

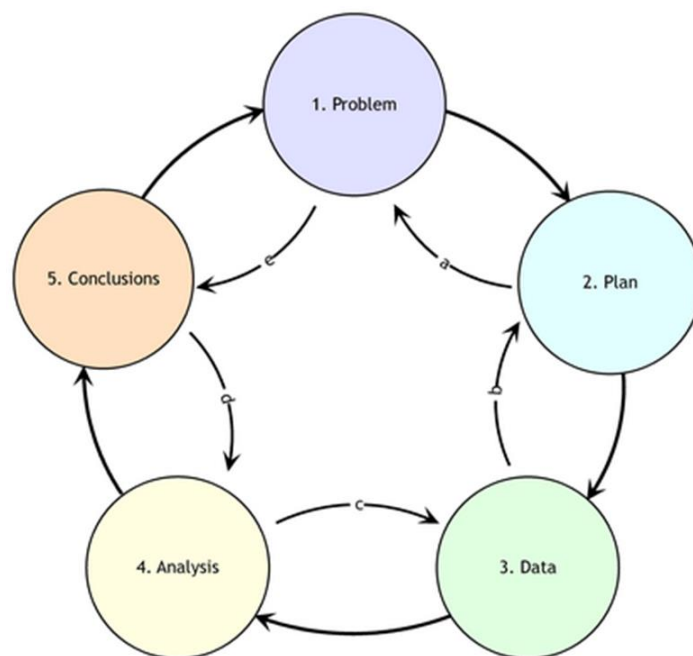
GIS Application Research Design Paper

The purpose of the GIS application research design paper is to give students an opportunity to demonstrate their understanding of the key GIS topics covered in this course through an application-focused research paper.

Research Design Papers due May 11, 2021, 11:59PM

The Major Points and Tips

- Students will select an application area of interest to them and provide detailed information on 1) key geospatial questions, 2) the information, data and tools used to answer them, 3) presentation and usage, and 4) overall findings.
- Students ARE NOT expected to perform any GIS analysis, rather, students will summarize specific tools and workflows that could be used and expected outcomes. Consider this paper more of a custom research design paper.
- All sections described below in the details are required for a full score on the final paper.
- The structure of your paper should include a section for *each* of the three place-based questions with all the corresponding information for each question within the section. Beyond that, I leave design and formatting to you.
- Tip – the use of tables in the paper will be extremely helpful for organizing some of the information. Don't try to put everything into a narrative format.
- Don't approach this work in a strictly linear fashion. You'll identify your questions first, but they may be refined based on data and tools. Along the same lines, data and tools can affect one another as well. As part of the paper's final conclusions, note some of the things encountered that modify your questions, data and/or tools. Remember the framework ->
- **A key to success is first researching what others have done – there's nothing wrong with following an existing methodology!**



- References are important and required, but there is not specific citation style.
- How long should my paper be? I don't have a length in mind, other than to say that it would be at least 10 pages, but certainly could be more depending on a number of factors. Going through the process of the research design is far more important than page count on your final document.
- Please submit in a Word document format to allow for Review & Track Changes.
- **Don't forget to ask me questions!**

Paper Details

1. Application area of interest

Students are strongly encouraged to choose an application of GIS that is of interest to them, as that makes the exercise even more enjoyable! With that, also consider the scope of the application.

Carefully read through ALL of the steps in this assignment and be certain you can complete all of the requirements. Starting with too narrow of a scope could potentially make the remainder of the research design difficult.

The appendix of this assignment has a handful of application areas; most are very broad. The list is far from comprehensive and is only meant to get you thinking. Start doing some online research to help decide on an area of interest – Esri's website might be a good resource as they have a wealth of documentation on different uses of GIS.

Paper Guidelines

- Summarize your application area of interest, including a high-level overview of how GIS is being used, in no more than 4 paragraphs.

2. Place-based questions for the area of interest

Before beginning this part of the exercise, refer to the Thinking Spatially exercise and Esri's *The Language of Spatial Analysis*. You'll find this document as required material for this exercise. The taxonomy of spatial analysis includes six high-level categories that classify and group related analytical questions. Students will use this taxonomy to identify questions.

Paper Guidelines

- For three of the six major categories, identify and describe at least one type of analysis. In your paper, be sure to identify the high-level category for each. When complete, you'll have identified a **minimum of three types of analysis**. *The six categories are discussed in Chapter Two.*

3. Geospatial information that can support the place-based questions

Describe the types of information necessary to answer each of your place-based questions. Keep in mind the difference between “information” and “data”. For example, if I wanted to know the population of children under the age of 12 per square mile for a county, the **information one would need is population data by county that includes age ranges that allow me to identify those 12 and under**. The **data one would need might be 2010 Census population data by county**.

4. Sources of data to meet the information needs of the place-based questions

Describe sources of data that meet your information requirements. Here you’ll most likely find a number of data sets that *could* be used. The data that you discover may further shape your questions and may impact the types of analysis tools you’ll be able to use.

Paper Guidelines

- Describe the specific data sets you plan to use in your analysis, as well as some of the potential data sets that you eventually decided not to go with, including the reason why.
- Can I use the same data set to answer more than one question? Yes! That’s ok, but try and make sure you’ve good a diverse amount of data big-picture.

5. Characteristics of the data

For three datasets PER question (which means nine in total) that you decide to use in your hypothetical analysis, describe the dataset’s characteristics. Note characteristics that you were unable to determine. To do this successfully, you’ll need to actually go and look for data, including related metadata. You don’t need to download any data, but you need to find the data and understand it.

I’m setting the requirement of three data sets per analysis question because some types of analysis like site suitability may use many more datasets – I don’t want you to have to document two dozen datasets! You’ll still list them in #4, but you won’t have to provide all of the details I’m looking for below. If this doesn’t make sense, please let me know!

Paper Guidelines

- Include the following data characteristics:
 - Data set title and brief description
 - Source of data
 - Data model and file format (ex. Vector shapefile, raster image, Vector Geodatabase)
 - Data publication date and geographic extent
 - Data coordinate system
 - Data accuracy / scale / resolution
 - Key attribute fields needed for analysis

6. Data geoprocessing

For each of the data sets provided in #5, describe any geoprocessing that may be necessary – field calculations, clipping/sub-setting, resampling, etc. If nothing needs to be done to the data for the analysis, please note that.

Paper Guidelines

- Complete for each of the datasets provided in #5.
- *By now you've noted the importance of having a general sense of the types of analysis you're going to perform and are probably starting to get a feel for the iterative nature of the analysis design process.*

7. Geospatial tools used to answer the questions

Describe the GIS tools and workflows you'll use with the data to answer the questions. Here's where you'll need to rely **heavily** on Esri's ArcGIS Online help documentation, or the help documentation for QGIS. You could be a bit more software-agnostic and reference specific analysis tools from the online spatial analysis textbook resource (<https://www.spatialanalysisonline.com/HTML/index.html>).

Paper Guidelines

- You will have at least one tool or workflow described for each question. The workflows may consist of multiple tools being used.

8. Types of output from analysis and its use

For each question and analysis(es), describe the output and how it would be used.

Paper Guidelines

- Describe output for each analysis, including the type of data set or information product it is, and how it would be used to support decision making. For each output, describe any pro's and con's regarding its use. Does it save time? Does it inform better? Does it reveal something? Can it be use to further analyze something? How much should decision makers rely on it, based on the quality of the input data?

9. Proposed method(s) for sharing and communicating results

For each (or one approach for all) of your questions and output, describe some of the ways in which you could share this information. For example, your output could be maps, charts and graphs, reports, data sets available for download, web map services, or maybe even an online mapping application.

Paper Guidelines

- You don't need to write pages on this, but describe at least two ways you'd share your results. (money is no limit) ;^)

10. Conclusions

Please summarize your experience. Issues encountered, thoughts on outcomes, potential pitfalls, value statement (can be your own qualitative/subjective thoughts) regarding the use of GIS for the application of interest, etc.

Paper Guidelines

- A few paragraphs will suffice.

10. Citations

Paper Guidelines

- Please cite any references or quotes used for any part of your paper. It is ok for the paper to be heavily referenced.

Paper Structure

The following are guidelines for the structure of your paper...

1. Application area of interest

Summarize your application area of interest, including a high-level overview of how GIS is being used, in no more than 4 paragraphs.

2. First of Three Place-based questions for the area of interest

Before beginning this part of the exercise, refer to the Thinking Spatially exercise and Esri's The Language of Spatial Analysis. You'll find this document as required material for this exercise. The taxonomy of spatial analysis includes six high-level categories that classify, and group related analytical questions. Students will use this taxonomy to identify questions. For three of the six major categories, identify and describe at least one type of analysis. In your paper, be sure to identify the high-level category for each. When complete, you'll have identified a minimum of three types of analysis. The six categories are discussed in Chapter Two.

a. Geospatial information that can support the place-based questions

Describe the types of information necessary to answer each of your place-based questions. Keep in mind the difference between "information" and "data". For example, if I wanted to know the population of children under the age of 12 per square mile for a county, the information one would need is population data by county that includes age

ranges that allow me to identify those 12 and under. The data one would need might be 2010 Census population data by county.

b. Sources of data to meet the information needs of the place-based questions

Describe the specific data sets you plan to use in your analysis, as well as some of the potential data sets that you eventually decided not to go with, including the reason why.

A table would work great for this information.

i. Characteristics of the data (for first of at least three datasets)

Describe the dataset's characteristics. Note characteristics that you were unable to determine. To do this successfully, you'll need to actually go and look for data, including related metadata. You don't need to download any data, but you need to find the data and understand it.

1. Include the following data characteristics:

- **Data set title and brief description**
- **Source of data**
- **Data model and file format (ex. Vector shapefile, raster image, Vector Geodatabase)**
- **Data publication date and geographic extent**
- **Data coordinate system**
- **Data accuracy / scale / resolution**
- **Key attribute fields needed for analysis**

A table would work well for this...

(Now repeat for two other datasets)

I'm setting the requirement of three data sets per analysis question because some types of analysis like site suitability may use many more datasets – I don't want you to have to document two dozen datasets! You'll still list them but you won't have to provide all of the details I'm looking for below. If this doesn't make sense, please let me know.

c. Data geoprocessing

Describe any geoprocessing that may be necessary – field calculations, clipping/sub-setting, resampling, etc. If nothing needs to be done to the data for the analysis, please note that.

d. Geospatial tools used to answer the questions

Describe the GIS tools and workflows you'll use with the data to answer the questions. Here's where you'll need to rely heavily on Esri's ArcGIS Online help documentation, or the help documentation for QGIS. You could be a bit more software-agnostic and reference specific analysis tools from the online spatial analysis textbook resource (<https://www.spatialanalysisonline.com/HTML/index.html>).

i. Types of output from analysis and its use

Describe output for each analysis, including the type of data set or information product it is, and how it would be used to support decision making. For each output, describe any pro's and con's regarding its use. Does it save time? Does it inform better? Does it reveal something? Can it be use to further analyze something? How much should decision makers rely on it, based on the quality of the input data?

Repeat #2 for your two other questions, including all of the sub-topics

3. Proposed method(s) for sharing and communicating results

For each (or one approach for all) of your questions and output, describe some of the ways in which you could share this information.

4. Conclusions

Summarize your experience. Issues encountered, thoughts on outcomes, potential pitfalls, value statement (can be your own qualitative/subjective thoughts) regarding the use of GIS for the application of interest, etc. A few paragraphs should suffice.

5. Citations

Cite any references or quotes used for any part of your paper. It is ok for the paper to be heavily referenced.

Appendix

Telecom and Network Services

- Organizations can incorporate geographic data into their complex network design, optimization, planning, and maintenance activities. This data enhances telecom processes through better customer-relationship management and location services.

Accident Analysis and Hot Spot Analysis

- GIS data helps to identify accident locations, and road networks can be optimized using data intelligence. This intelligence helps to improve road safety measures and allows better traffic management.

Urban Planning

- GIS data analyzes urban growth and the direction of expansion. When appropriately applied, it can discover new sites for further development, considering various factors that are necessary for successful building.

Transportation Planning

- GIS data is commonly used for managing transportation issues. With the addition of environmental and topical data in a GIS platform, companies can plan for a new road or rail route.

Environmental Impact Analysis

- Data gathered via GIS applications is vital for conserving natural resources and protecting the environment. Impact statements assess the magnitude of human impact on the environment, which GIS integration helps indicate.

Agricultural Applications

- GIS data helps create more efficient farming techniques, alongside analyzing soil data in an advanced fashion. This can increase food production in different parts of the world.

Disaster Management and Mitigation

- Efficient GIS systems protect the environment and are developed to assist risk and disaster management.

Natural Resources Management

- With the help of GIS information, forests can be adequately maintained and managed. It is especially crucial for the allocation and geographic distribution of water, one of the more critical environmental constituents.

Banking

- Banking has evolved to become market-driven, and a bank's success depends mainly on its ability to provide customer-driven services. GIS data plays an essential role in planning, organizing, and decision making in the banking industry.

Taxation

- GIS data helps solve taxation problems and maximize government income. It is used for building permits and engineering and offers a system for managing property tax on a geographic basis.

Surveying

- Surveying involves measuring the location of objects on earth, and more organizations are using Global Navigation Satellite Systems (GNSS) for this function. This data incorporated into a GIS system can estimate area and prepare digital maps.

Geology

- Geologists use GIS data to analyze soil, assess seismic information, and create 3D displays of geographic features. It can also be used to analyze rock characteristics, and identify the best location for different functions.

Assets Management and Maintenance

- GIS data helps organizations become more efficient with finite resources. With an understanding of the population at risk, planners can allocate resources more efficiently.

Planning and Community Development

- GIS data helps us understand and meet global challenges. As GIS technology rapidly advances, there are various innovative applications in the planning sector. GIS tools can be used to integrate geographic intelligence into planning processes, and have the potential to change how we think and behave.

Dairy Industry

- The dairy industry uses GIS data for distribution, production, and identifying the location of shops. It is a useful tool for planning in the field of dairy farm management and allows for better decision making.

Irrigation Water Management

- The availability of water directly affects crop production in a given region. GIS data can identify significant crops and determine yield, involving efficient techniques for spatial and time domain.

Pest Control and Management

- Pest control is essential to agricultural production, and GIS technology plays a vital role in mapping out infested areas. Organizations can consequently develop more effective pest management plans.