Research in Progress: Engineering Research for Indigenous Engineering Techniques

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Engineering Research for Indigenous Engineering Techniques – Research in Progress

Abstract

As universities enroll more Native American engineering majors and hire more Native faculty, it has become imperative to be able to find research related to Indigenous techniques and methods in engineering. Since fewer than 1% of all articles in Compendex and Inspec have the words "indigenous," "native," or "aboriginal" in the title, abstract or keyword fields, this becomes a challenge. As part of our broader research project into how to discover Native American research in science databases, this paper focuses on engineering terms, broad terms for engineering and specifically on prominently known Arizona tribes, whose various colonial and Native names also present challenges for identifying relevant research. Examining both Compendex and Inspec on the Engineering Village platform, we explore the Boolean command protocol challenges as well as the unique search options offered on the Engineering Village platform. The selected topics for this segment of the research highlights the challenges of the terms for Indigenous water use and Native farming techniques. This paper will highlight important skills and considerations for librarians who assist with research on Native American engineering topics and will also address current deficiencies in the controlled vocabularies in major engineering databases.

Introduction

As universities enroll more Native American engineering majors and hire more Native faculty, it has become imperative to be able to find research related to Indigenous techniques and methods in engineering. Most of the engineering terms are specific to the physics, the descriptive terms of the thing, or the way of doing/making of the thing primarily using the English language terminology. Native American engineering is identified by their individual tribal vocabularies along with their culture or people. Therefore, identifying this additional information associated with their engineering is also necessary at some point.

Since fewer than 1% of all articles in Compendex and Inspec have the words "indigenous," "native," or "aboriginal" in the title, abstract or keyword fields, this becomes a challenge. Keeping in mind that these words all mean local or original to the area, it is necessary to add people terms to eliminate native plants, fungi, fishes, and animals to focus on the peoples and cultures. When that is done, the small size of the results becomes more glaring. When you add various people terms to these three words you find that you have 0.02% (4375 results) of the database. Even when we also included the selected Arizona tribal names, First Nations (Canada), Alaska, and Hawaii we still had fewer than 10,000 results which is 0.048% of the database. At the time of the research, these combined databases had just over 21,000,000 items.

As part of our broader research project into how to discover Native American research in science databases, this paper focuses on engineering terms, broad terms for engineering, and specifically on prominently known Arizona tribes, whose various colonial and Native names also present challenges for identifying relevant research.

Examining both Compendex and Inspec on the Engineering Village platform, chosen for the advanced search engine flexibility, we explore the Boolean command protocol challenges as well as the unique search options offered on the Engineering Village platform. Once we have identified advanced methods it will be easier to focus on the core elements and keywords that will be productive in a "Google Scholar" style search on search engines with restricted search capabilities used by the professional engineering society digital libraries.

The selected topics for this segment of the research highlights the challenges of the terms for Indigenous water use and Native farming techniques. This paper will highlight important skills and considerations for librarians who assist with research on Native American engineering topics and will also address current deficiencies in the controlled vocabularies in major engineering databases.

Literature Review

This research project has its origins in the 1980s when the university wanted to start an American Indian Studies department and asked me to find all the articles we could on the Anishinaabe people, known as the Ojibwe or Chippewa peoples in that area. This led to the article in Database that focused on searching techniques for articles on Native Americans and included the Anishinaabe/Chippewa/Ojibwe peoples [1]. With all the changes in the spelling and transliterations of tribal names and the issues with colonial names of Indigenous people, we then revamped the research to focus on the Arizona Native peoples of the O'Odham (Pima) and Diné (Navajo) Nations [2]. As part of our literature review, we examined how thesauri and other vocabulary have changed. The Thomas articles [3], [4] both speak to the changing vocabulary from general terms "Native American" and "American Indian" to specific tribes. Although both terms "Native American" and "American Indian" are still used widely, it may be changing at a faster pace than before. She also addresses the gradual move away from broad generic terms such as Indigenous. Ullstrom [5] also points us to the Native Peoples' nomenclature. Certainly, older articles are under the colonial names, yet the most recent trend is to use the name the people give themselves even if the spelling in English is not consistent over time. Knowing that this research had to contend with the indexing as it currently exists, observations were noted, but not reported here, about the article retrieval based on the publication dates. We also considered how information is organized. Metoyer & Littletree [6] underscored how the ways of knowing are expressed differently between Native American peoples and the colonial majority culture's organization of knowledge which impacts finding information in databases. This difference was highlighted by the 2019 write up of wayfinding and voyaging research [7], with results similar to our research.

Methodology

We started with the thesauri or controlled vocabulary of both databases to ascertain if any consistent terminology for Native peoples existed. Compendex did return one article each for

Aboriginal Water Program
Indigenous Construction Industry
Indigenous Energy Production

Indigenous Multinational Corporations
Indigenous Petroleum Resources
Native American Indian Tribes
Native American Issues
Aleut Native

But also had

Native Iron
Native Oxide Films
Non-Native Speakers

While this may indicate developing controlled vocabulary, it is still far from adequate. In our searches we discovered a more consistent use of some keywords in the uncontrolled terms, usually suggested by the authors. However, it was not a reliable method of discovering all related articles.

Finding no specific vocabulary that met our needs for this research, we decided to use the existing terms for water and farming combined with the general terms – indigenous, native, aboriginal. We also needed to use the specific terms used for the selected Arizona tribal nations paired with our more general water and farming terms. To do this, we used the search strategies of Soto, Sanchez, Mueller-Alexander, and Martin [2] and modified them for the Engineering Village platform. Those strategies, with a few modifications due to search engine differences, can still be done in ProQuest and EBSCOhost if that is the platform used for INSPEC. Compendex is only available on Engineering Village, STN and Dialog (ProQuest).

Based on our experience, we chose these search strategies to edit and replicate for access to specific tribal information. We chose the ProQuest versions from the article as being closest in the search strategy to what was needed for Engineering Village commands. These choices also put the focus on North American Native peoples with some indication of the utility of Indigenous, Native, or Aboriginal people terms for North American groups. Table I shows the searches used in ProQuest [2] that were selected, then modified for use in Engineering Village.

We also added Hawaiian Native terms, a search not done in the previous research. This article primarily reports on the last search strategy for the Diné and O'Odham tribes in Arizona and the Southwest, although the earlier searches informed our search strategies for this.

The search strategies listed above conform to ProQuest protocols and the EBSCOhost ones are very similar. Why these are constructed this way is explained in the Proximity command section. The * is a truncation symbol for all word ending variations, but the ?, ??, and ??? at the end of words provide for only those exact number of characters, a truncation limitation to avoid unwanted words that start the same as the root word typed. Truncation in Engineering Village uses autostemming, a feature that can be toggled on or off for the entire search. The issues surrounding automatic stemming are explained in the discussion of the search results. The double quotes (“ ”) are used for loose phrases and the now defunct in Engineering Village, curly

brackets ({ }) for exact phrases to keep words together in a string. This is covered in more detail in the discussion of Engineering Village commands.

TABLE I
SELECTED PROQUEST SEARCHES TO USE IN ENGINEERING VILLAGE

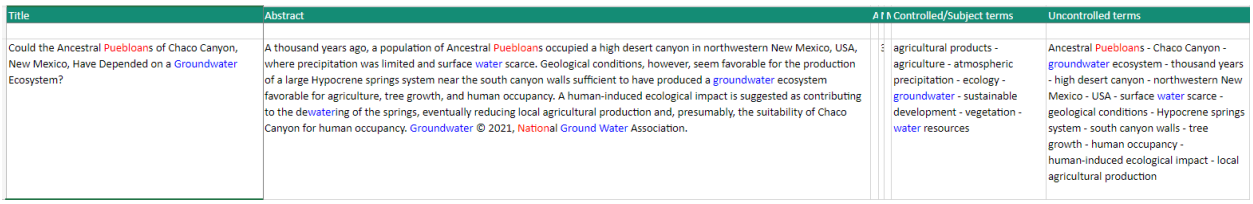
Search Strings
1. *((Alaska* OR Canada OR Canadian*) N/1 Native*)) NOT ((Alaska* OR Canada OR Canadian*) N/1 Native))*
2. *((Alaska* OR Canada OR Canadian*) N/1 Native*) OR Amerind* OR (America* N/3 Indian*) OR Eskimo* OR Aleut OR Inuit OR ((Indigenous OR Native* OR Aborigin*) N/1 (population* OR People* OR Tribe* OR Tribal)*
3. *First Peoples OR First Inhabitants OR Tribal Nation*
4. *<tribal names> (3n) (Nation?? or Indian or Indians or Trib?? or Reservation??)*
a. *(Navajo OR Navaho OR Navahu OR Dine OR Diné) n/1 (Nation? OR Trib?? OR Indian OR Indians OR Reservation? OR Communit???)*
b. *((Tohono OR Akimel OR Hiaced OR Hia-ced OR Hiac-ed) n/1 ("O'Odham" OR Oodham OR Ootham OR Authum)) OR ((Pima OR Papago OR "Sand Papago") n/1 (Indian* OR Tribe* OR Communit* OR Nation* OR Reservation*))*

While we did explore the NOT command; however, we still advise against its use because of what it excludes.

We note that the search engines are not case sensitive at this time, they are included in this article as capitalized to follow publication standards. We also discovered that the coding for the "é" in Diné can be read and translated by different computer programs into several odd characters in the searching process or printing of the word in the saved search strategy, so both the accented and unaccented terms were used. This should be considered whenever using words with diacritical markings on a letter or letters in a word.

We also made the decision to only research the dominant English language colonial names for consistency across the research. For any given Tribe, the spelling variations in French or Spanish should also be included or at least considered, particularly if there are many articles not in English or for which there are non-English abstracts and keywords included.

To more easily identify terms and relevance in the downloaded citations we used Kutools [8], an add-on to Excel, that simplified our analysis by highlighting our terms in the selected fields and allowed counting the occurrences of each term more easily. Fig. 1 and Fig. 2 provide examples. Notice Kutools finds the string of characters even when they are part of another word.



Title	Abstract	Controlled/Subject terms	Uncontrolled terms
Could the Ancestral Puebloans of Chaco Canyon, New Mexico, Have Depended on a Groundwater Ecosystem?	A thousand years ago, a population of Ancestral Puebloans occupied a high desert canyon in northwestern New Mexico, USA, where precipitation was limited and surface water scarce. Geological conditions, however, seem favorable for the production of a large Hypocrene springs system near the south canyon walls sufficient to have produced a groundwater ecosystem favorable for agriculture, tree growth, and human occupancy. A human-induced ecological impact is suggested as contributing to the dewatering of the springs, eventually reducing local agricultural production and, presumably, the suitability of Chaco Canyon for human occupancy. Groundwater © 2021, National Ground Water Association.	agricultural products - agriculture - atmospheric precipitation - ecology - groundwater - sustainable development - vegetation - water resources	Ancestral Puebloans - Chaco Canyon - groundwater ecosystem - thousand years - high desert canyon - northwestern New Mexico - USA - surface water scarce - geological conditions - Hypocrene springs system - south canyon walls - tree growth - human occupancy - human-induced ecological impact - local agricultural production

Fig. 1. Example of the highlighting available using Kutools. From the water search.

Title	Abstract	Controlled/Subject terms	Uncontrolled terms
Marapu and Farming: How Tourism Shape Rural Development and Ancient Tradition of Sumba Indigenous Community - Indonesia	Tourism National Product during 2016 - 2017. Tourism development has extended beyond "Bali" Island in Eastern Indonesia in recent years. One of the famous and well-known tourism destinations in Eastern Indonesia is located in Sumba Island. This Island settled Indigenous communities practice Marapu belief system that closed related to the traditional practicing farming that attract Tourism. The paper explores Marapu and farming traditions and how recent Tourism promotions of Sumba Island have shaped rural development and ancient traditions. Data for this study were gathered as part of the first Author study on Farming System Research in Sumba Island, East Nusa Tenggara (ENT) province in last 10 years. The study showed that Marapu tradition is still practiced for local communities, however they have been able to incorporate some crops into traditional farming system for the market demand. The paper highlight that mixed-cropping system and diversity of food commodities keeps practiced by local communities of Sumba Island in order to minimize risk in fragile ecosystem. Strategy for Tourism development in Sumba Island should strengthen the local traditions/culture particularly in farming and in the same time protecting local resources/environment.	crops - socio-economic effects - travel industry	Tourism shape rural development - ancient tradition - tourism development - Bali Island - Eastern Indonesia - famous known tourism destinations - well-known tourism destinations - Sumba Island - Indigenous communities practice - marapu belief system - traditional practicing farming - farming traditions - tourism promotions - marapu tradition - local communities - traditional farming system - farming system research - tourism national product - Sumba indigenous community - Indonesia - East Nusa Tenggara province - ENT

Fig. 2. Example of the highlighting available using Kutools. From the Indigenous farming search.

Discussion

We initially searched all fields. We then checked the AF or affiliations field and the AG or funding agency field to determine the false drops. The major problem was institutions with a colonial tribal name that were not managed by the Tribes themseles (Pima Community College, Maricopa Community College). Individual institution campus locations added another place name issue with colonial names as geographical locations (Northern Arizona University, Yavapai). In Arizona, ten of the fifteen counties are named using colonial Tribal designations, with the community colleges all operated by the dominant culture. The two known exceptions are Diné College, formerly Navajo Community College, and Tohono O'odham Community College which are under the direct control of those Nations. This initial research is less interested in where the work was done than on the discovery of the Indigenous engineering terminology of the topics covered. We downloaded complete records so we are able to do an institution and granting agency analysis later.

It was decided that for this research in engineering we would limit the use of the terms to the article title, abstract, and keywords to ensure that the term used was relevant to what we were looking for. This is a common search parameter in many science databases. It also avoids irrelevant term usage in the full text or other searchable field terms. The Title/Abstract/Keyword search option corresponds to the ProQuest TIABSU command. Previously, this was TI,AB,SU which stood for Title/Abstract/Subject field codes in a search. This means the computer won't look at other searchable fields in the records. There is no equivalent in EBSCOhost currently without doing the search for each field and using the OR command to combine them.

Engineering Village Commands

Before beginning this massive research, we reread the Engineering Village Support Center materials [9]. During the course of this research, Engineering Village changed their search rules, underscoring the importance of always keeping up to date with current search features. The biggest change was the elimination of the exact string search curly brackets ({ }) command for word phrases (strings of characters). The { } exact search is now the same as " " loose search, which allows punctuation and spaces between the words in the string. This is a disaster for Native American nomenclature – not just the tribal names, but also the terms used for engineering concepts. This is a problem for some terms when the exact spacing and punctuation makes a difference in the term, for example O'Odham or AI/AN. While "O'Odham" works in almost all cases the same as {O'Odham}, this is not true for AI/AN for American Indian/Alaska Native. During our research the { } found the right term and placed it at the top of the list until it was eliminated as a search command. However, with the " " search, the results show all the AI (artificial intelligence) and when the next word is "an." This happens in quite a few article titles in engineering. The Search relevance algorithm placed the Artificial Intelligence articles at the top of the list. Finding the correct meaning takes time and patience. Using this AI/AN acronym is not worth the aggravation in an engineering search without the { } option. To its credit, ProQuest (DIALOG) still has the EXACT command that works quite well with the AI/AN search term. In engineering and Engineering Village in particular, searching for "American Indian" OR "Alaska Native" usually is sufficient to retrieve all relevant articles since one or both terms are usually spelled out in the abstract, keyword fields or title. Table II illustrates the difference in how the searches look.

TABLE II
ENGINEERING VILLAGE SEARCH STRINGS COMPARING EXACT { } TO LOOSE " " STRING

Search Strings
{O'Odham} *{AI/AN}* *"O'Odham"* *"AI/AN"* *"American Indian"*

The { } did not help during our research for Diné. We recommend always searching using the diacritics. Search engines ignore diacritics in searching as well as other special characters, which are "replaced" (read as) with a space when the diacritic is between letters. When the diacritics are modifications to a specific letter rather than occupying another space next to the letter, this is when the false drops occur the most. This will become a growing problem as more research uses the Native language terms in the titles and abstracts of articles.

Proximity Searching

For word proximity in a specified order Engineering Village has no command like the ProQuest PRE/ command – words in this order with up to x words in between them, and the EBSCOhost WITH/ command, which works the same as the ProQuest PRE/ command. You can use the simple phrase itself with only a space between the words, knowing that it looks for the words together and then moves them farther apart until it is an AND between the words. If the words need to be together, use the " ". The NEAR command [10] is for words in any order.

Because Indigenous research is burgeoning worldwide, we made a few discoveries about search terms that may apply more broadly than just engineering. Engineering Village is set to autostem [11] or truncate a word to the root word. Until we turned that off, "Indian" was shortened to India, "farming" was shortened to "farm" and found articles with all variant endings. Even if you turn off autostemming, truncation is possible within parentheses. The caution here is that truncation with the NEAR command changes it to an AND command.

Soto, et al [2] searched (America* N/3 Indian*), which in Engineering village would only be possible as ($American NEAR/3 $Indian). It works for the Article title, abstract and keyword search, but if it is just an article title search, it would be changed to an AND search. We did try (American NEAR/3 Indian) instead. However, based on our results, we now advise using the " " for "American Indian" and not using proximity (NEAR) searching. While it is not a severe problem yet, when you want "American Indian" use that term in the double quotes. The proximity (NEAR) search will find any use of Indian with American. The correct use we found was consistently the string "American Indian". More correctly, if we still had the { } command, we would prefer that to avoid any punctuation between the words where "American" ends a sentence and "Indian" begins the next sentence. Too many articles involving Americans and India were found with the near command. The differences in the search strings are shown in Table III.

TABLE III
ENGINEERING VILLAGE SEARCH STRINGS USING NEAR COMMAND WITH AND WITHOUT TRUNCATION

Search Strings
($American NEAR/3 $Indian)
(American NEAR/3 Indian)

Even with the word "Indian" paired with an American tribal name, e.g. "Pima Indian," it is possible to find a cluster of articles that use the phrase with another word that alters the utility of the phrase. We did find a Pima Indian phrase that could have altered our results: "Pima Indian Diabetes", a dataset now being used for machine learning. (A description of the Pima Indian Diabetes cohort is found in Nelson et al [12].) The majority (84%) of the "Pima Indian" terms in our search were the diabetes dataset giving us a misleading idea of the number of articles about

Pima Indians that might work when we added our other concepts. Further investigation did reveal that no “Pima Indian diabetes” or “Pima Indian diabetics” phrases altered our search results. This is important because you do not want to use the NOT command if you can avoid it.

NOT commands automatically exclude any article with the terms that follow the NOT command. This happens even if other terms you do want are in the article. Valid research can be missed or lost completely this way. To maximize results, it is wise to do your search with all the desired terms then determine if a NOT command is even warranted to rule out the unwanted terms. In Engineering Village Quick Search mode, if you use a NOT command in command drop down box, that changes the order of the search because in Engineering Village the command orders are processed in this order: NOT, AND, then OR. In contrast ProQuest command processing order is PRE, NEAR, AND, OR, NOT and in EBSCOhost the order is: AND, OR, NOT. This processing order is why many experienced searchers do complicated searches with each of their search concepts individually and then go back to combine them in a separate combine command. Doing this allows you to see the size of each set of terms for your concepts to gauge what may be influencing the false drops. This is when the decision is made to use the NOT command. The combine command is found under search history or recent searches in most databases including Engineering Village.

For more complicated or long searches, especially with a NOT command, we encourage the use of the Expert search mode. Engineering Village puts in “extra” parentheses throughout the search in the Quick Search mode, making it a challenge to correct any syntax errors or spelling errors when looking at the records results search statement.

For our actual searches, we ended up modifying the original Soto, et al [2] searches to comply with the NEAR command limitations in Engineering Village. The NEAR command [10], [11], [13] cannot have more than one term on either side of the command and truncation using the * is not allowed if autostemming is turned off. The use of truncation symbols * and ? (single character) changes the NEAR to an AND command, but if both terms use the dollar sign ($) it will provide truncation of both terms. Table IV shows how this would appear in the search.

TABLE IV
ENGINEERING VILLAGE SEARCH STRING WITH TRUNCATION USING NEAR COMMAND

Search String
($navajo NEAR/1 $communities)

The simple, easy to read ProQuest and EBSCOhost NEAR command, which does allow multiple words combined with OR on either side of the NEAR command, is illustrated in Table V.

TABLE V
TRIBAL NAMES SEARCH USING NEAR COMMAND WITH TRUNCATION IN PROQUEST

Search String
((Navajo OR Navaho OR Navahu OR Dine OR Diné) n/1 (Nation? OR Trib?? OR Indian OR Indians OR Reservation? OR Communit???))

In Engineering Village, the simple search of Table V becomes this longer search in Engineering Village in Table VI.

TABLE VI
ENGINEERING VILLAGE SEARCH USING NEAR COMMAND WITHOUT TRUNCATION

Search String
(((Diné NEAR/1 Nation) OR (Dine NEAR/1 Nation) OR (Navajo NEAR/1 Nation) OR (Navaho NEAR/1 Nation) OR (Navahu NEAR/1 Nation) OR (Diné NEAR/1 Tribe) OR (Dine NEAR/1 Tribe) OR (Navajo NEAR/1 Tribe) OR (Navaho NEAR/1 Tribe) OR (Navahu NEAR/1 Tribe) OR (Diné NEAR/1 Indian) OR (Dine NEAR/1 Indian) OR (Navajo NEAR/1 Indian) OR (Navaho NEAR/1 Indian) OR (Navahu NEAR/1 Indian) OR (Diné NEAR/1 Reservation) OR (Dine NEAR/1 Reservation) OR (Navajo NEAR/1 Reservation) OR (Navaho NEAR/1 Reservation) OR (Navahu NEAR/1 Reservation) OR (Diné NEAR/1 Community) OR (Dine NEAR/1 Community) OR (Navajo NEAR/1 Community) OR (Navaho NEAR/1 Community) OR (Navahu NEAR/1 Community) OR (Diné NEAR/1 Reservation) OR (Dine NEAR/1 Reservation) OR (Navajo NEAR/1 Reservation) OR (Navaho NEAR/1 Reservation) OR (Navahu NEAR/1 Reservation)) WN KY)

We did try the $ on both terms, which worked for each individual term as a search, but there are syntax errors when all were used together with OR commands. It was less complicated to just type out the word variations we needed and stick with the singular people terms for one search and add the plurals in another. However, combining the two searches with singulars and plurals yielded the same number of results.

Indigenous Engineering Terms

Having "solved" our tribal names terms to use, we moved on to the engineering terms. We are interested in the Indigenous farming techniques and the use of water in the Diné and O'Odham nations in Arizona. Interestingly, farming is a broader term with agriculture, crops, and irrigation being narrower terms in the INSPEC thesaurus. Compendex does not use farming but does use farms. Crops, agriculture, and irrigation are narrower terms. Thus, deciding to truncate engineering terms becomes more important. While not a problem in these two databases in Engineering Village, searching

*farm**

could retrieve farmacia and other such variations. We could also have chosen to search the term as

farm???

While English is the dominant language, there are other languages in these databases.

The Indigenous engineering terms do not exist unless a specific term is included in the title or abstract by the author. We were unable to find anything written on the O'odham's method called Ak Chin Oidag Himdag, which is a way of respectful gardening using flood farming. At this time, there are no articles in these databases with the concept of Oidag. Even using the truncated English word "garden*" the only article found about the O'Odham was a review of two unrelated software programs from 1987.

We found just seven articles on flood farming in Arizona or the Southwest. The best results were using the search:

Flood farming

Rather than the search:

"flood farming"

Changing this search to include some of the flood farming methods of delivering water, we suddenly found a lot more – 2007 articles. The search string used is illustrated in Table VII.

TABLE VII
FLOOD FARMING TERMS WITH GEOGRAPHIC TERMS FOR THE SOUTHWEST U.S.

Search String
(((flood farming OR canals OR acequia OR acequias OR aqueduct OR aqueducts OR irrigat) WN KY) AND ((Arizona OR "New Mexico" OR Texas) WN KY))*

Canals is a misleading term to use because we did find quite a few articles on the modern Salt River Project's Central Arizona Project canals, channeling the Colorado River water. This canal project modified and reused the ancient canals previous groups built (Hohokam or Huhugam in Central Arizona). These ancient channels are typically called "canals" in Arizona with some use of the term "acequias". Canals and aqueducts are used in various methods of flood farming and irrigation, but these modern canals or Roman style aqueducts we think of are not the dominant variation used by the O'Odham [14] or the peoples with the ancient acequias which relied on rainfall runoff or snow melt channeled to the fields [15] rather than a modern canal system always full of water from distant places.

When we searched for various water terms with our selected tribes, we found just 80 articles for this search. Table VIII shows the search strategy when collective people terms are used with Tribal names.

TABLE VIII
WATER TERMS AND SPECIFIC TRIBES

Search String
(((water OR groundwater OR rainwater OR irrigation OR canals OR acequia OR acequias OR aqueduct OR aqueducts) WN KY) AND (((Diné NEAR/1 Nation) OR (Dine NEAR/1 Nation) OR (Navajo NEAR/1 Nation) OR (Navaho NEAR/1 Nation) OR (Navahu NEAR/1 Nation) OR (Diné NEAR/1 Tribe) OR (Dine NEAR/1 Tribe) OR (Navajo NEAR/1 Tribe) OR (Navaho NEAR/1 Tribe) OR (Navahu NEAR/1 Tribe) OR (Diné NEAR/1 Indian) OR (Dine NEAR/1 Indian) OR (Navajo NEAR/1 Indian) OR (Navaho NEAR/1 Indian) OR (Navahu NEAR/1 Indian) OR (Diné NEAR/1 Reservation) OR (Dine NEAR/1 Reservation) OR (Navajo NEAR/1 Reservation) OR (Navaho NEAR/1 Reservation) OR (Navahu NEAR/1 Reservation) OR (Diné NEAR/1 Community) OR (Dine NEAR/1 community) OR (Navajo NEAR/1 Community) OR (Navaho NEAR/1 Community) OR (Navahu NEAR/1 Community) OR (Diné NEAR/1 Reservation) OR (Dine NEAR/1 Reservation) OR (Navajo NEAR/1 Reservation) OR (Navaho NEAR/1 Reservation) OR (Navahu NEAR/1 Reservation) OR "O'Odham Nation" OR "O'Odham tribe" OR "O'Odham Indian" OR "O'Odham Community" OR "O'Odham Reservation" OR "Oodham Nation" OR "Oodham Tribe" OR "Oodham Community" OR "Oodham Reservation" OR "Ootham Nation" OR "Ootham Tribe" OR "Ootham Indian" OR "Ootham Community" OR "Ootham Reservation" OR "Authum Nation" OR "Authum Tribe" OR "Authum Indian" OR "Authum Community" OR "Authum Reservation" OR "Pima Nation" OR "Pima Tribe" OR "Pima Indian" OR "Pima Community" OR "Pima Reservation" OR "Papago Nation" OR "Papago Tribe" OR "Papago Indian" OR "Papago Community" OR "Papago Reservation" OR Hohokam OR Huhugam OR Puebloans OR Anasazi) WN KY))

The people group terms with our tribal names were clearly a limitation. Changes in the proximity of the tribal names and collective people terms were not pursued based on earlier search results.

For the farming terms, this search found 122 articles including ones on Pima cotton, not an unexpected result, since it is named after the Pima (O'Odham) people who did the research and development of the cotton with the USDA in the twentieth century [16]. Pima cotton articles were 25% of the results. The search strategy use is shown in Table IX.

TABLE IX
FARMING TERMS AND SPECIFIC TRIBES

Search String
(((farm OR "companion planting" OR "three sisters" OR crops OR agriculture OR cultivat*) WN KY) AND ((Navajo OR Navaho OR Navahu OR Diné OR "O'Odham" OR Oodham OR Ootham OR Authum OR Pima OR Papago OR Hohokam OR Huhugam OR Puebloans OR Anasazi) WN KY))*

Notice that for the farming terms we omitted the collective people group terms. It did find some false drops, but given the small retrieval set, the omission of collective people terms improved the results. Omitting the collective terms for groups of people works for specific tribal names when the results are small but should always be used when more generic terms like "indigenous", "native", or "aboriginal" are used or when there are high numbers of results.

This led us to shorten the water search to just the Tribal names as shown in Table X.

TABLE X
WATER TERMS AND SPECIFIC TRIBES

Search String
(((water OR groundwater OR rainwater OR irrigation OR canals OR acequia OR acequias OR aqueduct OR aqueducts) WN KY) AND ((Navajo OR Navaho OR Navahu OR Diné OR "O'Odham" OR Oodham OR Ootham OR Authum OR Pima OR Papago OR Hohokam OR Huhugam OR Puebloans OR Anasazi) WN KY))

The shorter tribal terms version provided 356 articles compared to 80 records with the people group terms.

To be sure we did not overlook something and, observing that in our other searches many articles about Indigenous peoples farming methods included crop names, we also searched for two specific O'Odham crops grown in Arizona. These crops are not unique to Arizona, but the names in the O'Odham languages are. Although there were no results at the time of the research, we searched for the crops with Tribal names as shown in Table XI.

TABLE XI
SPECIFIC BEAN TERMS WITH O'ODHAM NATION TERMS

Search String
(((bavi OR tepary OR "Phaseolus acutifolius" OR kalvash OR garbanzo OR "Cicer arietinum" OR chickpea) WN KY) AND "O'Odham" OR Oodham OR Ootham OR Authum OR Pima OR Papago OR Hohokam OR Huhugam OR Puebloans OR Anasazi) WN KY))

Changing to the broader geographical terms, we do find one article which used Arizona in the abstract. The article never mentions a tribe because it was an experiment conducted at a non-tribal Arizona educational institution with the inoculants collected from an Arizona domesticated field-grown tepary beans.

It is good to keep in mind that just as we never expect full disclosure of all processes in articles funded by corporations, each Indigenous community has its own governance guidelines about what is proprietary and what may be shared. This certainly contributes to the small number of articles about techniques, but it is more likely that there are not many articles written yet from the Indigenous perspective. This tentative conclusion is based on both conclusions in Soto, et al [2] and reading all the abstracts from all of our searches. The next phase of this research is to analyze the articles for Indigenous perspective.

During our research, we discovered several uncontrolled terms that seem to be used consistently:

traditional knowledge
Indigenous knowledge
ancient knowledge

These terms could be paired with tribal names for more general information on a topic or with geographical locations when you do not need to be about a specific group.

Conclusion

Our research has led us to be flexible, knowing that, beyond the search engine limitations, the Tribal names and terms will continue to be our most limiting factor at this time. Finding the best engineering terms is also a challenge since indexing is done to the specific engineering topics. Very few of the articles had a main heading that was in any way helpful for the type of engineering. Currently, both general engineering terms and more specific terms should be used including as many as needed to describe the engineering areas involved in the topic. We did

notice that more articles are including the Tribal terms for the engineering concept in either the title, the abstract or both. This is important because the Tribal term may include more than just the translated or general engineering concept in English or not have a direct translation. A number of Tribes, including the Diné [17], are creating modern scientific vocabulary for terms and concepts not available in their Native language. As these become available, we hope that these terms will be used in the article titles, abstracts, and author supplied keywords to increase the retrieval rate of these articles.

This paper is research in progress focusing on the discovery of articles. The next phase of the research to identify Indigenous authors and institutions and good ally research. Additional engineering areas related to construction are also in the works.

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