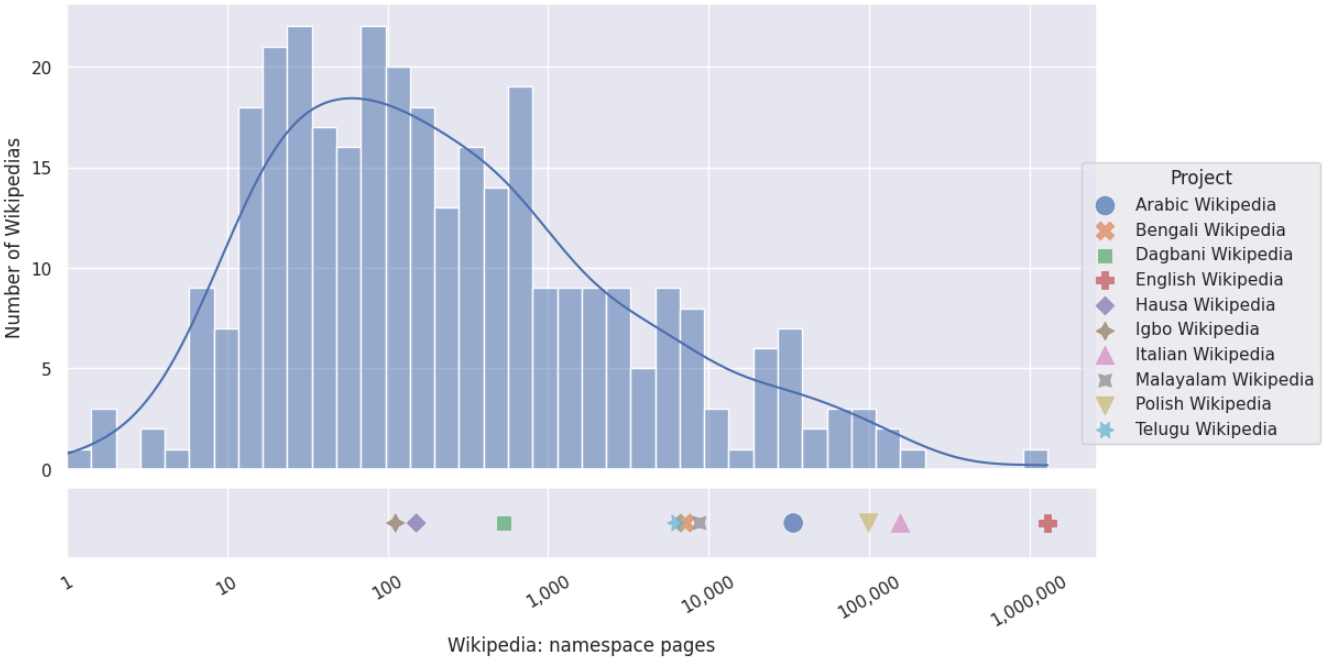


Figure 11. Number of Wikipedia: namespace pages on WPs of participants (lower chart), with the distribution of the number of such pages per WP, across all WPs (upper chart). Pages in the Wikipedia: namespace typically document policies agreed upon by each community.

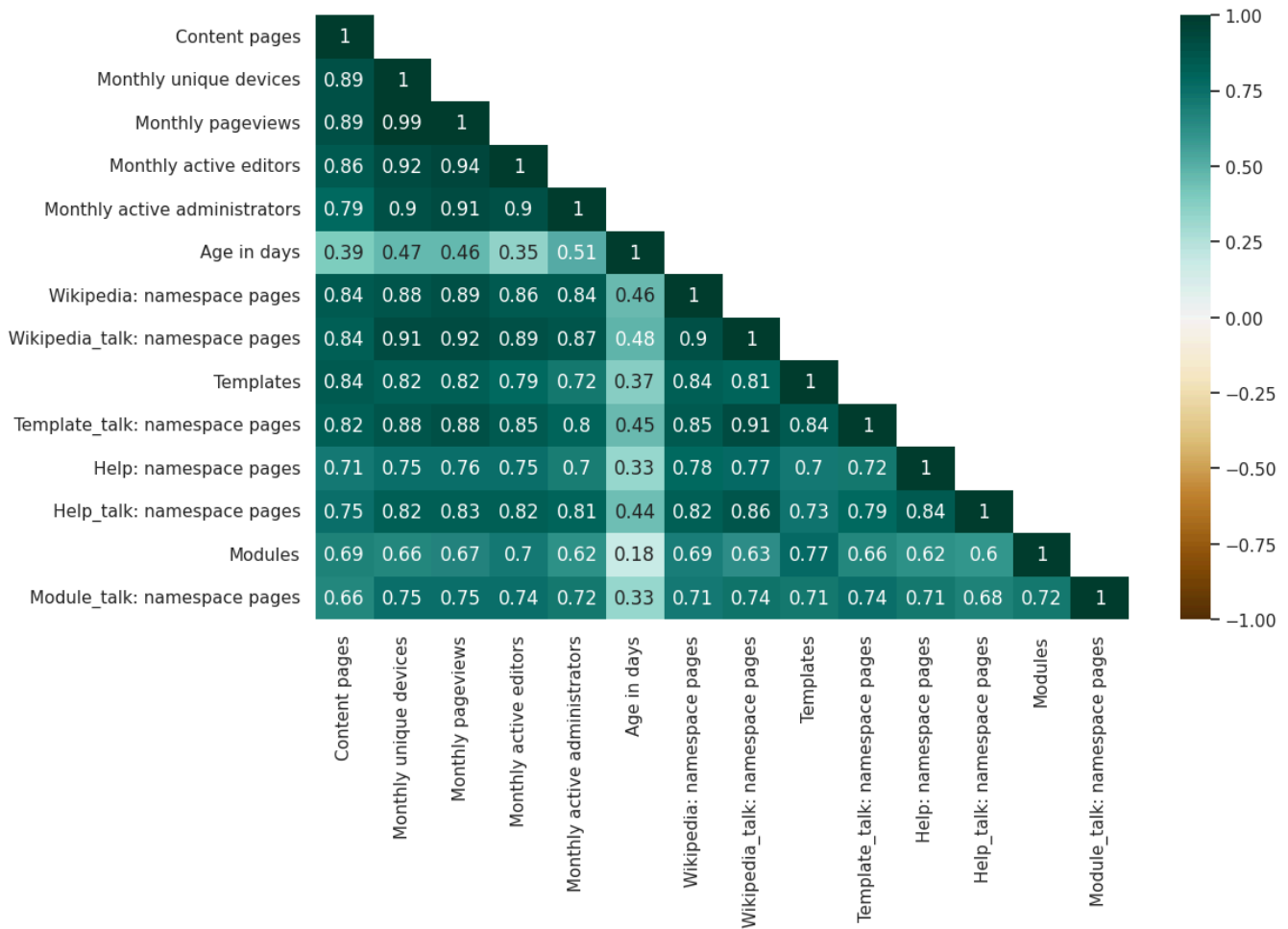


Figure 12. Correlations for pairs of key metrics and numbers of pages in Template:, Module:, Help: and Wikipedia: namespaces, and in corresponding talk namespaces, across the population of WPs. Each WP was taken as a single unit of observation, with each having a single associated value on all the measures listed. All values except age were log-transformed to approximate normal distributions before calculating correlations (Pearson's correlation coefficient).

As Figure 12 shows, many key metrics (e.g., pageviews, total content pages, active editors) track closely with each other and with the numbers of templates, modules, and policy pages.

This analysis alone is not sufficient to demonstrate that templates, policy and social structures tend to complexify and differentiate between WPs and co-evolve within WPs. However, we would reasonably expect such tendencies to result in correlations like those

shown above. Some proposals discussed in the [Further research section](#) could be first steps to digging deeper into this topic.

The Jupyter notebook used to query and process data, and generate plots, is available here:

<https://gitlab.wikimedia.org/andyruessg/jupyter_notebooks/-/blob/deb8ba7341f415398d9f98dee566a91f7d03b4fa/wiki_comparison.ipynb>. All counts of pages exclude redirects.

F. Template samples

`{{Bio}}`

The `{{Bio}}` template [\[30\]](#) on Italian WP implements the editorial policy of that WP for biographies. Instead of generating an infobox, the template outputs a paragraph of prose with basic information about a person, together with an image. The Italian WP page regarding editorial conventions for biographies [\[35\]](#) recommends using the template at the top of such articles. Detailed usage instructions for the template appear in its documentation. English WP does not have a similar template for biographies.

The template is a wrapper for a 1000-line Lua script which itself imports several Lua modules.

[Figure 13](#) shows this template in use.

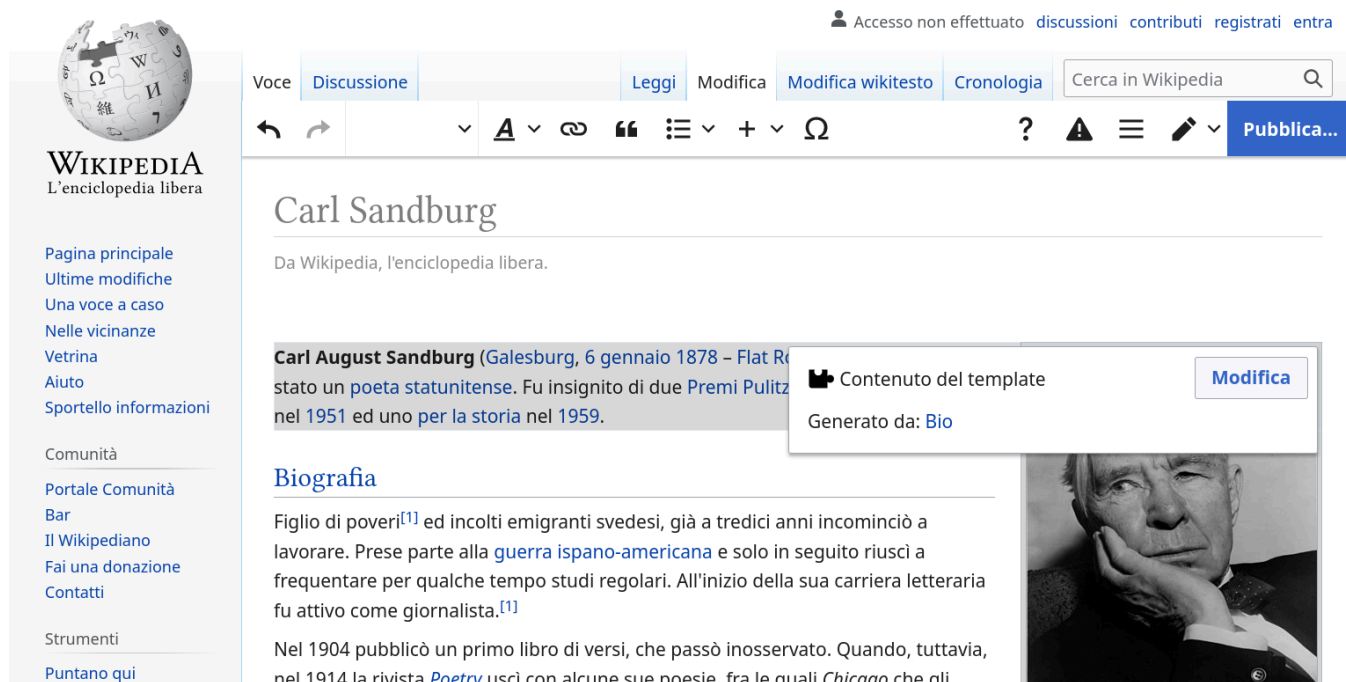


Figure 13. Screenshot of a biography article on Italian WP being edited using Visual Editor. We see the article’s first paragraph and accompanying photo are generated using the {{Bio}} template.

{{Infobox_YouTube_personality}}

This template [31] is used on English WP to create infoboxes for articles about YouTubers. It consists of 135 lines of template code, and calls (transcludes) over 100 other templates.

Although templates are technical features, the template’s talk page [32] centers on editorial policy, specifically, what information should appear in infoboxes about YouTubers, and how the information should be ordered.

This demonstrates the double function of templates as both code and policy. Although English WP has a general policy page explaining how to write articles about YouTubers, the exact conventions regarding YouTuber infobox content are only set out in the template’s code, and the template’s talk page mixes discussion of policy and technical issues.

G. WF Demonstration

The video demonstration shown to participants [3] consisted in a demonstration of a mock-up of a possible WF integration with WP, with a voice-over explanation. The mock-up was based on the Visual Editor feature for mobile devices. It showed an article in English WP containing text generated by a WF function (Figure 14). The function was copied from English WP and pasted into an article on a different topic on Hausa WP (Figure 15). After being pasted, the function output automatically switched to Hausa and adapted to reflect the article topic.

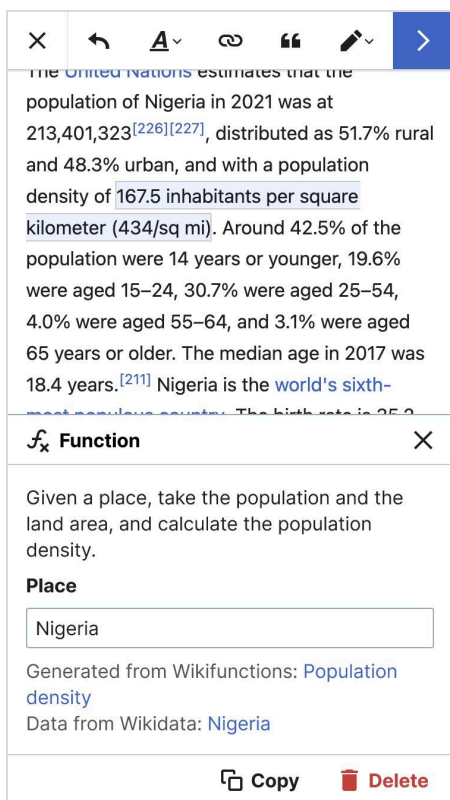


Figure 14. Mock-up of a function being copied to English WP, as seen in the video demonstration viewed by participants.

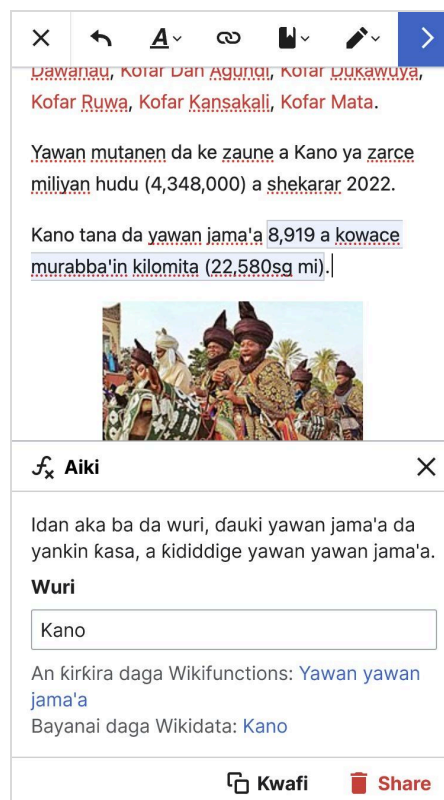


Figure 15. Mock-up of the same function after being pasted into Hausa WP, as seen in the video demonstration viewed by participants.

H. Additional participant quotes

First version, machine translation, then as a native Igbo speaker, you make those segments that you're translating read naturally in Igbo. It's not really tough.

– *P16, Igbo Wikipedia contributor, Nigeria*

Sometimes, we try to teach them [how to do] some technical changes. It depends if you want to help contribute, it depends on the individual motivation. Most people don't want to go deep in perfecting their editing skills.

– *P10, Hausa Wikipedia contributor, Nigeria*

It's even hard enough to get templates written in a big community.

– *P24, Wikifunctions contributor, Australia*

Asking for help, I think, is basic in Wikimedia projects.

– *P19, Italian Wikipedia contributor, Italy*

The most recent template [...], no, little single line in a template, that we've written in Australia was to solve the problem of a new census coming out every five years.

So, in Australia, they do a census once every five years, and the populations get published by the Australian Bureau of Statistics. So, there used to be a thing where every five years, on Wikipedia, many editors would get excited at the release of these new numbers. And these are not even regular editors. These are just random people just knowing their suburb hadn't been updated yet and they would come in and they'd change stuff.

They were trying to change the infobox, and they would often just change the population but not the reference to the population, and basically mess stuff up.

And so, regular editors had their own turf. So, somebody would try to do the whole of [a region] and would get annoyed at all of these fly-by-nights who were messing stuff up. But then, also, the person who knew what to do viewed the whole thing as a massive chore, because there's, let's say, 30,000 [...] locals that are on Wiki and that needed this change, and so it was a massive chore to go through them all and update all that.

So [...] the thing we did most recently for 2021 was, firstly, we had matched all the Wikipedia articles to their corresponding Wikidata items, and so we already knew that task was done, which meant that [...] we could put the new populations into Wikidata as a mass upload kind of thing. [...]

So, Wikimedia Australia got somebody who was interested in writing a Lua module to do this. And so we now have something that can produce just the “population equals” line in 30,000 locations, backed by Wikidata.

But that “population equals” line needed a fair bit of design. [...] So, all of that effort went to just the population tag on an Australian infobox. But all of the effort could easily be used for lots of infoboxes around the world, and that would be best housed on Wikifunctions.

– P24, *Wikifunctions contributor, Australia*

So, the user came to the talk page, and mentioned that he or she can't edit those templates because he doesn't understand what the code is about. So, yeah, at that time, I think I replied on that article's talk page, because I have seen some other templates on English Wikipedia that have the option to redirect to the Wikidata.

– P20, *Malayalam Wikipedia contributor, India*

People are working with these technical issues. [...] We have to minimize all these barriers [...] so we can work more easily.

– *P6, Bengali Wikipedia contributor, Bangladesh*

In theory, there are Village Pumps in other languages on Wikidata, but in practice, at least the Polish one is not really active there on Wikidata. Instead, it's easier to ask the question, for example, on the Wikipedia Village Pump, where there are more editors and it's more likely to be answered [...] because just more people watch new threads on the Wikipedia Village Pump rather than on the Polish subpage of the Wikidata Village Pump. So, I suppose it's hard to make people watch that page, because some people are primarily Wikipedia editors and they just know something about Wikidata and go there from time to time. There are some people who are primarily Wikidata editors, and they will notice or they will answer on that Wikidata Village Pump, but at least for Polish, there are not so many such people. And I suppose that, for Wikifunctions, it will be very similar.

– *P25, Wikifunctions contributor, Poland*

I. Further reading

Below are links to texts of various sorts, on topics related to this research. Most have already been referenced elsewhere in this report. This is not an exhaustive literature review.

For volunteer proposals and discussions of global templates, see [\[10\]](#), [\[11\]](#), [\[12\]](#), and [\[15\]](#).

For research on editor community dynamics, see [\[21\]](#), [\[25\]](#) and [\[28\]](#).

Research on content translation, smaller wikis, and templates can be found here, [\[5\]](#), [\[9\]](#) and [\[26\]](#), with many more texts listed here [\[8\]](#).

For previous studies about WF, see the Research section of this page [\[2\]](#).

Acknowledgments

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A few sentences in [Section 2. Background](#) were adapted from internal WMF documents written by the Abstract Wikipedia Team and the Design Research Team.