UNIVERSITY OF SOUTH DAKOTA
BEACOM SCHOOL OF BUSINESS

Coyote Business Consulting

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South Dakota Manufacturing & Technology Solutions

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EXECUTIVE SUMMARY

South Dakota Manufacturing and Technology Solutions (SDMTS) challenged four student consultants to a partnership on their Supply Chain Optimization and Intelligence Network (SCOIN) Project. The scope of the project focused heavily on creating an interactive map of manufacturers in South Dakota and developing an interactive dashboard for SDMTS and manufacturers in South Dakota to utilize. Additionally, the team analyzed these deliverables to provide insight on gaps and opportunities within the South Dakota supply chain.

INTRODUCTION

South Dakota Manufacturing and Technology Solutions is South Dakota's Manufacturing Extension Partnership (MEP) business center. SDMTS helps manufacturers increase productivity through implementing lean and continuous improvement practices. SDMTS received federal funding through the Chips and Science Act signed into law in 2022.

We worked under the direction of SDMTS Supply Chain Business Advisor Angela Allen and Beacom School of Business CBC Advisor Dr. Dan Tracy. Through the University of South Dakota Beacom School of Business Coyote Business Consulting, we have worked closely with Angela to develop a consulting project SDMTS can use as a part of their Supply Chain Optimization and Intelligence Network Project and share with manufacturers across South Dakota. The scope of the project consisted of a data cleanup and validation, supply chain visualization, and an opportunity and gap analysis. With multiple different layers to this project, our team gained invaluable insights into artificial intelligence, web scraping, visualization tools, and the power of Excel.

METHODOLOGIES

In the early stages, we focused on familiarizing ourselves with the D&B Hoovers data to determine the best cleanup method and use for our maps. Working closely with Angela, we discussed the best measures to provide an accurate cleanup within our time frame and resource constraints. We determined conducting a minor data cleanup and developing a validity percentage based on our confidence the business exists were the strongest options. The data cleanup consisted of ensuring uniformity among the data and removing any duplicates.

From the D&B Hoovers data, we selected variables that correspond with a business existing. We tested the following variables: phone number, URL, D-U-N-S Number, Address, and Active Business. ChatGPT generated Python code enabling us to web scrape Bing for these variables.

To webscrape for phone numbers we used a reverse phone lookup through the Yellow Pages URL. Each phone number was placed at the end of the URL and the link was searched. For URLs, each URL was searched and if the URL went through, it was considered valid. We searched Bing for the D-U-N-S number and keywords related to its active status. We were surprised to find that not all D-U-N-S numbers returned as active. We searched the address to see if it existed. After web scraping the addresses, we realized each address was valid and it was not a strong measure to include in our confidence interval. The active business test searched for the company name, address, and keywords about its activity status. After conducting these tests, we are confident 68.80% of the businesses are active. Because the data came from D&B Hoovers and we performed the web scraping on Bing, we cannot guarantee the accuracy or completeness of the information.

We also worked with ChatGPT to write Python code to extract a description of each business from Bing. The code searched for the company name and pulled three sentences describing the business. While D&B Hoovers provided a description of each business, we felt it was basic and repeated some information provided by the NAICS industry description. We used our descriptions in the dashboard; however, if SDMTS prefers the D&B Hoovers description this can easily be changed by copying and pasting the descriptions into the dashboard tables. More information about this can be found below in updating the dashboard.

The entire validity sheet is in the OneDrive folder and below is a snapshot.

Company Name	Company Identifier	Valid Phone Number	URL Validity	Valid D-U-N-S	Valid Address	Active Business	Phone Number, URL, Active Business, DUNs	Phone Number, URL , DUNS, Address
Dakota Provisions, LLC	1	1	1	1	1	1	100%	100%
Interbake Foods LLC	2	1	1	1	1	0	80%	100%
Empirical Foods, Inc.	3	1	1	1	1	1	100%	100%
Royal Canin USA, Inc	4	1	1	1	1	0	80%	100%
Tyson International Service Center, Inc. A	5	0	0	1	1	1	60%	50%
Saputo Cheese USA Inc.	6	1	1	1	1	0	80%	100%
Valley Queen Cheese Factory, Inc.	7	1	1	1	1	1	100%	100%
Tyson International Service Center, Inc.	8	0	0	1	1	1	60%	50%
Cimpl's, LLC	9	1	0	1	1	0	60%	75%
Smithfield Packaged Meats Corp.	10	1	0	1	1	1	80%	75%
Schiltz Foods, Inc	11	1	1	1	1	1	100%	100%
South Dakota Soybean Processors, LLC	12	1	1	1	1	0	80%	100%
New Angus, LLC	13	1	1	1	1	1	100%	100%
Red's All Natural, LLC	14	1	1	1	1	0	80%	100%
Mars Petcare US, Inc.	15	1	1	1	1	1	100%	100%
Cass-Clay Creamery, Inc.	16	1	1	1	1	0	80%	100%

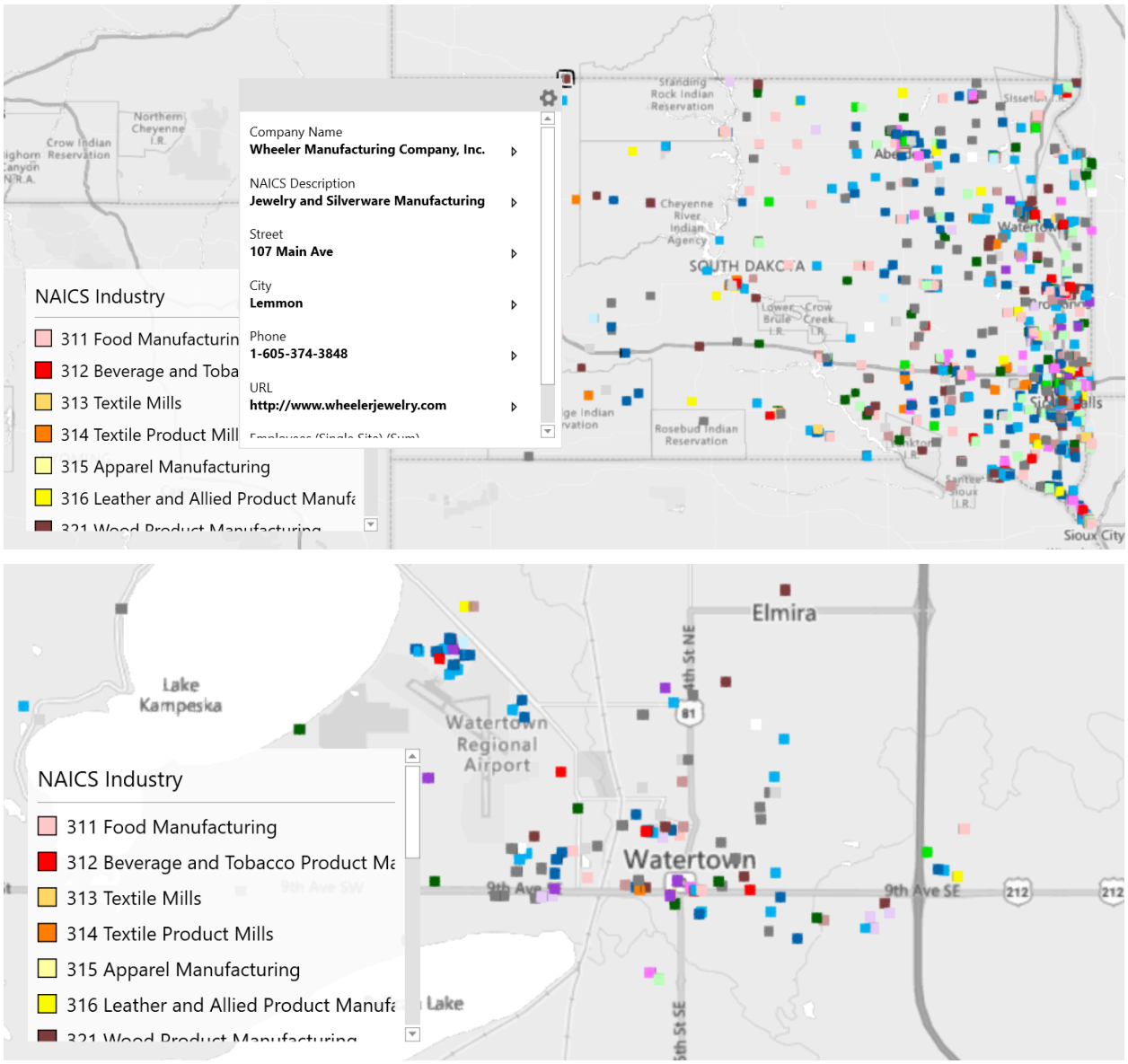
To ensure dashboard users can validate businesses on their own, we included a button leading to the South Dakota Secretary of State website. Users can enter a business and it will return the business' standing. Due to it being a government website and using a reCaptcha, we did not have the capability to web scrape it. Additionally, we contacted the Secretary of State for a data dictionary and pricing for the database; however, we did not believe it would be a good use of monetary resources for the project.

Alongside data clean up and validation, we spent a significant portion of the early stages determining how to categorize suppliers on the maps. We looked at the D&B Hoovers Industry, NAICS code, and SIC code. After creating visualizations to better understand the data and testing them in the map, we determined the first three digits of the NAICS code (which divides the suppliers into 21 industries) provided the best representation.

To map the data, we needed the longitude and latitude of each company. We utilized ChatGPT to write a Python script that took the original spreadsheet, used the address of each company to find its coordinates, and output a new spreadsheet with the original data plus the latitude and longitude of each company. The Python script used a geocoding API key we generated to perform this conversion. Once we mapped the data, it was simple to find errors. There were three companies whose coordinates ended up outside of South Dakota despite their addresses being within the state. We manually entered the correct latitude and longitude for those businesses using a website to convert the addresses to coordinates.

DELIVERABLES

Excel Power Map



We utilized Excel's Power Mapping tool to create a visualization of the supply chain. Hovering over a company pulls up company information including company name, NAICS description, address, phone, URL, and employees. Users can smoothly zoom in and out and pan to see different areas of the map. The companies are categorized and color coded by NAICS industry as seen in the legend. Users can choose to filter the companies displayed on the map using either the slicers on the dashboard or the filters within Power Maps. The slicers on the dashboard filter the data located in a table on a separate sheet.

Clicking the “Update Map Data” button runs a macro to transfer the filtered data onto another sheet that the map is pulling from. Finally, clicking “Refresh Data” within the map will update the map to match the filtered data. Filtering directly within Power Maps just requires the user to add the desired filters with the “Add Filter” button on the layer pane of the map.

One limitation with Power Maps is the inability to click on the link to the company’s website or even copy the link in order to paste it in a browser. Additionally, the map is only accessible when downloaded to Excel and not in a web browser like BatchGeo.

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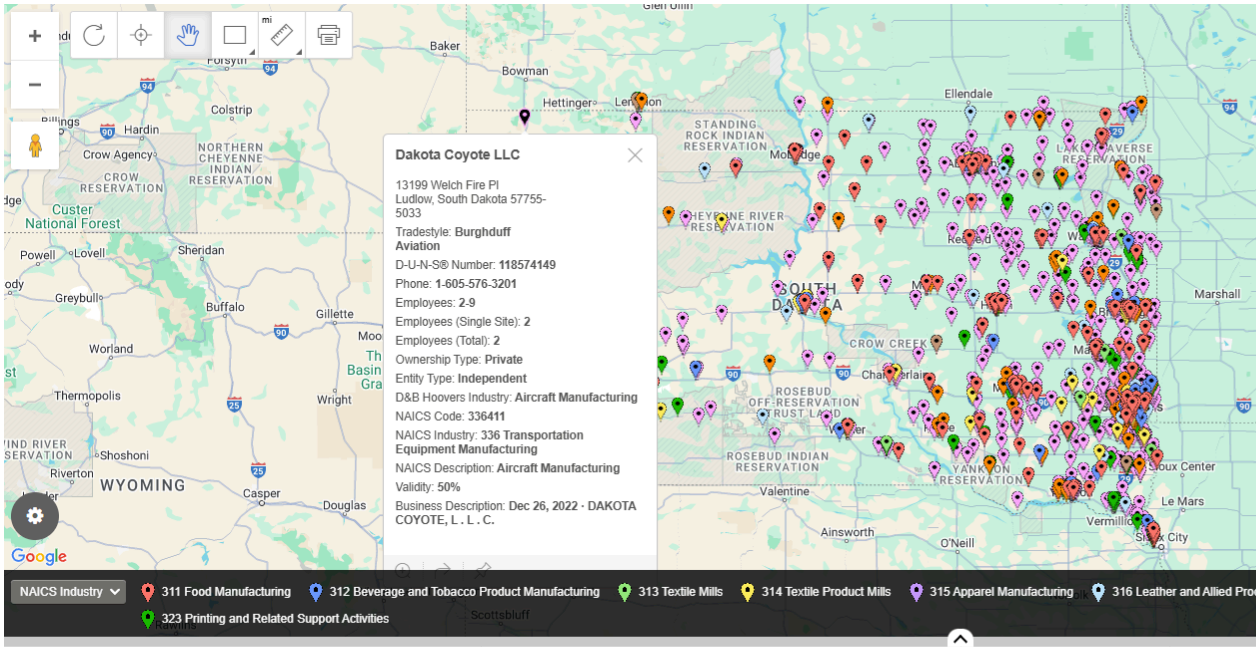
BatchGeo Map



Company Name	Tradestyle	Street	City
Platinum Car Brokers L.L.C.		3425 N Fairgrounds Loop Ste D	Spearfish
Dakota Coyote LLC	Burghduff Aviation	13199 Welch Fire Pl	Ludlow
Bill & Judi Weinberger		3700 S Westport Ave	Sioux Falls

We also utilized BatchGeo’s mapping software as a secondary tool to visualize South Dakota’s supply chain. The navigation functions in BatchGeo work in the same way as Power Map, but the experience is not nearly as smooth and user friendly. Additionally, the legend along the bottom only has the capability to display nine subcategories at a time, so if there are more than nine, the user must click an arrow to scroll through them all.

Despite these limitations, BatchGeo has advantages that Power Maps does not offer. It allows the user to click on the company name, which directly opens the company’s website link in a new tab (if the company has a URL listed, which is indicated by blue text rather than black text). It

also allows users to click on the company's address taking them directly to that address on Google Maps in a new tab. The data is displayed in table form on the bottom, and clicking on a company (or companies) on the map highlights the corresponding row(s) within the table.

BatchGeo makes multiple levels of filtering relatively easy. The user can just click on the desired subcategory or subcategories in the legend within the selected category, and by using the dropdown on the left, the user can pick additional categories to filter by.

Dashboard

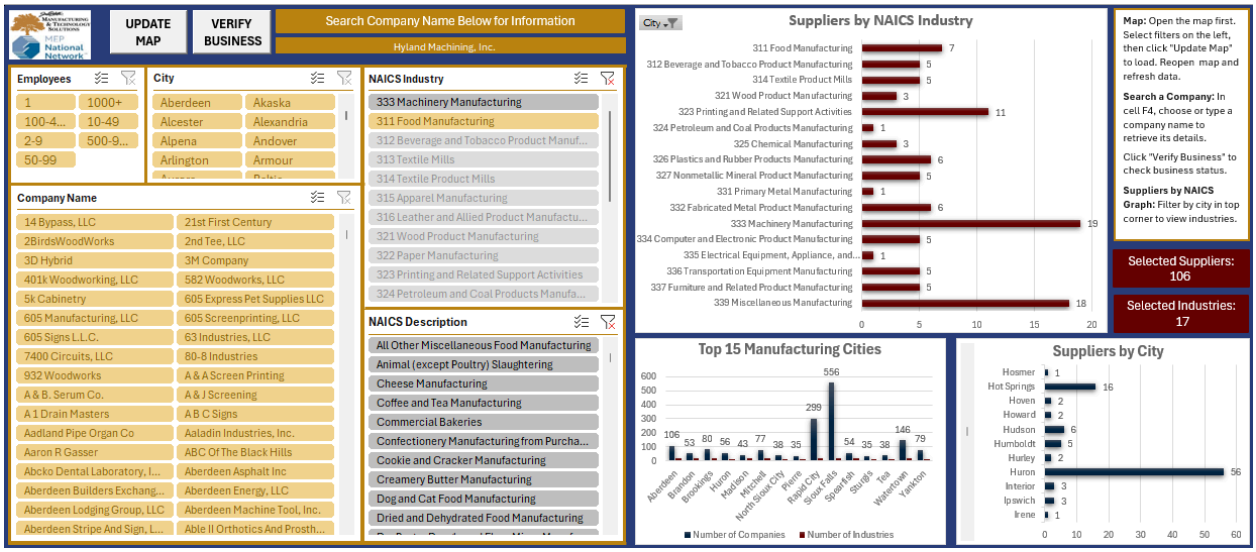
The dashboard was developed in Excel using Macros and VBA. After consulting with both the South Carolina MEP and Angela, we concluded that Excel would provide the most user-friendly and accessible platform for South Dakota manufacturers. While we explored alternatives such as Microsoft Access and Power BI, we found that users were generally less familiar with those tools. Although Power BI offers a more intuitive interface, its licensing costs made it impractical for this project. Therefore, we determined that Excel remained the most effective and accessible solution.

The key features and functionalities of the dashboard are outlined below. Standard Operating Procedures (SOPs) for both the Excel Dashboard and Power Map are available in the shared OneDrive folder.

The primary goal of the dashboard was to offer an accessible and straightforward way for users to retrieve and manipulate data from the D&B Hoovers dataset.

Dashboard Key Features

- Slicers to filter the Excel Power Map
    - An "Update Map" button to update the map data
- A "Verify Business" button to open the SDSOS website
- A search bar to enter or select a company name retrieving information about the company
- A chart to filter by cities to see their number of suppliers per NAICS Industry
- A visual representation of the Top 15 Manufacturing Cities in SD
- A scrollable chart showcasing Suppliers by City



Updating the Dashboard

The majority of the dashboard is designed to allow for updates to be made to the data or for completely new sheets of data to be entered. The dashboard pulls from Table, Pivot Table, and Table 2. Changing information about a company already existing in the data will not impact the functionality of the dashboard. It is important, however, to ensure all sheets are updated. For example, if you meet with Hyland Machining and they provide a new phone number, the phone number must be updated on every sheet, and it will reflect on the dashboard. The dashboard will need to be reuploaded to your website for users to see this change. Entirely new lists of data can be copied onto the existing sheets in place of the entire data set already there. In order to keep the macros and VBA code functional, this sheet must be set up the same way as the current sheet.

If you would like to add a new sheet to pull from or change the format of a sheet, those changes need to be reflected in the VBA and macro code. The entire code will not need to be replaced, but anywhere that references a sheet or column name or specific cells, columns, rows, or ranges, needs to be changed. For example, if you receive a new list of companies from D&B Hoovers, the simplest way to add the sheet is to format it to look like the tables already in place and copy and paste it in. This will reduce any impact on macros, VBA's, pivot tables, and charts.

Sharing the Dashboard and Maps with Users

Due to the use of macros, the dashboard cannot be embedded into a website. For sharing purposes, we recommend hyper linking the dashboard or BatchGeo maps to your website along with the Standard Operating Procedures. This will allow users to download the dashboard and use its features. The BatchGeo map can be opened in a web browser by clicking the link. We recommend that SDMTS utilize and share both the Excel Dashboard/Power Map and BatchGeo

with manufacturers in South Dakota. The tools complement each other as BatchGeo allows for a simple way to view the map while the Excel dashboard allows you to filter certain aspects and pull up an easy-to-read view of company information. We have added more information in the future opportunities section below as potential ways to combine them.

To ease sharing and reduce the chance of accidentally corrupting the underlying data, some sheets on the dashboard have been protected and hidden. The Data sheet with the original data is hidden and fully protected. The Pivot Table sheet containing all the pivot tables that connect to the charts is hidden but cannot be protected. The Table sheet cannot be hidden and is protected with the use of autofilter enabled. The Table2 sheet is hidden and protected with the use of autofilter enabled. The Map Data tab cannot be hidden or protected, but there is limited risk of any changes to this sheet causing issues, as the macros that update that sheet delete its content and paste in the correct data each time the "Update Map" button is clicked. Even if any of the underlying sheets were corrupted in some way, the user would always be able to re-download the file from SDMTS.

To unhide sheets, right-click on any of the sheet tabs along the bottom and click "Unhide." The password for the protected sheets is "sdmtsdash"

Gap Analysis

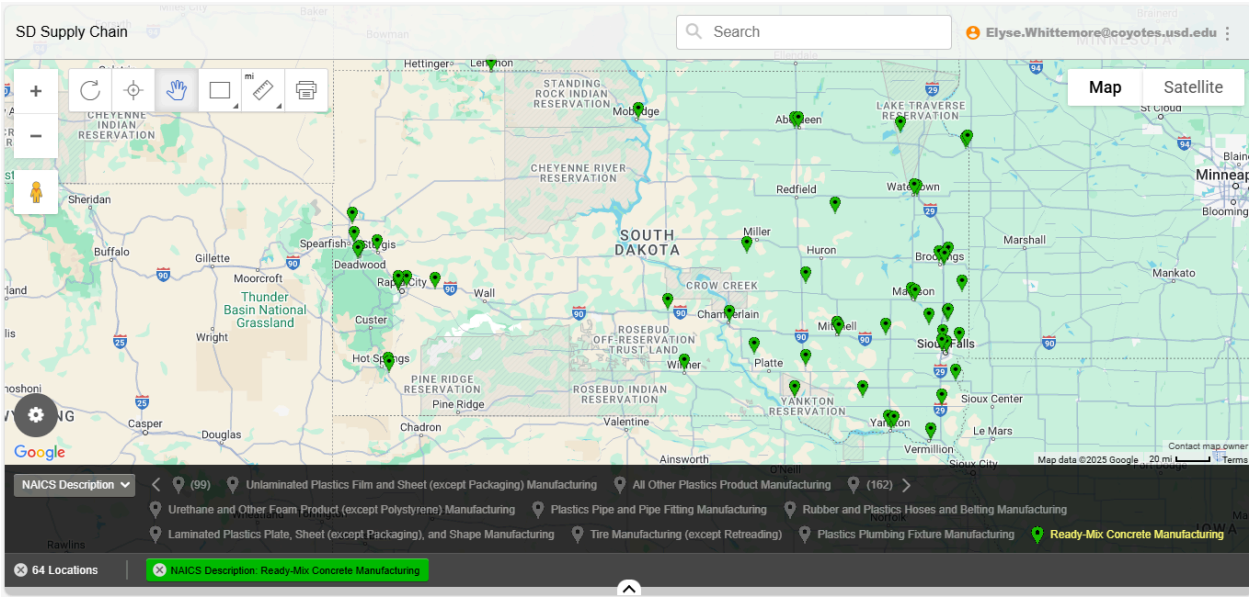
Upon analyzing the BatchGeo and PowerMap, we found that cities could be categorized into one of three tiers based on the number of manufacturers they have. Tier 1 is cities with 35+ companies, which include Sioux Falls, Rapid City, Watertown, Aberdeen, Brookings, Yankton, Mitchell, Huron, Spearfish, Brandon, Madison, North Sioux City, Tea, Pierre, and Sturgis. Tier 2 is cities with 15-34 companies and includes Belle Fourche, Harrisburg, Box Elder, Beresford, Black Hawk, Piedmont, Vermillion, Custer, Hot Springs, Britton, Canton, Hartford, Lennox, and Whitewood. Tier 3 is cities with 14 or fewer companies and includes the remaining towns and cities. We are particularly interested in the tier 2 companies; the majority were larger communities located in rural areas.

Among the many uses for the BatchGeo map is the ease with which one can visualize the geographical distribution of businesses that produce specific products as designated by their NAICS description. If a prospective business coming to South Dakota wishes to start a manufacturing operation, they can quickly get an overview of the existing ecosystem of suppliers for a relevant intermediate input product. This information can be used by them to co-locate into the existing supply chain network. For example, existing suppliers of end products used by other companies could use this map to conduct a survey to determine growth opportunities, which could allow prospective businesses to locate in niche markets to improve the viability of business plans and ensure the state is adequately supplied with important products. For instance, when one pulls up explosives manufacturing in South Dakota, both suppliers are located east river; this

result is surprising to us. Given the prevalence of mining west river, we expected to see at least one explosives manufacturer on that side. This could indicate an opportunity for an explosives manufacturer to co-locate to this region of the state to plug into the demand centers for explosives.

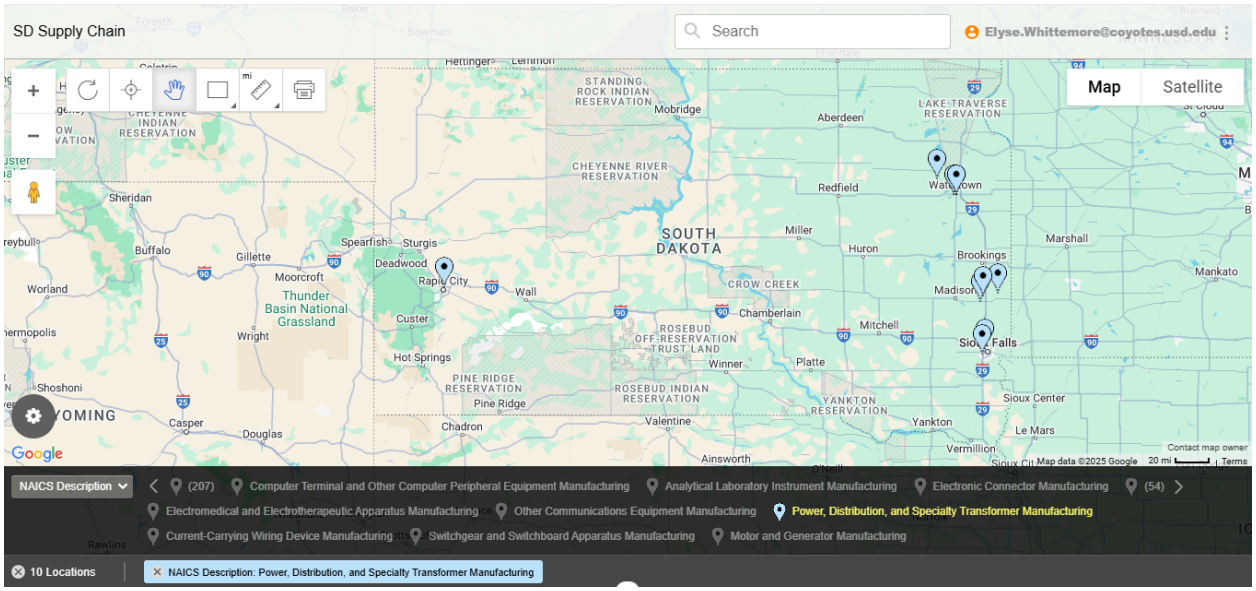
While we cannot explain all opportunities, below are a few we found interesting and are strong examples of how the map can be used.

The map below displays ready-mix concrete manufacturing and companies are widely dispersed throughout the state. This makes sense given concrete is needed everywhere and can't be transported long distances. We were surprised Huron does not have a Ready-Mix Concrete Manufacturing company and see this as an opportunity.

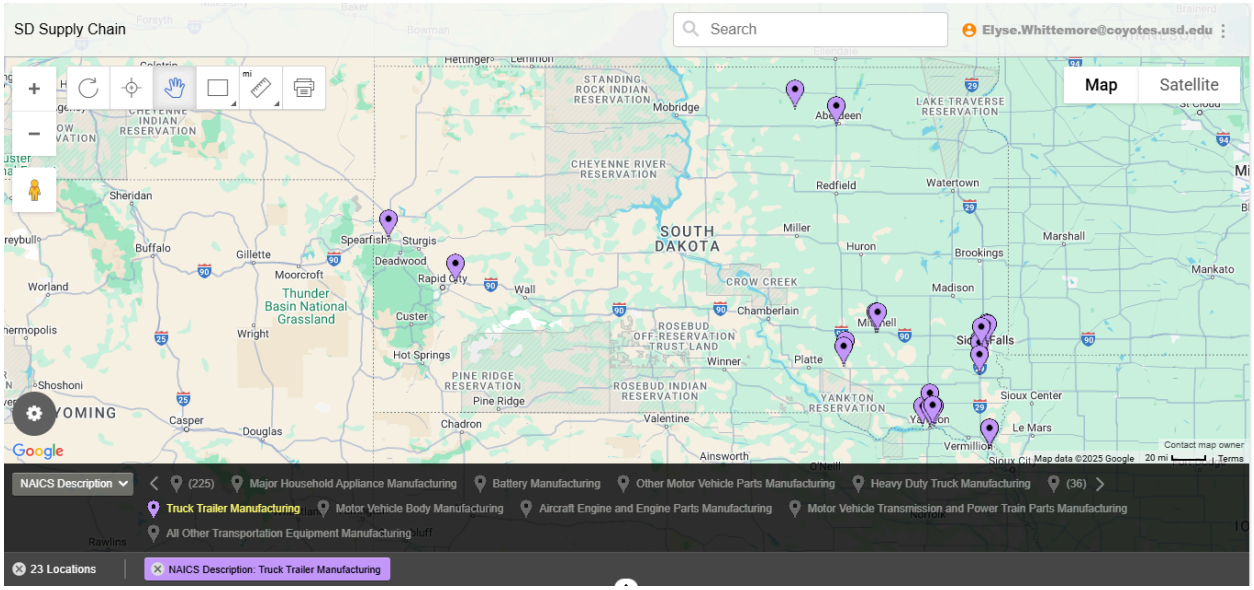


The Power, Distribution and Speciality Transformer Manufacturing map below is interesting because the companies are located north of Sioux Falls along I-29, which makes sense given the

number of wind farms in this area.



While predictable based on I-90 and I-29, the location of Truck Trailer Manufacturers told an interesting story. It makes perfect sense to see these manufacturers along the interstates; however, the number in Yankton stood out to us.



A second practical implication of a gap analysis is its ability to inform state policymakers of areas where targeted industrial policy can have a differential impact. One can envision a future policy by the Governor's Office of Economic Development in collaboration with the South Dakota Chamber of Commerce in a west-river based community of running a marketing campaign paired with a tax credit to encourage an explosives company to locate a factory to supply the underserved market. Policymakers and other stakeholders may also find this map

valuable as it could be used to guide the development of transportation infrastructure to support industrial buildout. For example, if opportunities for development in West River are identified–such as in the prior explosives example–areas proximate to mining operations that are attractive for business development but lack adequate transportation infrastructure could be places for targeted improvements in existing highways or railways depending on the anticipated needs of the industry in question.

Future Opportunities

In the future, one feature that could be added to the dashboard is a button that links to the BatchGeo map. It would look similar to the two buttons currently at the top, and it would be relatively simple to set up.

For the gap analysis, one future opportunity to explore is the creation of benchmark towns as a model for growth-oriented towns. The cities in South Dakota can be broken up into three tiers based on the number of manufacturers in each town, as described above. There may be an opportunity to select “benchmark” towns that are successful in each tier and showcase them for other towns of similar size. Both the Governor’s Office of Economic Development and growth-oriented towns can learn from these benchmark towns. Although they may not need to replicate the same makeup of manufacturers, it could be a good model to start with and build off of. The map can help policymakers find opportunities to develop small towns, which will, in turn, help connect individuals to their towns through new manufacturing jobs so they are less likely to leave.

CONCLUSION

South Dakota Manufacturing and Technology Solutions has made great strides in helping manufacturers in South Dakota by providing them with high-quality business advising. Our Excel Dashboard, Power Map, and BatchGeo Map will provide South Dakota manufacturers with an additional resource to analyze their supply chain strategy and identify growth opportunities. The scope of our project helped to create a real-world tool to be utilized, bridging the gap between academia and industry. We hope our work provides a strong foundation for Angela and SDMTS to finish their SCOIN project and provide quality services to South Dakota manufacturers.

We appreciate the opportunity to learn from Angela Allen and SDMTS. Through Angela, we were able to learn about her vision for this project and incorporate her interests into our map and dashboard. This project provided immense learning opportunities, and we grew dramatically in numerous skills. We learned how to utilize artificial intelligence to streamline processes. There were many aspects of the project that we learned how to automate, which contributed greatly to the success of the project. Additionally, we learned how to communicate with AI in a way that yields useful results. We grew our Excel skills far beyond many of the basic functions we first knew how to do. Additionally, we realized the importance of utilizing our resources. We relied heavily on meeting with and learning from numerous professors and faculty in the University of South Dakota's Beacom School of Business.

Our project advisor, Dr. Dan Tracy, was an immense help in mentoring, gathering information, and bouncing ideas off of. He constantly asked thought-provoking questions to push us outside of our comfort zone with this project.

Thank you for partnering with the Coyote Business Consulting group at the University of South Dakota. We appreciate Angela's time in providing us with the information needed to complete our project. Angela provided us with strong consulting experience and was an excellent resource. We hope SDMTS can use our maps, dashboard, and gap analysis as a starting point to complete their SCOIN project. We look forward to building upon the University of South Dakota's relationship with South Dakota Manufacturing and Technology Solutions.