Best Practices for Graphics in Metropolitan Transportation Plans

by

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A REPORT

submitted in partial fulfillment of the requirements for the degree

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Abstract

There are over four-hundred Metropolitan Planning Organizations (MPOs) in the United States that are federally required to communicate regional long-range priorities in their Metropolitan Transportation Plan (MTP). These plans provide a long-term vision that drives the prioritization and development of billions of dollars worth of transportation improvement projects. Despite the value of these plans, most MTPs fall short on their ability to feel user-friendly (Florida Department of Transportation, 2013). One explanation may be the fact that there is a lack of guidance for good graphic communication. MPOs need to think strategically about how to visualize their information. Therefore, this research is intended to serve as a resource to create appealing and more effective graphics for the general public, stakeholders, and elected officials.

Over 1,500 graphics were carefully researched from a random selection of twenty MTPs from MPOs across the United States (with a population less than 200,000). Each graphic was categorized into one of three graphic types used within MTP documents: spatial, numeric, and concept graphics. Extensive quantitative analysis was conducted on these graphics in order to understand existing practice among the twenty MTPs. The application of graphic communication principles for these graphic types enable MPO planners and decision makers to understand "best practices" for graphics in MTP documents. In turn, these recommendations have the ability to enhance the way information is presented publicly and strengthen the overall quality of a document that serves as the overarching regional transportation vision for the future.

Best Practices for Graphics in Metropolitan Transportation Plans

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Master of Regional & Community Planning
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ABSTRACT

There are over four-hundred Metropolitan Planning Organizations (MPOs) in the United States that are federally required to communicate regional long-range priorities in their Metropolitan Transportation Plan (MTP). These plans provide a long-term vision that drives the prioritization and development of billions of dollars worth of transportation improvement projects. Despite the value of these plans, most MTPs fall short on their ability to feel user-friendly (Florida Department of Transportation, 2013). One explanation may be the fact that there is a lack of guidance for good graphic communication. MPOs need to think strategically about how to visualize their information. Therefore, this research is intended to serve as a resource to create appealing and more effective graphics for the general public, stakeholders, and elected officials.

Over 1,500 graphics were carefully researched from a random selection of twenty MTPs from MPOs across the United States (with a population less than 200,000). Each graphic was categorized into one of three graphic types used within MTP documents: spatial, numeric, and concept graphics. Extensive quantitative analysis was conducted on these graphics in order to understand existing practice among the twenty MTPs. The application of graphic communication principles for these graphic types enable MPO planners and decision makers to understand “best practices” for graphics in MTP documents. In turn, these recommendations have the ability to enhance the way information is presented publicly and strengthen the overall quality of a document that serves as the overarching regional transportation vision for the future.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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CHAPTER 1

INTRODUCTION

As Metropolitan Planning Organizations (MPOs) progress in creating enhanced and easily accessible transportation services for a diversity of users, there has been a push to clearly convey information about existing systems and their anticipated future. Information about regional transportation systems are commonly found within Metropolitan Transportation Plans (MTPs), also known as Long-Range or Regional Transportation Plans. Such documents have been federally required for MPOs since the passage of the United States Federal-Aid Highway Act in 1962 (Florida Department of Transportation, 2013). These documents look 20 plus years into the future and provide the strategic direction to improve multimodal transportation systems by linking a regional vision to a long-term, financially realistic plan (Peckett & Duffy, 2012). Each plan must serve as a communication tool to educate a broad audience – including stakeholders, elected officials, and the public – about regional needs, challenges, and priorities.

Despite the value of MTPs, there is an apparent gap between these documents and the quality of the information communicated, especially regarding graphics. MTPs have historically been lengthy, full of jargon, and less than user-friendly. Therefore, this research was undertaken as an attempt to bridge the development of MTP documents and clear graphic communication. MPOs need to think more strategically about how to visualize information while presenting pathways to

create better, more effective graphics for the general public. Before incorporating interactive graphics or more robust graphic communication practices, MPOs need to be able to clearly communicate static two-dimensional graphics.

To understand the pathways of good graphic communication in MTP documents there needs to be an understanding of existing graphic practices within MTP documents; as well as an understanding of literature on graphic communication. For this research, the combination of the two provides a general understanding of the "best practices" for the spatial, numeric, and concept graphics. Tables were not evaluated as part of this research. By analyzing over 1,500 graphics across twenty randomly selected MPOs with a population of 200,000 residents or less, there is evidence that MPOs can enhance their MTP by incorporating simple graphic communication principles (Florida Department of Transportation, 2013). The public, stakeholders, and elected officials will likely to take an interest to MTPs if there is a strategic use of color, imagery, and visual representations.

Organization of Report

This research is formatted from broad to narrow perspective. Beginning with introducing the broad concept of graphic communication, followed by understanding how to communicate entire documents, to a graphic-specific discussion. Chapters 3 and 4 —Background and Document Presentation— provide a review of relevant graphic communication literature, exploring key definitions and relevance to MTP documents as well as the field of urban planning. Chapter 5 —Existing Practices— describes key quantitative and qualitative research observations about each MTP and the graphics within. Chapter 6 —Essential Graphics— provides practitioners with a list of essential and recommended graphics to utilize when developing graphics for MTPs.

Key Definitions & Acronyms

Metropolitan Transportation Plan (MTP)	Also known as a long-range transportation plan, the Metropolitan Transportation Plan is a federally required document that drives the funding prioritization of transportation improvement projects over a period of 20-25 years.
Metropolitan Planning Organization (MPO)	A designated local decision-making body that is responsible for carrying out the metropolitan transportation planning process for localities in urbanized areas with populations over 50,000; as determined by the U.S. Census.
Graphic Communication	"The art and science of integrating writing and design" so that a message or series of messages may be clearly, concisely, and visually communicated to a particular audience (Schriver, 2013).
Spatial Graphic	Also known as maps, are meant to simply convey spatial relationships and patterns.
Numeric Graphic	Conveys relationships among numbers. This includes graphs, charts, and other related figures to represent numeric and statistical data.
Concept Graphics	A visualization that is aspatial and non-numeric. This type of graphic primarily includes photography and illustrations.

CHAPTER 2

METHODOLOGY

There are two objectives for this inductive research. First, this research aims to explore the existing graphic communication practices within Metropolitan Transportation Plan (MTP) documents. Second, in combination with existing practice and literature on graphic communication, this research aims to recommend best graphic practices for MTP development in the future including outlining what graphics are essential. This research analyzes twenty MTPs selected from a stratified random sample of Metropolitan Planning Organizations (MPOs) with a population under 200,000. MPOs with a population of this size are not transportation management areas and are typically understaffed and underfunded even though their plans affect nearly 23.3 million people (Sciara, 2017; United States Department of Transportation, n.d.). This research can benefit MPOs of this size because they often create their MTP in house. In total, five MPOs were randomly selected within each of the four geographic regions as defined by the U.S. Census Bureau: the West, Midwest, Northeast, and South. The total sample size of twenty MPOs equates approximately 10 percent of all MPOs serving a population of 200,000 residents or less.

CHAPTER 3

BACKGROUND

For years urban planning and graphic communication were two fields of research that rarely coincided. In years since the 1980s, research has been conducted on the impact of graphic communication in various fields such as economics, science, and business. Despite the increasing literature on graphic communication, there are few resources in planning literature that focus on graphic practice. Frank (2003) argues that graphics form the backbone of communication in any field of planning.

What Is Graphic Communication?

Graphic communication can be a multifaceted term encompassing graphic design, visual communication, visual literacy, information design, and visualization. At its core graphic communication is about effectively communicating a message to an audience (Bamford, 2013). Schriver (2013) argues that graphic communication is "the art and science of integrating writing and design" so that a message or series of messages may be clearly and concisely communicated to a particular audience.

When Is Graphic Communication Effective?

Effective Graphic Communication within Documents

Contrary to popular belief, graphic communication goes beyond choosing the right font or correct color palette (Rodríguez Estrada & Davis, 2015; Schriver,

2015). Though these methods are important in graphic communication and can make a document look good, the topic itself is a thoughtful process that is used to engage audiences and produce something that informs the public, governmental staff, political representatives, or key stakeholders (Frascara, 2004; Rodríguez Estrada & Davis, 2015; Schriver, 2013). This process may include using various mediums to supplement the written text of a document, including: diagrams, maps, timelines, photographs, sketches, charts, and icons (Barton, Berger-Walliser, & Haapio, 2013).

Adams (2011) alludes that graphics are often critiqued for being distracting. Though some professionals share this belief, when used strategically, graphics become "indispensable partners of words in conveying information" (Kolin, 2010). When graphics are used strategically, Markel (2012), argues that there are five main functions. Graphics 1) become more appealing to readers; 2) clarify difficult concepts; 3) communicate an array of quantitative data; 4) provide instructions and; 5) visually communicate ideas to nonnative speakers.

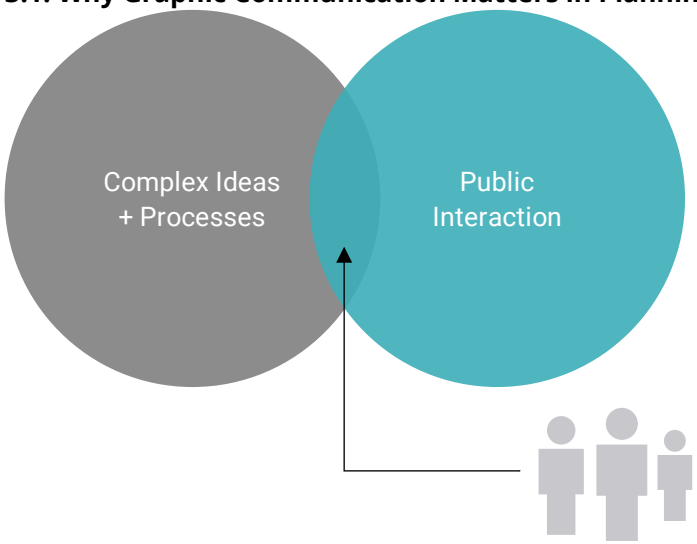
How Does Graphic Communication Apply to Planning?

Graphic designers have begun to adopt a holistic approach of graphic communication. The field of graphic communication has extended beyond a two-dimensional arrangement of shapes, color, and text. Modern graphic communication exists as a product that is capable of engagement and interaction on websites and within the physical environment. Planners have notably used graphic communication techniques in public meetings and design charettes for years. Yet, with the advances in the graphic communication sector, planners are called upon to utilize new graphic communication skills in order to involve individuals in the planning process. Despite this, it can be argued that static graphics in planning documents will never cease.

Planning Documents

Frank (2003) stresses that "graphics of various kinds [are] essential for clear communication in the planning profession" (Frank, 2003). Graphics such as maps, charts, and diagrams are valuable tools in documents because they have the ability to increase audience interest, improve information retention, and enhance public support (**Figure 3.1**)(Frank, 2003; Meisel & Baker, 2018). Furthermore, graphics can make documents more transparent, participatory, credible, and "trust-inspiring" (Barton et al., 2013; Schriver, 2015). Kirkhaug (2018) credits the lack of citizen engagement to the result of poorly communicated plans. Plans are often written in bureaucratic prose which can be confusing for the public and lead to ambiguity (Kirkhaug, 2018). Planning documents have been criticized for being unappealing because they are excessively long, technical, complex, and utilize "distant and unfriendly" language (Passera, 2017; Schriver, 2015). To resolve this, planners and other project participants must decide what information is sacrificed in simplification and what is featured. Graphics factor into a citizen-friendly plan (Florida Department of Transportation, 2013).

Figure 3.1: Why Graphic Communication Matters in Planning



Source: Meisel & Baker (2018)

CHAPTER 4

PLAN PRESENTATION

This chapter is meant to provide Metropolitan Planning Organizations (MPOs) with a general understanding of the graphic communication principles that apply to Metropolitan Transportation Plans (MTPs). When these principles are applied, MPOs can in turn focus on the development of unintimidating and user-friendly MTPs with user-friendly graphics. The document structure and appearance can have a great influence on how the document is perceived and understood by readers. At first, this chapter identifies a few general principles of how to clearly communicate an MTP through document presentation; providing a discussion on color, document layout, and other core principles that are by no means comprehensive. The second part of this chapter defines spatial, numeric, and concept graphics. Information from this section will carry over throughout the following chapters. This research aspires to help MPOs make better use of their data as they present complex and federally required concepts to the general public.

General Principles

In 2013, the Florida Department of Transportation Office of Policy Planning created a guidebook for Citizen-Friendly MTPs. They assessed 137 MTPs of various sizes from across the country on criteria related to citizen-friendliness in four categories: length, clarity, graphics, and vision. Based on their study, the provided seven key principles that are relevant to creating a citizen-friendly MTP. The key principles in developing a clear plan are as follows:

1. Developed with a clear vision;
2. Easy to access via the MPO's website;
3. Easy to read and understandable by the general public;
4. Of a reasonable page-length;
5. Sub-divided into meaningful sections (while being cognizant of federal requirements);
6. Free of excess information that could reasonably be located in ancillary documents (i.e., travel forecast model validation reports); and
7. ***Inclusive of appropriate methods for presenting the report's content (i.e., easy to understand charts and visual aids).***

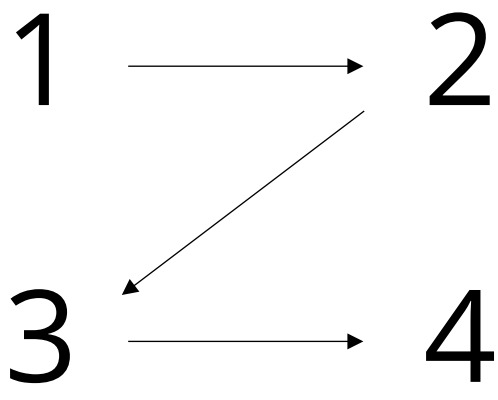
Document Length

For any document, as the page length grows there will be a decrease in the likelihood someone will read the document. Keeping this in mind can be valuable when developing an MTP. Shorter reports and chapters are more likely to be read. The Florida Department of Transportation Office of Policy Planning (2013) illustrates that brevity in sentence structure and document length can be beneficial. Short sentences with jargon free terms are easy to comprehend. In addition, it is important to be mindful that documents with more graphics lengthens the number of pages in a report as they require more space.

Document Layout

The layout of a document defines the spatial arrangement of text, images, colors, symbols, and "white space" on a page (Frank, 2003). A good mixture of these elements can attract readers, direct their attention, and clarify information. Knaflic (2015) argues that the design of a page can draw attention to where an audience is meant to look. He argues that it is important to put the most important information on the top left of a page (**Figure 4.1**). This helps guide readers through a graphic or page in order to ease information retention. A dense text document without much contrast or structure is often difficult to read. Adding consistent headings, page borders, and making font selections can provide a uniform look that may seem tedious to develop but can inherently save time when it is time to format the document. When developing the layout of the document it is important to remember that MTPs are likely to be posted online in a PDF format. Therefore, an image that crosses over two pages may not read as clearly in single page view as it would when printed.

Figure 4.1: The zigzag "z" of taking in information on a screen or page



Source: Knaflic (2015)

Color

Color is a unique tool that should be used with care. When using color in a graphic or document, it is important to remember that a graphic is only effective if a reader can access, read, and understand the content (Wong, 2010). For example, bold colors are best used when trying to emphasize a notable aspect. When bright or subdued colors are used everywhere, it is difficult for people to determine where to direct their attention (Lankow, Ritchie, & Crooks, 2012). Color is meant to be used sparingly so that the message trying to be conveyed is communicated deliberately and clearly. Once a color palette has been selected, it is crucial that this scheme becomes a uniform color scheme. The consistency of colors aids in maintaining a consistent theme (Florida Department of Transportation, 2013).

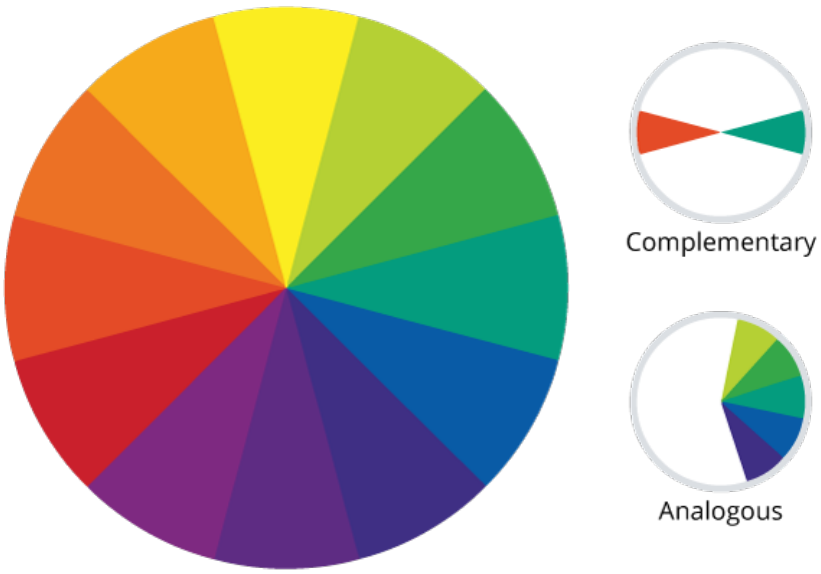
Color Combinations

To prevent overwhelming readers, it is important to use simple and vibrant color schemes which can be achieved through a disciplined application of "color wheel" design principles. Wong (2010) argues that numeric graphics (charts & graphs) should include basic colors and three to five shades of this color. The fewer colors the better. Similar principles can be applied to other graphic types.

On the color spectrum there are warm and cool colors. Warm colors are those in the red area of the color spectrum such as red, orange, yellow and brown. Cool colors are on the blue side and include, blue, green, purple, and neutral gray. When using warm and cool colors together, warm colors will visually overpower cool colors even when used in equal amounts (Wong, 2010). Colors such as red and blue should not be used at the same time as the eye cannot properly focus on them at the same time (Kosslyn, 2007). For numeric graphics especially, it is important to use either a warm color scheme or a cool color scheme. Only the darker shades or a different color should be used to highlight a segment.

When deciding a color palette, it is important to extend beyond preset colors. It is equally important to be cognizant of different color representations. For example, red and green when used together may associate with the Christmas holiday; red is strongly associated with loss; and green is associated with environmental practice. Despite the different representations, use logic to explore color schemes. Good graphic representations often involve a complimentary or analogous color scheme (**Figure 4.2**). Complimentary colors are opposite one another on the color wheel and analogous colors are sequential on the color wheel. The final test to ensure your graphic colors are clearly communicated is to print the chart in black and white or make a copy in gray scale to test if the graphic is sufficient. Though this section does not directly address color blindness or cultural colors, it is important for any organization to be aware that decisions with color may have different implications based on regional demographics.

Figure 4.2: The Color Wheel and Desired Color Scheme Harmonies



Typography

Typeface

The legibility of a report should be of great concern. There are few hard rules regarding typography, but for documents like an MTP, there are a few good practices. There are several types of font but the two most applicable font styles to use in an MTP are serif and sans serif fonts. These typefaces are the most clear and clear fonts facilitate easy reading. **Table 4.1** outlines the most common uses for serif and sans serif font. Stylized, or specialty fonts, such as fonts that look like handwriting or belong in a comic book should be avoided altogether.

Table 4.1: Serif vs Sans-Serif Font

Serif	Sans Serif
Aa	Aa
When to use serif font Serif letters express a feeling of authority and establishment. This type of font is often the easiest for people to read in long stretches. Most novels, magazines, and newspapers are set in serif typeface.	When to use sans serif font Sans serif letters express a feeling of modernity and are viewed as clean and simple. It is most common for this typeface to be used in titles, subtitles, and captions. Though it is less common, some reports may benefit from sans serif text.

Sources: Frank (2003); Lewis (2015)

Hierarchy

Typography also provides readers with a visual cue of hierarchy in reports. Visual hierarchy can be established by using different font sizes and weights. There are no hard rules regarding font size, but **Table 4.2** provides a starting point for the design of documents. There are other means to provide structure and emphasis on text for hierarchal clarification such as the use of underlining, italics, color, line spacing, or indentions (Frank, 2003). However, these must be used carefully because without proper consideration, these modifications can impede readability and overall appearance of the report. It is also important to note that long stretches of text are difficult to read when text is UPPERCASE or *italic*.

Table 4.2: Font Sizes for Document Creation

Element	Type Size (in points)
Chapter Titles	18-36
1st order headings	14-24
2nd order headings	10-18
Body text	8-12
Figure captions	6-10
Figure labels, notes	6-10
Page headers and footers	6-10
Annotations in graphics	5-8

Source: Frank (2003)

The Three Types of Graphics

Graphics are a crucial part of any document and must be used to compliment the text of a document. As for MTPs, there are three graphic types: spatial graphics, numeric graphics, and concept graphics (**Figure 4.3**). The following section defines each of these graphic types.

Figure 4.3: Three Types of Graphics in Metropolitan Transportation Plans

Spatial Graphics

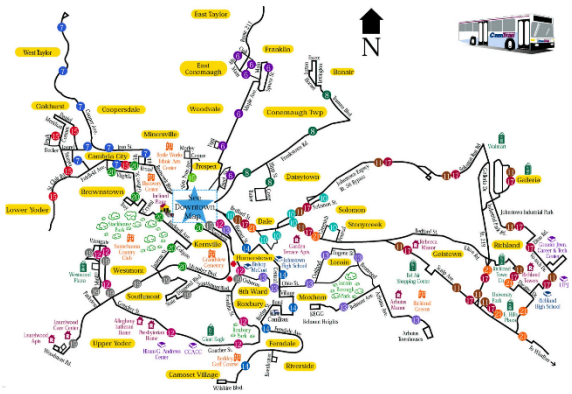
Spatial graphics, also known as maps, can be complex but are meant to simply convey spatial relationships and patterns. MTPs are comprised of thematic maps which are typically "made with a single purpose in mind" (Penn State University Department of Geography, n.d.). **Table 4.3** provides a simple definition of a thematic map. A checklist for best practices when creating thematic maps can be found in Appendix A. Thematic maps can be categorized in two ways: by categorical data or quantitative data. Categorical maps are meant to communicate distinct non-numeric information while quantitative mapping focuses on representing a relative ranked order (**Figure 4.3**). Regardless of the purpose, map making "is an art as well as a science" (Frank, 2003). Knowledge about map color, line weight, texture, and orientation can "catalyze information and give it agency" (Frank, 2003), not just make the map look good. The use of maps can give the reader "a sense of orientation with regard to demographics and system wide information" (Florida Department of Transportation, 2013).

Table 4.3: Spatial Graphics Defined

Map Type	Definition
 Thematic Map	Used to graphically express spatial patterns and relationships. Maps assist with three general tasks: illustration/explanation, navigation, and analysis.

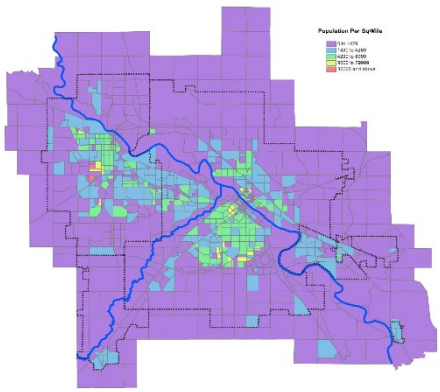
Figure 4.4: Categorical vs Quantitative Maps

Categorical Map



Source: Cambria County Metropolitan Planning Organization (2016)

Quantitative Map



Source: Black Hawk County Metropolitan Area Transportation Policy Board (2018)

Numeric Graphics

Numeric graphics in the context of this report are graphs, charts, and other related figures used to represent numeric and statistical data including percentages, monetary, or numeric values. These graphs, charts, and other figures are intended to convey relationships among numbers more quickly and clearly than what is possible using tabular form (Zelazny, 2001). **Table 4.4** provides a simple definition of the most common and practical numeric graphics. When a numeric graphic is presented properly, the information enables readers to clearly discover patterns. However, Kosslyn (2007) argues that some numeric graphics fail. Wong (2010) contends that “anyone can create graphics” with modern technology and describes why certain graphics fail. Numeric graphics primary fail because people present them with visual tricks such as clashing colors or 3D effects (Wong, 2010). These visual tricks distract readers from content. A proper numeric graph should have no extra layers of colors or patterns and there should be no embellishments made to distract readers from the clarity of the information. A checklist for best practices when creating numeric graphics can be found in Appendix A.

Table 4.4: Numeric Graphics Defined

Chart Type	Definitions
 Vertical Bar Chart	Used when illustrating differences between specific point values such as comparing changes over time, analyzing parts of a whole, or ranking values.
 Horizontal Bar Chart	Used virtually the same as a vertical bar chart however, horizontal bar charts are used only to view parts of a whole and show a ranking of values. These charts are never used to compare a change over time.
 Stacked Bar Chart & 100% Stacked Bar Chart	Used when there is a need to show multiple part-to-whole relationships from discrete or continuous data. The stacked bar is used to make nominal comparisons while the 100 percent stacked bar focuses on the comparison of each part.
 Line Chart & Line Chart with Points	Used to show a trend by displaying a continuous data series or discrete values over a period of time.
 Pie Chart	Used to show the size of each part as a percentage of a whole. These charts are the least practical and most misused chart.

Concept Graphics

Concept graphics are visualizations that are aspatial and non-numeric. This type of graphic primarily includes photography and illustrations. Concept graphics are the most diverse graphic type. These graphics are typically used as a reference to the text of a document to clarify a concept or to direct attention. **Table 4.5** provides a basic definition of the most commonly found concept graphics within MTPs. A checklist for best practices when creating numeric graphics can be found in Appendix A.

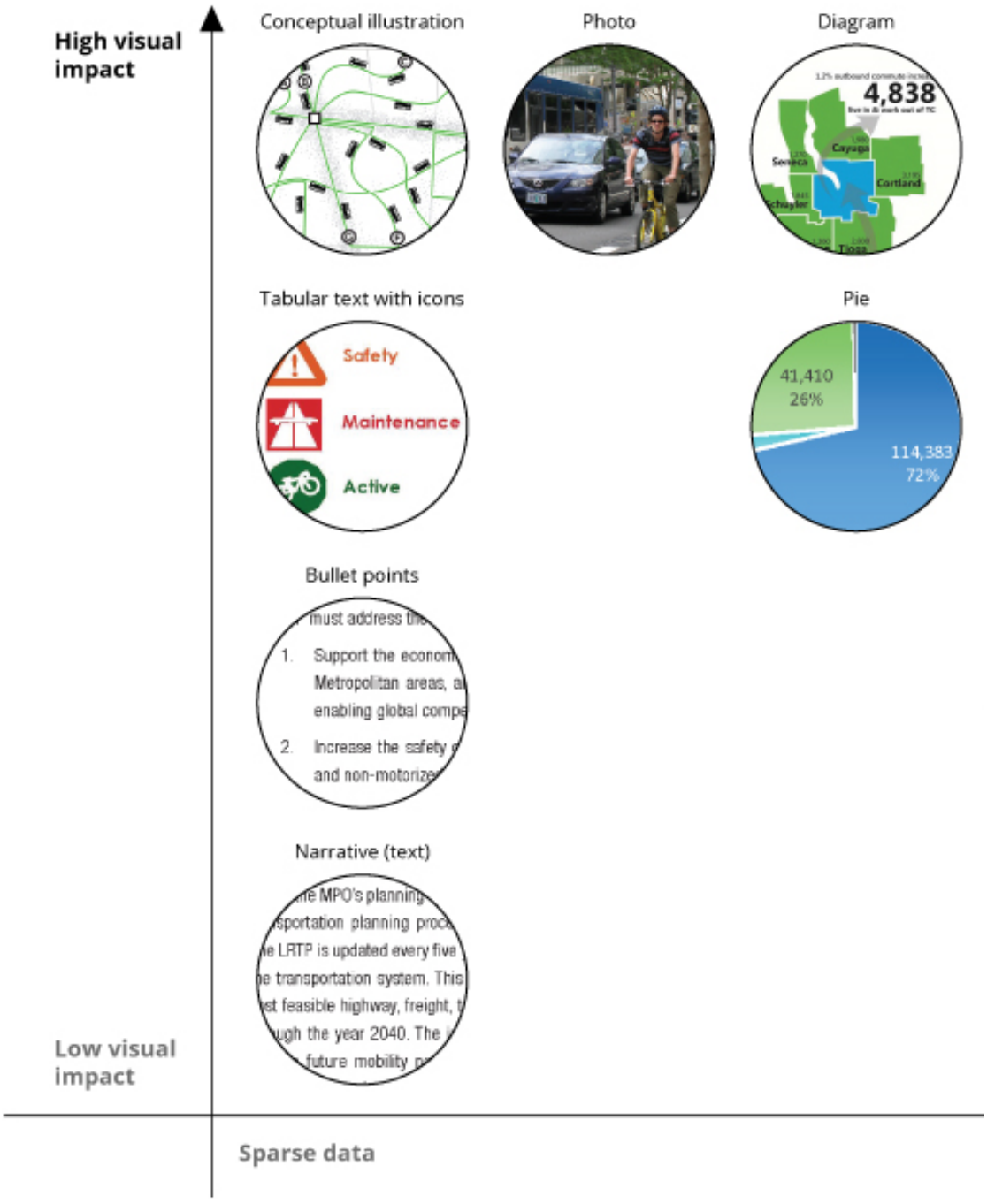
Table 4.5: Concept Graphics Defined

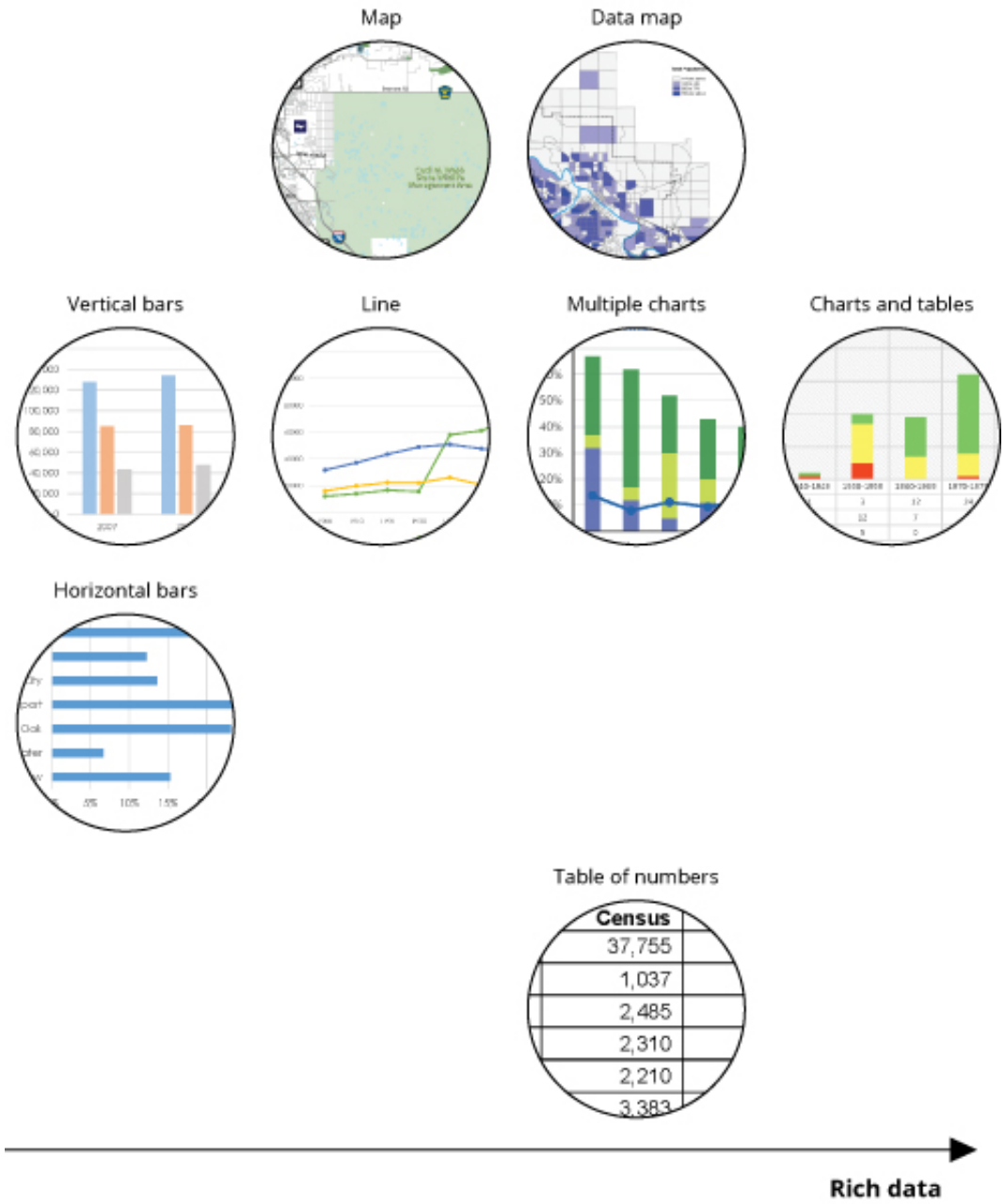
Chart Type	Definitions
 Photograph	Used when trying to evoke an emotion, present evidence, or increase reader retention.
 Resource & Logo	Used to inform readers of an additional website, plan, report or organization.
 Diagram	Used to convey general ideas, interactions, timelines, and relationships.
 Document Navigation	Used as a reoccurring icon throughout a document to direct readers to a particular concept or idea.

The Graphic Continuum

Simply put, there are a lot of ways to visualize information (Schwabish, 2014b). The use of various shapes, images, chart types, and colors help an audience understand patterns and relationships. Wong (2010) was one of the first to identify a 'visual-data continuum' amongst spatial, numeric, and concept graphics. In her work, she implies that visualizations themselves exist on a continuum where graphic choices and presentation have an influence on audience impact. **Figure 4.5** provides a rendition of her work that is relevant to MTP graphics. There are graphics such as photographs that are sparse with data or graphics that are rich in data such as data maps that will both have a high audience impact. Schwabish (2014) further contends this by arguing that all graphics can be classified and that there are logical graphic choices based on the story or the information trying to be conveyed to an audience. In order to facilitate easy decision making for graphics in MTPs, a flow chart has been developed based on expert literature and can be found in Appendix A.

Figure 4.5: Visual-Data Continuum: Rich data, high visual impact





Note: this figure has been recreated from a graphic published by Wong (2010) to represent relevant graphics within MTPs

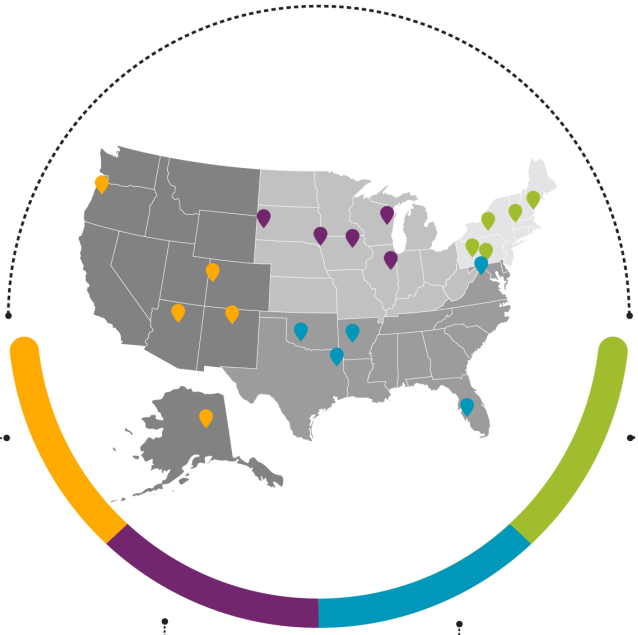
Image sources (in no particular order): Black Hawk County Metropolitan Area Transportation Policy Board (2018); Champaign Urbana Urbanized Area Transportation Study (2014); Charlotte County-Punta Gorda Metropolitan Planning Organization (2015); Fond du Lac Metropolitan Planning Organization (2015); Grand Valley Metropolitan Planning Organization (2014); Ithaca-Tompkins County Transportation Council (2014); and Longview Metropolitan Planning Organization (2017)

CHAPTER 5

EXISTING PRACTICES

Across the four U.S. Census Regions, twenty Metropolitan Planning Organizations (MPOs) with a population under 200,000 were randomly selected for research on the graphic characteristics of their latest Metropolitan Transportation Plan (MTP). **Figure 5.1** and **Table 5.1** provide a general perspective on characteristics of the selected MPOs. Across each MTP, just over 1,500 graphics were coded. Each graphic was categorized as either a spatial, numeric, or a concept graphic. These categories encompass —but are not limited to— figures such as diagrams, maps, timelines, photographs, sketches, renderings, and charts. Researching these three types of graphics enables a general understanding of the existing graphic communication practices within MTP documents. The information on the following pages provides a snapshot of how MTPs compare holistically, regionally, or individually.

Figure 5.1: Geographic Distribution of the Metropolitan Planning Organizations



WEST

Albany Area Metropolitan Planning Organization
Albany, OR

Fairbanks Metropolitan Area Transportation System
Fairbanks, AK

Flagstaff Metropolitan Planning Organization
Flagstaff, AZ

Grand Valley Metropolitan Planning Organization
Grand Junction, CO

Santa Fe Metropolitan Planning Organization
Santa Fe, NM

MIDWEST

Black Hawk County Metropolitan Area Transportation Policy Board
Waterloo, IA

Champaign County Regional Planning Commission
Urbana, IL

Fond du Lac Area Metropolitan Planning Organization
Fond du Lac, WI

Rapid City Area Metropolitan Planning Organization
Rapid, SD

Siouxland Regional Transportation Planning Association
Sioux City, IA NE SD

SOUTH

Charlotte-Punta Gorda Metropolitan Planning Organization
Port Charlotte, FL

Lawton Metropolitan Planning Organization
Lawton, OK

Longview Metropolitan Planning Organization
Longview, TX

Tri-Lakes Metropolitan Planning Organization
Hot Springs, AR

Winchester-Frederick County Metropolitan Planning Organization
Winchester, VA

NORTHEAST

Adams County Transportation Planning Organization
Gettysburg, PA

Berkshire Metropolitan Planning Organization
Pittsfield, MA

Cambria County Metropolitan Planning Organization
Ebensburg, PA

Ithaca-Tompkins County Transportation Council
Ithaca, NY

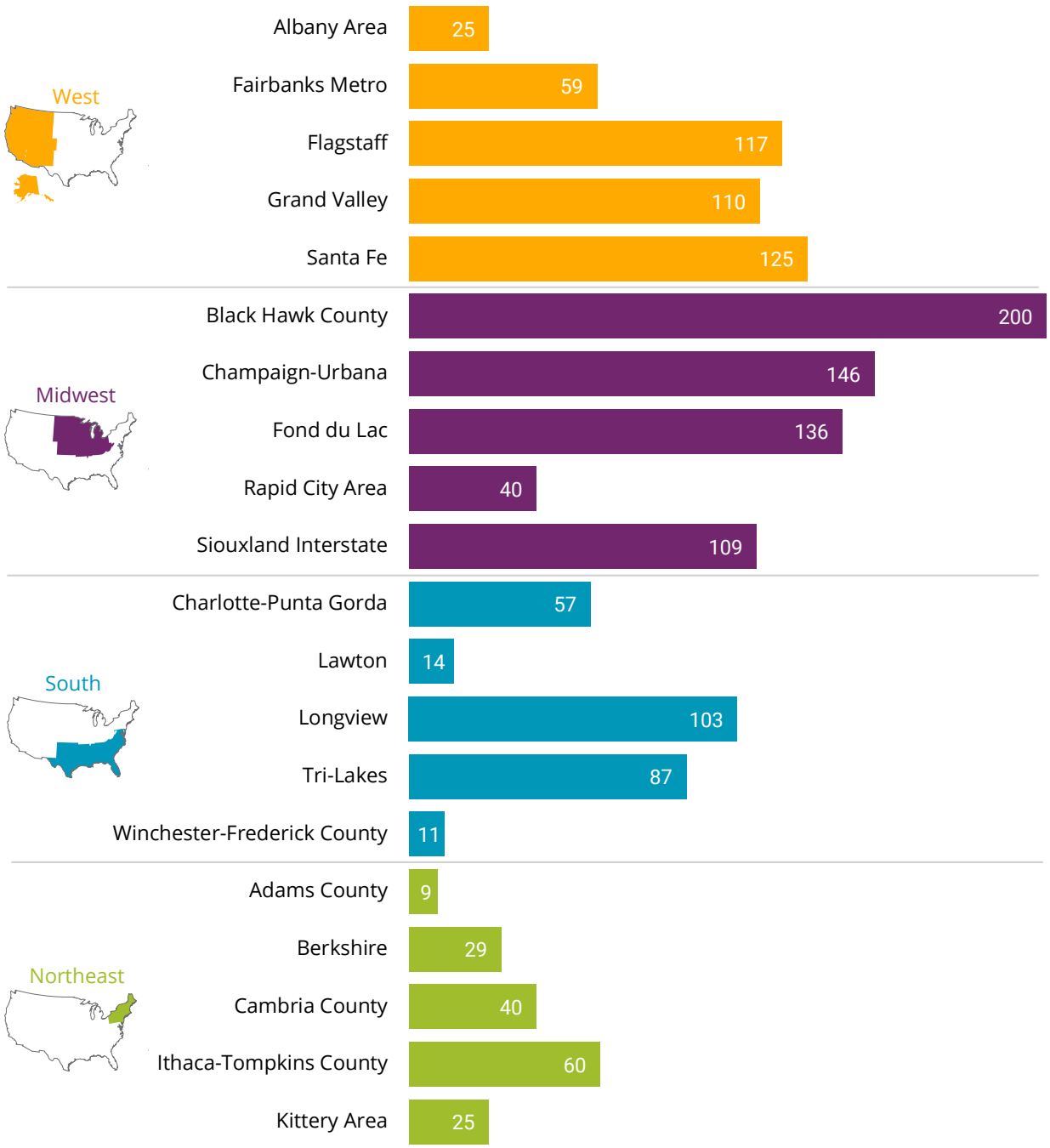
Kittery Area Comprehensive Transportation System
Springvale, ME

Table 5.1: Selected Metropolitan Planning Organizations

	Metropolitan Planning Organization	2010 Census Population	Major City, State	Latest MTP Publication
West	Albany Area Metropolitan Planning Organization	57,721	Albany, OR	2018
	Fairbanks Metropolitan Area Transportation System	72,565	Fairbanks, AK	2015
	Flagstaff Metropolitan Planning Organization	83,912	Flagstaff, AZ	2017
	Grand Valley Metropolitan Planning Organization	133,075	Grand Junction, CO	2014
	Santa Fe Metropolitan Planning Organization	116,386	Santa Fe, NM	2015
Midwest	Black Hawk County Metropolitan Area Transportation Policy Board	121,157	Waterloo, IA	2018
	Champaign Urbana Urbanized Area Transportation Study	161,041	Urbana, IL	2014
	Fond du Lac Metropolitan Planning Organization	60,199	Fond du Lac, WI	2015
	Rapid City Metropolitan Planning Organization	106,024	Rapid, SD	2015
	Siouxland Interstate Metropolitan Planning Council	115,853	Sioux City, IA NE SD	2016
South	Charlotte County-Punta Gorda Metropolitan Planning Organization	161,230	Port Charlotte, FL	2015
	Lawton Metropolitan Planning Organization	86,299	Lawton, OK	2015
	Longview Metropolitan Planning Organization	117,298	Longview, TX	2017
	Tri-Lakes Metropolitan Planning Organization	90,507	Hot Springs, AR	2015
	Winchester-Frederick County Metropolitan Planning Organization	78,616	Winchester, VA	2017
Northeast	Adams County Transportation Planning Organization	101,407	Gettysburg, PA	2017
	Berkshire Metropolitan Planning Organization	131,232	Pittsfield, MA	2016
	Cambria County Metropolitan Planning Organization	151,348	Ebensburg, PA	2016
	Ithaca-Tompkins County Transportation Council	101,566	Ithaca, NY	2014
	Kittery Area Comprehensive Transportation System	48,680	Springvale, ME	2014

Source: United States Department of Transportation (n.d.) | Note: the latest MTP publication in August 2018

Figure 5.2: Number of Graphics within Each Metropolitan Transportation Plan



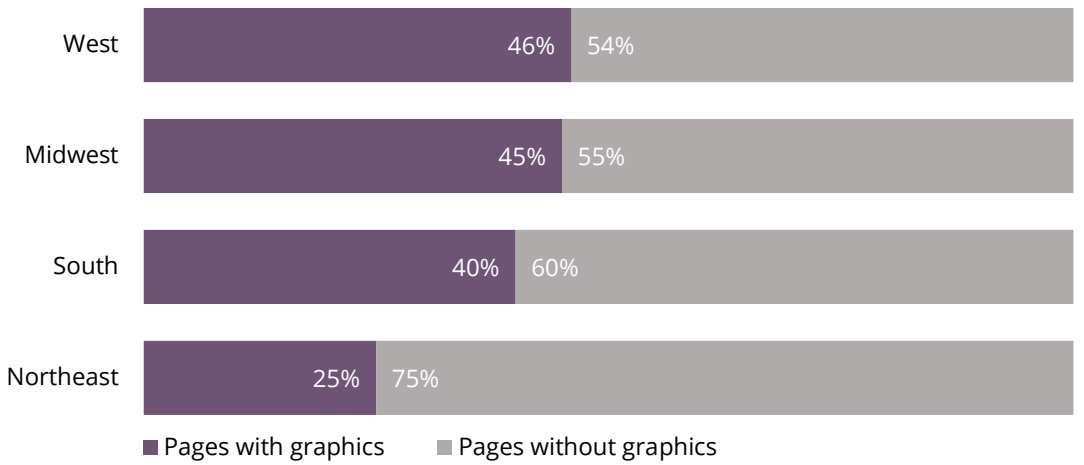
An Overview of Graphic Trends

MTPs include a myriad of graphics that are meant emphasize written information. A creative use of color, imagery, and visual representation through the use of maps, charts, and illustrations are proven to be appealing to the general public (Florida Department of Transportation, 2013). **Figure 5.2** provides a general overview of the total count of graphics found within each researched MTP. There is an evident disparity between the total number of graphics across individual MPOs as well as regions. However, this may indicate that there are regional trends among the way an MTP is graphically presented. For instance, the West and Midwest have a larger total number of graphics than the South and Northeast.

Page Size

When comparing plans regionally and including pages as a factor, it is noteworthy that there is a similar range in the percent share of the number of pages with and without graphics with an exception for the Northeast. **Figure 5.3** provides information on the concentration of graphics rather than the total graphic count. Though, there are plans that have a higher concentration or count of graphics, this does not indicate that these plans are exemplary.

Figure 5.3: Percent Share of Pages with and without Graphics



Defining Spatial, Numeric, and Concept Graphics

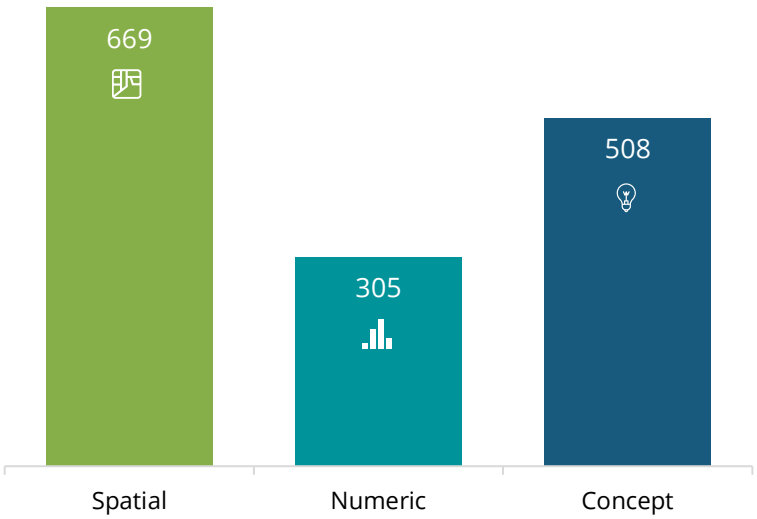
The previous chapter, Chapter 4, provides a detailed description of spatial, numeric, and concept graphics. For quick reference, the following provides a general definition of spatial, numeric, and concept graphics:

- *Spatial graphics*, also known as maps, are meant to simply convey spatial relationships and patterns.
- *Numeric graphics* convey relationships among numbers. This includes graphs, charts, and other related figures to represent numeric and statistical data.
- *Concept graphics* are visualizations that are aspatial and non-numeric. This type of graphic primarily includes photography and illustrations.

General Trends

In total, there were 1,577 graphics coded and analyzed for the purpose of this research. Spatial graphics are the most common graphic type found within the researched MTPs; followed by concept and numeric graphics (**Figure 5.4**).

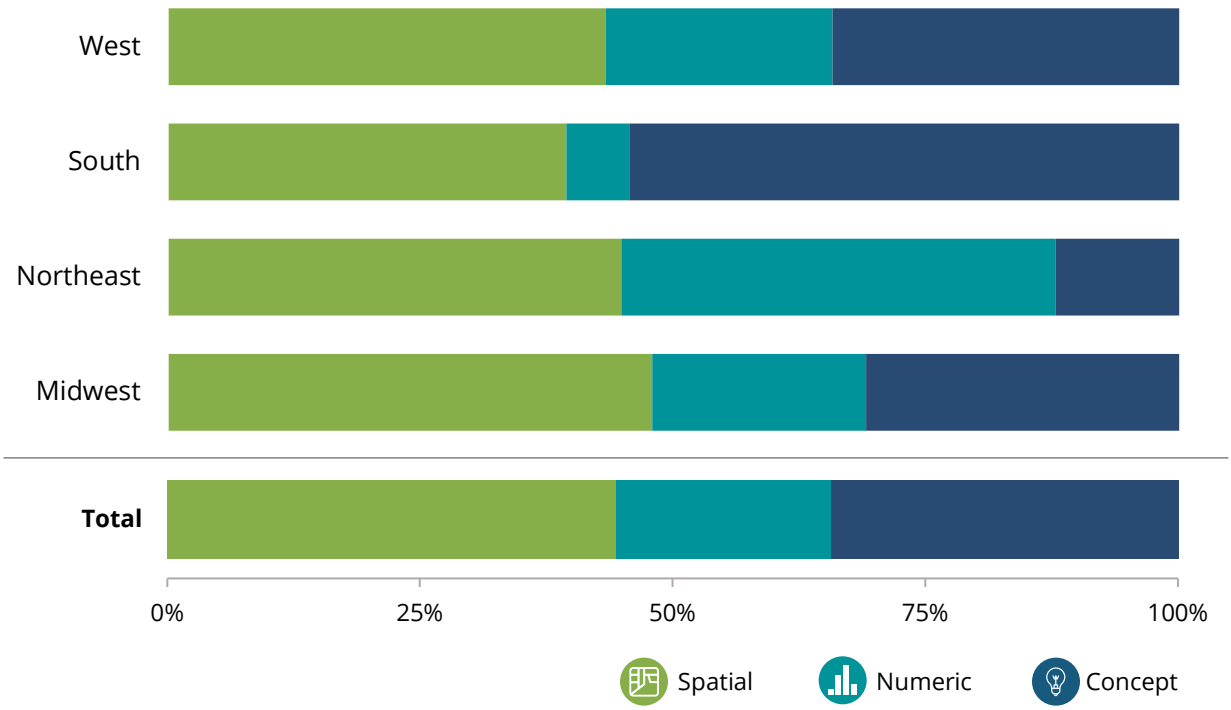
Figure 5.4: Total Graphic Count by Type



Note: this count excludes document navigation graphics which are described later in this chapter

There are interesting trends regionally and among all graphics. **Figure 5.5** depicts the regional share of graphics. Across all four regions, there is consistency regarding the percentage of spatial graphics used. Despite this, there is a varying degree of numeric and concept graphics. Outlier MTPs may be partly to blame for this trend. For instance, the western region may appear to be the most similar region to the total breakdown, but this similarity is due to an outlier. The Santa Fe MPO had a total of 65 concept graphics, or 48 percent of the regional share of concept graphics. Without the high number of concept graphics within the Santa Fe MPO, the share of graphics would appear entirely different for the western region.

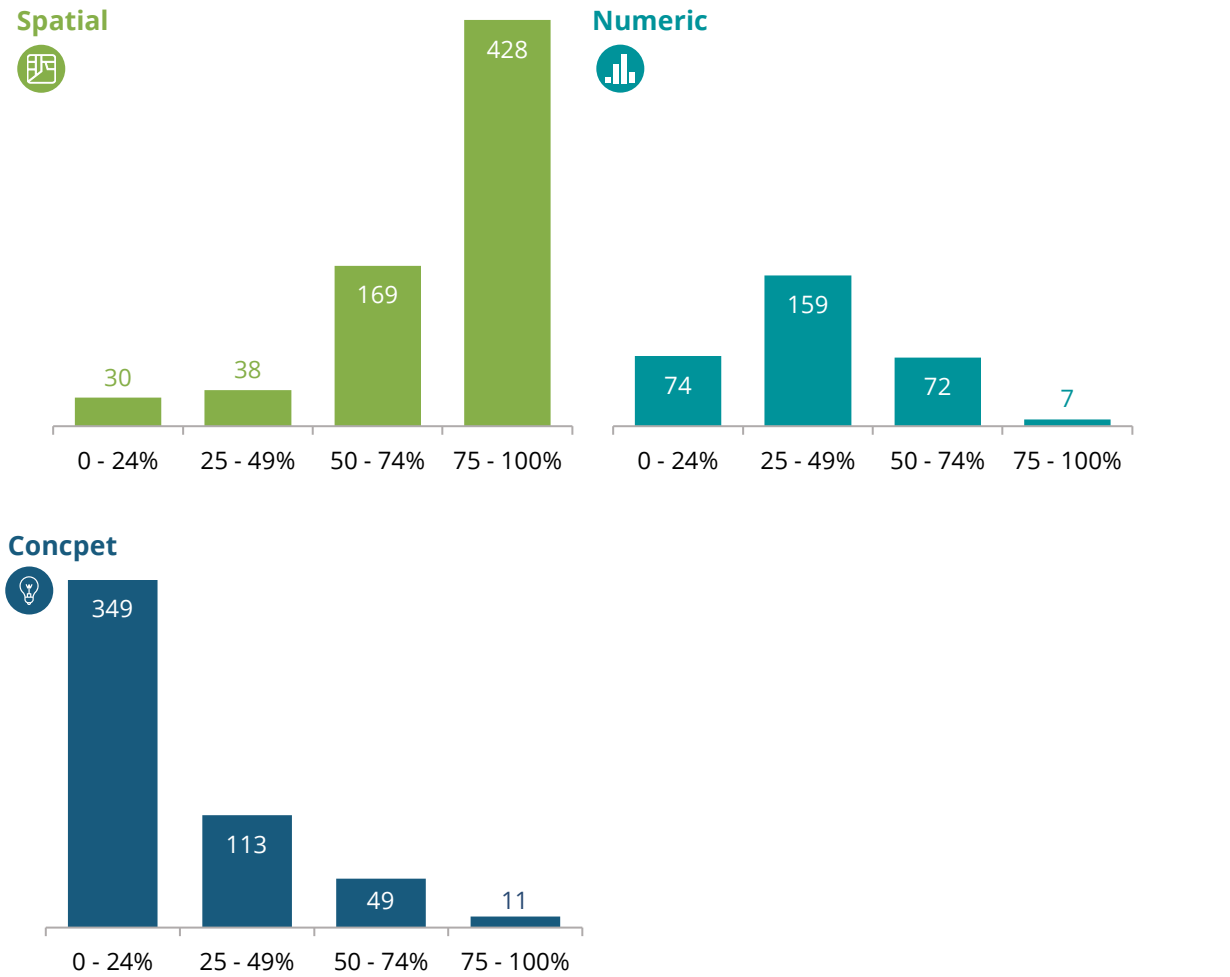
Figure 5.5: Regional Split by Graphic Type



Graphic Size

In the researched MTPs, there was an evident correlation between graphic type and the size of the graphic (**Figure 5.6**). Spatial graphics tend to be larger in size, taking up approximately 75 to 100 percent of the page whereas concept graphics had an inverse relationship. Most concept graphics take up 25 percent or less of a page. This relationship is logical as maps tend to display a high volume of information and detail in contrast to other formats. The more detailed a graphic, such as a map or diagram, the graphic should be larger for reader clarification.

Figure 5.6: Size of Graphics



Note: this count excludes document navigation graphics which are described later in this chapter

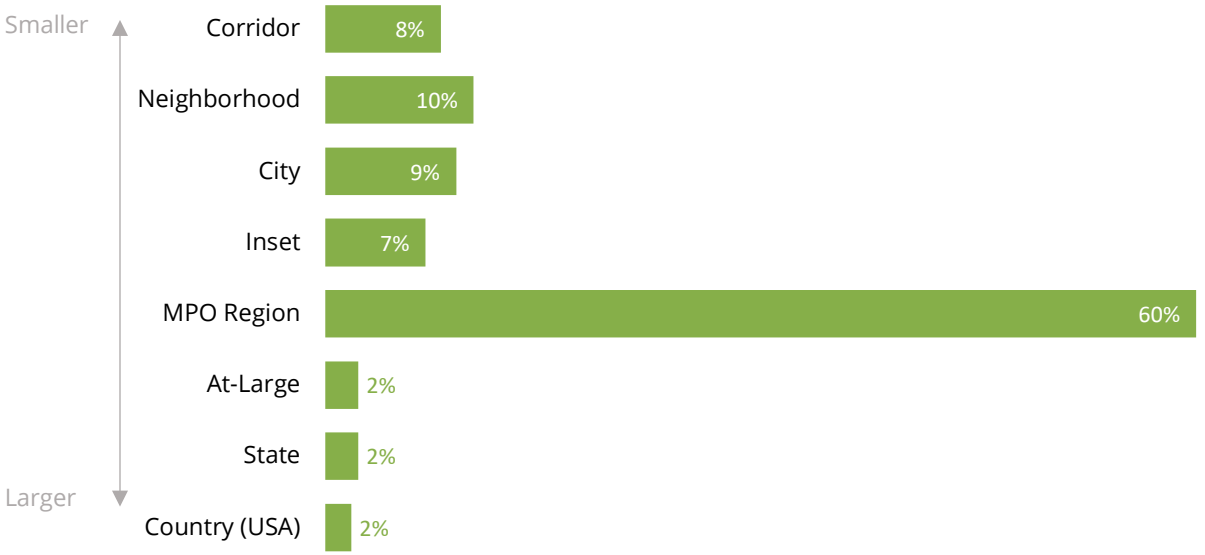
Spatial Graphic Trends & Themes

Spatial graphics, or maps, are the most common graphic type in MTPs. Spatial graphics total 45 percent of the graphics found within the researched MTPs. These graphics convey spatial relationships and patterns.

Spatial Scale

Amid analyzing graphics, there was a notable difference between the number of graphics at various spatial scales (**Figure 5.7**). Maps were sized down as small as a corridor spatial scale to typically highlight a local project. Maps made between a corridor and MPO region scale were primarily utilized to show a greater level of detail regarding existing or proposed transportation systems. However, most MPOs created a standard template for all maps within their plan. Standard template maps typically showcase the entire MPO region. There were a few maps at a larger spatial scale than the MPO region. These large scaled maps typically orient readers to where the MPO region is located within a state or depict a national trend.

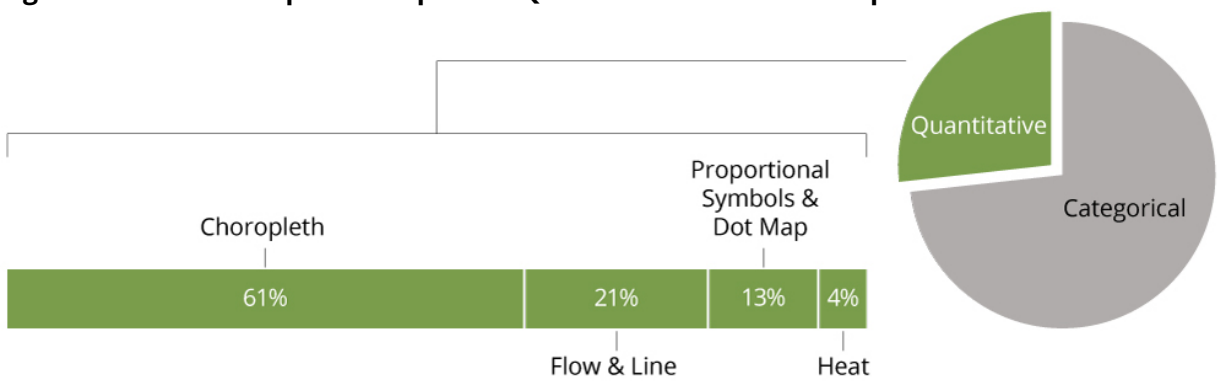
Figure 5.7: Graphics by Spatial Scale



Thematic Maps

Thematic maps are "made with a single purpose in mind" (Penn State University Department of Geography, n.d.) and can be categorized in two ways: by categorical data or quantitative data. 73 percent of the graphics found within the selected MTPs were categorical. As depicted in Chapter 4, categorical maps are meant to communicate distinct non-numeric information while quantitative mapping focuses on representing a relative ranked order. Though quantitative maps total 27 percent of all spatial graphics, they have a high concentration of information. **Figure 5.8** portrays the variation in the different types of quantitative thematic maps. Choropleth maps are among the most prevalent types of thematic maps and are the most commonly used thematic map in general (Penn State University Department of Geography, n.d.). Within MTPs, choropleth maps depict the geographic distribution of the data at different magnitudes and are commonly used in MTPs to represent demographic, environmental justice, and transit access information.

Figure 5.8: Common Spatial Graphics & Quantitative Thematic Maps



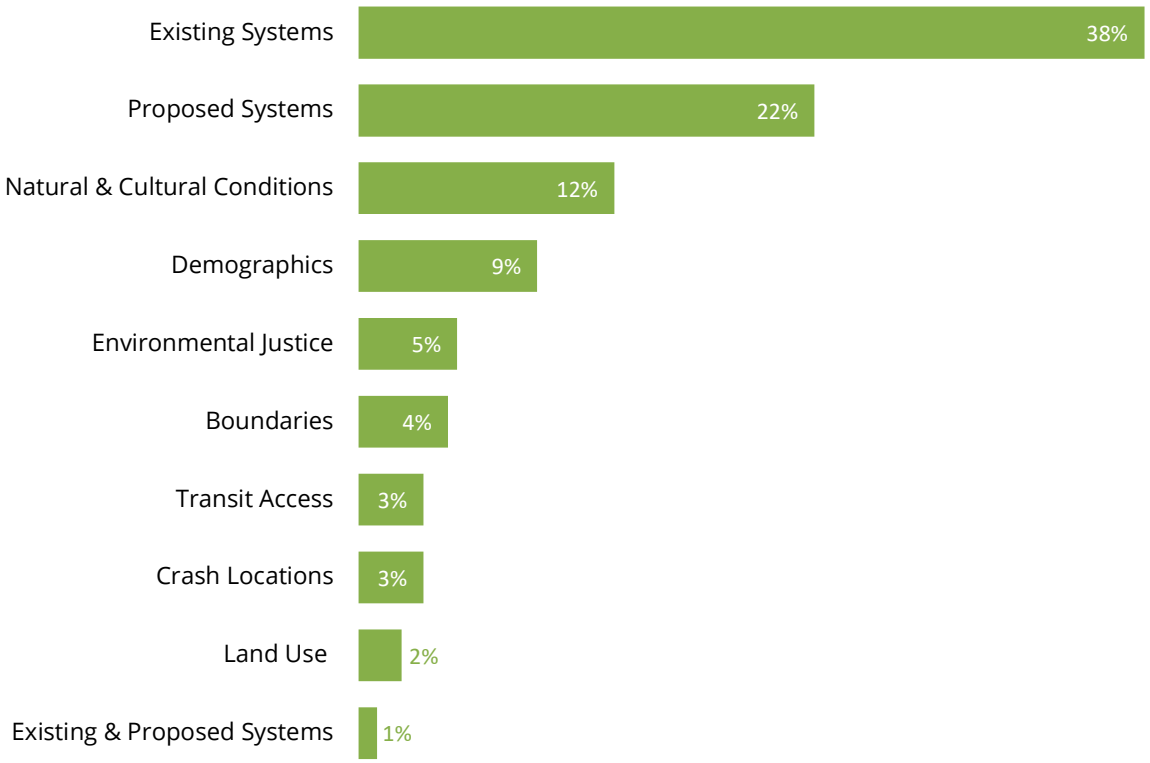
Spatial Graphic Themes

A thematic map focuses on a single theme. **Figure 5.9** represents a ranking of the ten themes among the researched MTPs.

1. *Existing system maps* are the most common thematic maps. These maps highlight information on existing bicycle systems, sidewalk gaps, functional classification, capacity, or other related maps on existing infrastructure and systems for the year the MTP was published.
2. *Proposed systems maps* extend beyond the year the MTP was published and look 10 to 20 years into the future on how certain projects will develop and influence the existing system such as connecting a trail network or seeing how a roadway expansion will address capacity.
3. *Natural and cultural condition maps* focus on environmental or cultural considerations surrounding the transportation network, such as floodplains, natural areas, and wildlife resources.
4. *Demographic maps* regard the general population within the MPO region such as the number of people per square mile, employment density, or household growth.
5. *Environmental justice maps* are similar to demographic maps however, they are meant to show that transportation services and benefits are fairly distributed to all people regardless of race, national origin, or income.
6. *Boundary maps* are likely the simplest of maps. These maps are meant to depict confined borders such as metropolitan planning area boundaries, city limits, or traffic analysis zones.
7. *Transit access maps* may encompass demographic or environmental justice information but they are meant to statistically show how fixed route transit services serve the hotspots of the MPO region.
8. *Crash location maps* spatially depict where types of fatal and injury crashes occur within the MPO region.

9. *Land use maps* are coded to identify particular zoning uses within a city, including residential, business, or agricultural areas.
10. *Existing and proposed system maps* combine these two maps into one.

Figure 5.9: Spatial Graphics by Theme



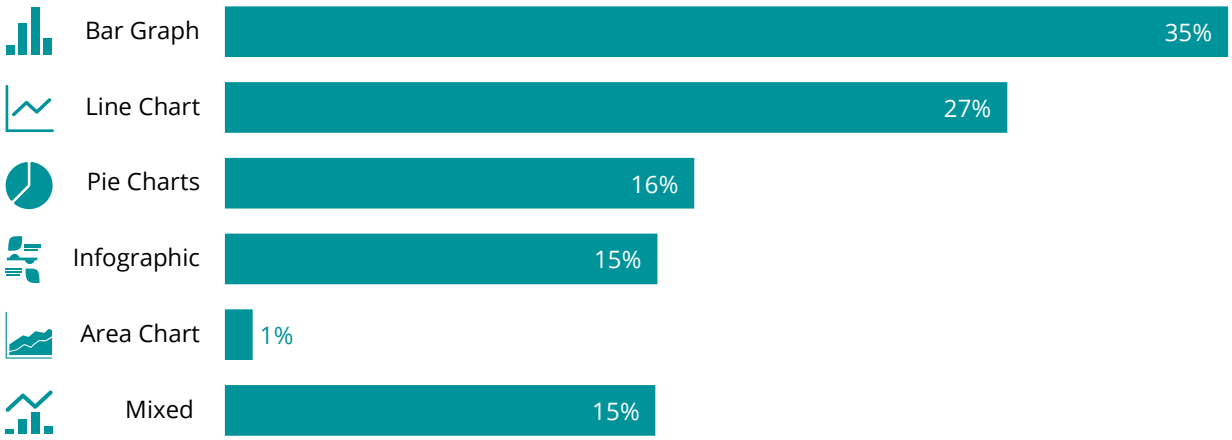
Numeric Graphic Trends & Themes

Numeric graphics are the least common type of graphic and total approximately 21 percent of the graphics found within the researched MTPs. Numeric graphics are graphs, charts, and other related figures used to represent numeric and statistical data including percentages, monetary, or numeric values. These graphs, charts, and other figures are intended to convey relationships among numbers. Some would argue that charts are the most misused because of default settings in programs such as in Stata, SAS, Excel, and other commonly available programs (Schwabish, 2014a; Wong, 2010).

Common Numeric Graphics

Figure 5.10 provides a perspective of what charts are most common in MTPs. These trends are relatively consistent with the commonality of charts across similar documents and among similar professions. Detailed descriptions of each chart type can be found in Chapter 4 and a checklist of best practices when creating a few of these charts can be found in Appendix A.

Figure 5.10: Common Numeric Graphics

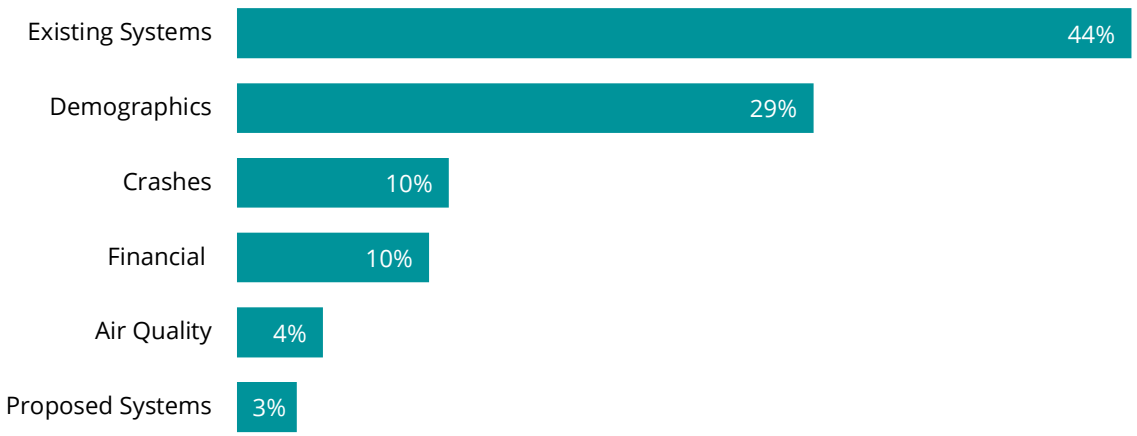


Numeric Graphic Themes

Charts, like maps, address a single theme. **Figure 5.11** represents a ranking of the six themes among charts in the researched MTPs.

1. *Existing system charts* are the most common numeric graphics. These charts highlight various information such as mode share to work, bridge sufficiency ratings, or transit ridership.
2. *Demographic charts* regard the general trends among the population such as discerning the population by age or vehicles per household.
3. *Crash related graphics* provide information on the total count of fatal and other injury crashes.
4. *Financial graphics* showcase how regional projects will be funded.
5. *Air quality charts* are the least common. This may be because not every MPO under 200,000 people is required or has a need to address air quality considerations when planning.
6. *Proposed systems charts* extend beyond the year the MTP was published and look 10 to 20 years into the future. These graphics include project mode share changes, future vehicle miles traveled, and projected ridership.

Figure 5.11: Numeric Graphics by Theme



Concept Graphic Trends & Themes

Concept graphics are visualizations that are aspatial and non-numeric. MPOs typically use photographs, diagrams, and illustrations within their MTP to communicate ideas and relationships. **Figure 5.12** shows the percent share of concept graphics. Definitions for photograph, diagram, and resource graphics can be found in Chapter 4 and a checklist of best practices when creating or using these graphics can be found in Appendix A.

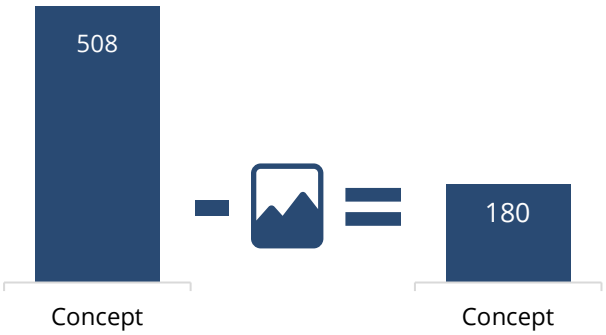
Figure 5.12: Common Concept Graphics

Note: navigation graphics have been omitted from this count

Filler Graphics

Two-thirds of all concept graphics are photographs and therefore, are the most popular of the concept graphics. There are so many photographs that they account for 22 percent of the total share of spatial, numeric, and concept graphics (**Figure 5.13**). Without photographs, concept graphics would only equate to 16 percent of the total count of graphics instead of the actual 34 percent. Kosslyn (2007) argues that photographs are the most "insidious types of illustrations." Photographs may be insidious because many MTPs are occupied with "filler" photographs. Filler graphics are not limited to photographs but are the most common. These graphics do not serve a purpose and typically used to fill odd spacing in reports or are used to make a document look appealing. This is problematic for MTPs because as previously mentioned, shorter reports and chapters are more likely to be read. These filler graphics may also be distracting. Graphics that do not serve a purpose should be omitted from future MTPs.

Figure 5.13: Concept Graphics without Photographs



Note: this count excludes document navigation graphics which are described later in this chapter

Repeat Graphics

Among concept graphics, there are several graphics that are repeated once or multiple times throughout the document. In this research, they are limited to repeated photographs, diagrams, and resource graphics such as document covers. In most situations, repeated graphics are separated by different chapters. One contributing factor for this may be because some MTPs can be downloaded by section through the MPO website. However, there are times when this may not always be best practice. On many occasions, these repeated graphics are not referenced within the text.

Document Navigation Graphics

There is one type of repeated graphic that needs to be recognized. Document navigation graphics are typically icons or symbols used throughout the document to help reiterate an idea or guide readers to particular topics. Document navigation graphics have been omitted from the total count of concept graphics in this section because these graphics were used 124 times. This does not mean that there are 124 separate icons in the researched MTPs, they were used various times do direct readers attention to a particular topic or concept. These graphics can represent regional goals or reinforce themes and are effective if they are clearly outlined at the beginning of the plan.

Concept Graphic Themes

Figure 5.14 represents a ranking of the five themes among the diagrams and resource & logo concept graphics. These themes were categorized differently than the themes depicted for photographs and renderings in **Figure 5.15**. Photographs and renderings look almost entirely different the other concept graphics because they provide more dimension by capturing the physical environment at a particular point in time. Photographs and renderings almost entirely show existing or proposed systems and therefore were broken down into further detail. This figure categorizes all photographs and renderings into ten themes.

Diagrams and Resource & Logos

1. *Resource graphics* reference external resources such as pertinent documents and websites. These graphics depict external documents by typically including a graphic of the front cover of the document. References to external websites are graphically represented in MTPs as a screen capture from the website.
2. *Process & Actors Involved graphics* commonly refer to the development of the plan. This includes the process graphics that show the steps taken to prior to the publication of the MTP and may extend beyond this to project implantation. Other process graphics may be specific to a project, such as a Safe Routes to School project. The actors involved graphics highlight particular organizations that were involved in the development of the MTP. These graphics include an organization chart as well as stand-alone logos.
3. *Aspirational System graphics* are diagrams that come from planning theory or guidebooks such as the National Association of City Transportation Officials (NACTO). These graphics are diagrams that show a particular idea of where the region aspires to go.
4. *Goal graphics* pertain to any graphic that outlines the MPO, state, and/or federal goals for transportation systems.

5. *Outreach graphics* relate to any public engagement diagram. Outreach graphics range from flyers used to solicit public meetings to actual diagrams of public input.

Photographs & Renderings

1. *Bicycle & Pedestrian photographs* are focused on portraying bicycle & pedestrian friendly infrastructure such as sidewalks, crosswalks, and bike lanes.
2. *Roadway & Intelligent Transportation System (ITS) photographs* portray the existing roadway infrastructure and sometimes just depict infrastructure conditions whereas other photographs portray broader topics such as a congested roadway. ITS photographs are typically images of digital signage.
3. *Transit photographs* depict any image related to a transit system. These graphics may include an exterior image of the bus or bus stop shelters.
4. *Destinations & Natural Feature photographs* showcase a variety of assets found within a region. These images may depict a natural features such as a state park but are typically photographs of a downtown environment or of even local attractions.
5. *Outreach photographs* relate to any public engagement experience.
6. *Construction photographs* depict all photographs that pertain to construction such as roadworkers or traffic cones.
7. *Aspirational System graphics* are renderings that show the potential future of a particular corridor or space.
8. *Aerial photographs* are images of a city taken with a birds-eye view.
9. *Aviation photographs* are any images that relate to the local airport.
10. *Freight photographs* depict any image related to freight. These images include an exterior image of a truck to a particular type of cargo.

Figure 5.14: Diagrams and Resource & Logo Concept Graphics by Theme

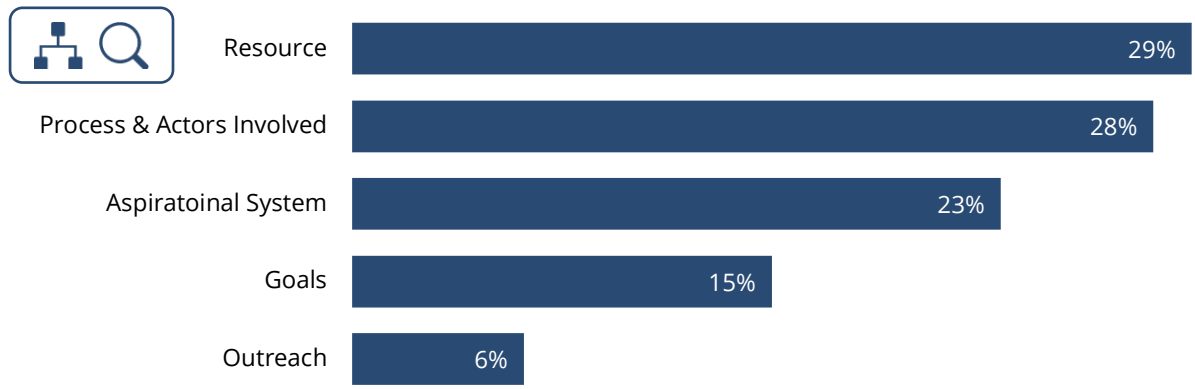
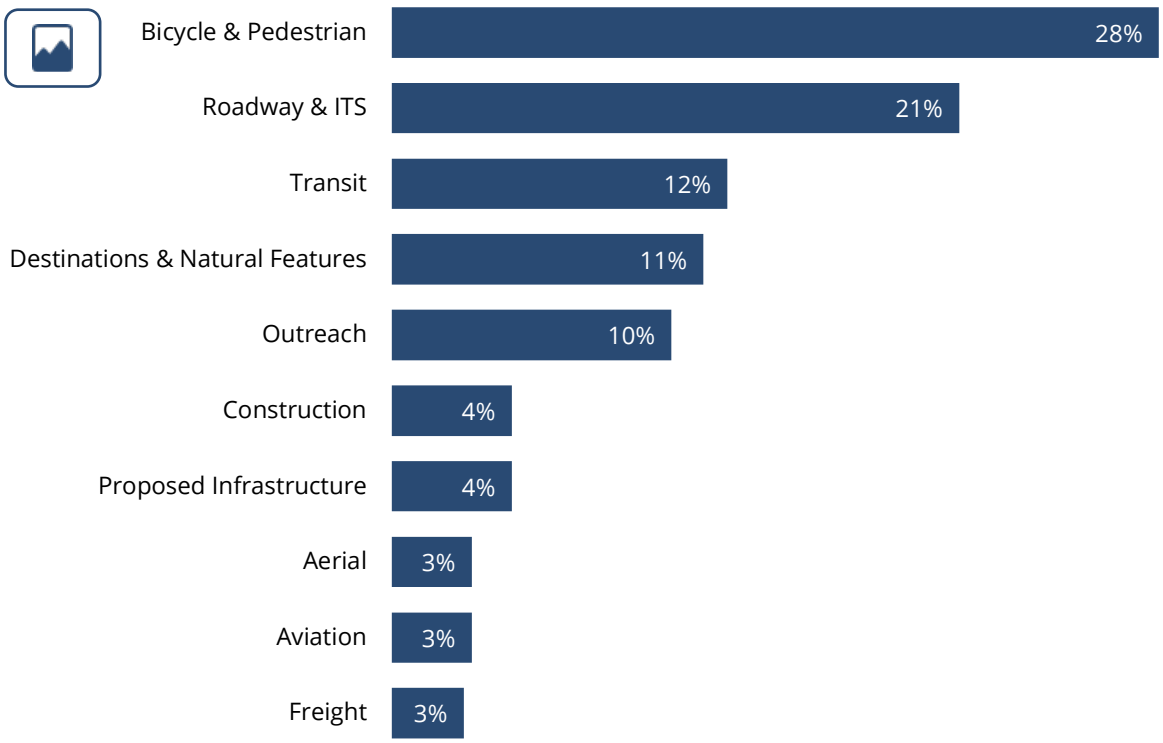


Figure 5.15: Photograph Concept Graphics by Theme



CHAPTER 6

ESSENTIAL GRAPHICS

The researched Metropolitan Transportation Plans (MTPs) offer a diverse range of graphics. Some plans have as few as nine graphics and others have as many as 200 graphics. In the instance of the Lawton Metropolitan Planning Organizations (MPO) MTP, all graphics in their plan are spatial graphics. On the other hand, spatial graphics make up 14 percent of the graphics found in the Santa Fe MPO's MTP while 22 percent are numeric graphics and the remaining 64 percent are concept graphics. Due to this disparity across all MTPs, this chapter was developed to provide MPOs with a much needed list of essential spatial, numeric, and concept graphics. Items found on these lists are commonly used graphics. By including graphics in MTPs, complex information can be clarified for the general public, stakeholders, elected officials, and MPO staff.

In addition, this chapter provides two examples of both weak and strong essential graphics for each graphic type. Discussion on the rationale behind the weak versus strong graphics is from graphic communication principles. These principles are either mentioned in Chapter 3 or can be found in Appendix A. It is important to note that MTPs are by no means confined to the essential graphics. In Appendix B, there are available lists of recommended spatial, numeric, and concept graphics that were less common. MPOs should continue to develop additional graphics that are pertinent to the regional vision, issues, or needs.

Spatial Graphics

As mentioned in Chapter 4, spatial graphics, also known as maps, are meant to convey spatial relationships and patterns.

Essential Spatial Graphics

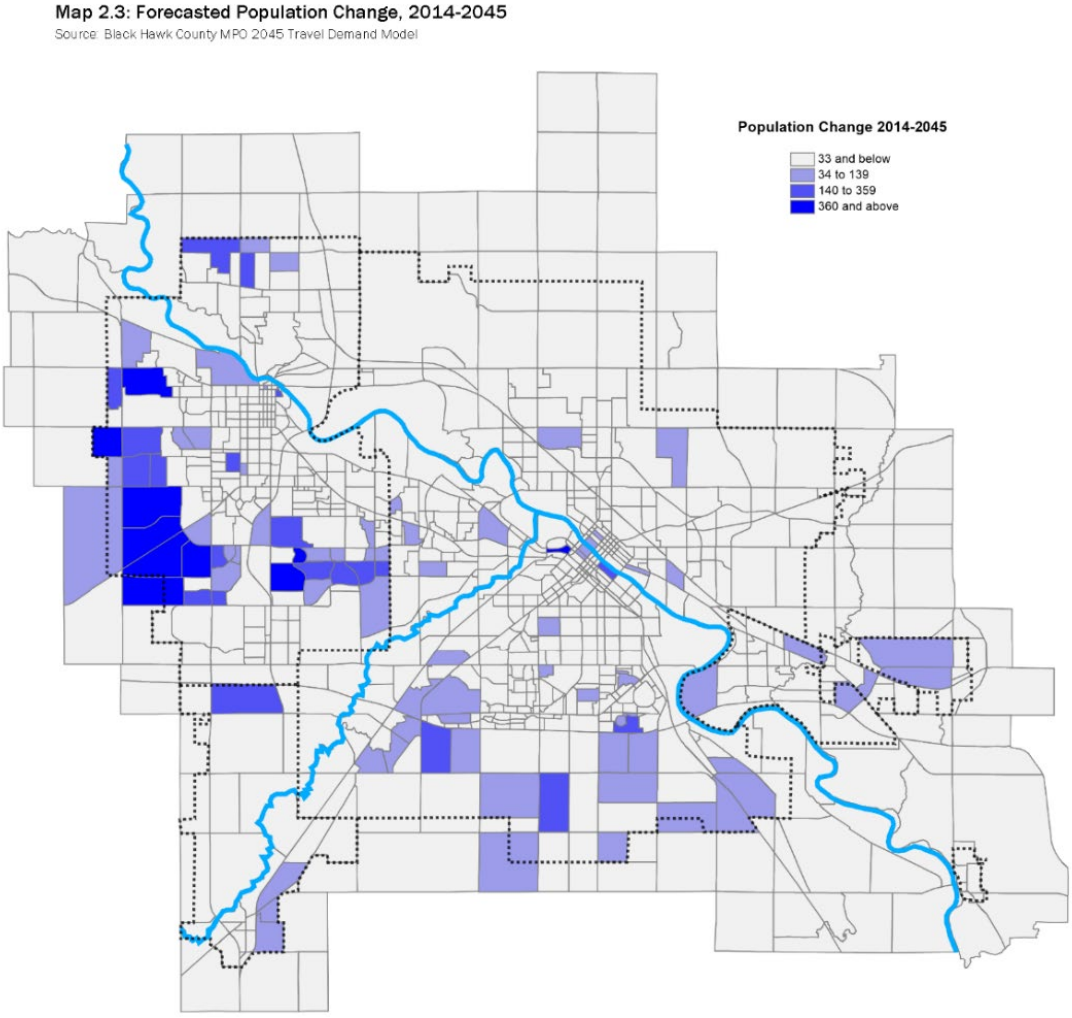
Table 6.1 provides a list of the thirteen essential graphics for MTPs. These graphics were selected not only because of performance measure requirements but also because they were pertinent to telling a basic MTP story. Nearly all MTPs communicated each of these essential ideas either in a spatial graphic, table, or text format. On the right-hand side of the table there is a pie chart for each essential graphic listed. Each pie chart represents the number of MPOs that already include the listed spatial graphic in the MTP. For instance, 16 of the 20, or 80 percent, of MPOs include a map of their Metropolitan Planning Area Boundary in the MTP. The information included in Table 6.1 is listed in the order from the graphic appearing most frequently to the least.

Table 6.1: List of Essential Spatial Graphics

Essential Spatial Graphics	MTPs w/ Graphic
1. Existing System (i.e. general infrastructure and/or system gaps)	 100%
2. Proposed System (infrastructure changes)	 85%
3. Metropolitan Planning Area Boundary	 80%
4. Level of Service (i.e. capacity or sidewalk connectivity)	 70%
5. Population Demographics (i.e. density, anticipated growth, household etc.)	 65%
6. Applicable Performance Metrics (i.e. crash locations or system performance)	 65%
7. Employment Demographics (i.e. density, anticipated growth, etc.)	 50%
8. Environmentally Sensitive Areas (if applicable)	 50%
9. Environmental Justice Areas (such as multimodal investments and/or transit stops in EJ areas)	 45%
10. Fiscally Constrained Projects	 45%
11. Scenario Planning/Modeling	 30%
12. MPO Location Within the state(s) (possible as an inset map)	 15%
13. Air Quality (if applicable)	 10%

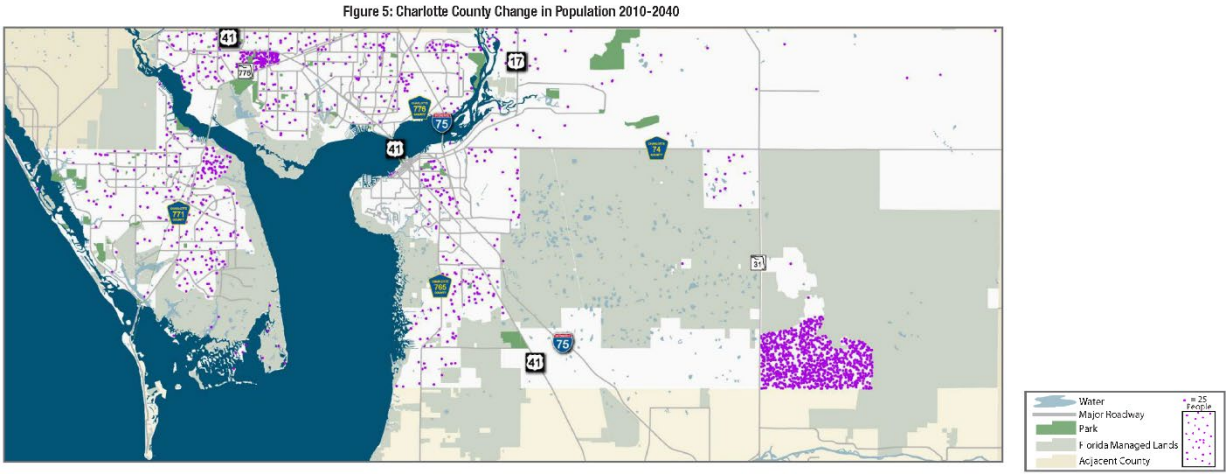
Selected Spatial Graphic Example 1 of 2

Figure 6.1: Weaker Population Demographic Example



Source: Black Hawk County Metropolitan Area Transportation Policy Board (2018)

Figure 6.2: Stronger Population Demographic Example



Source: Charlotte County-Punta Gorda Metropolitan Planning Organization (2015)

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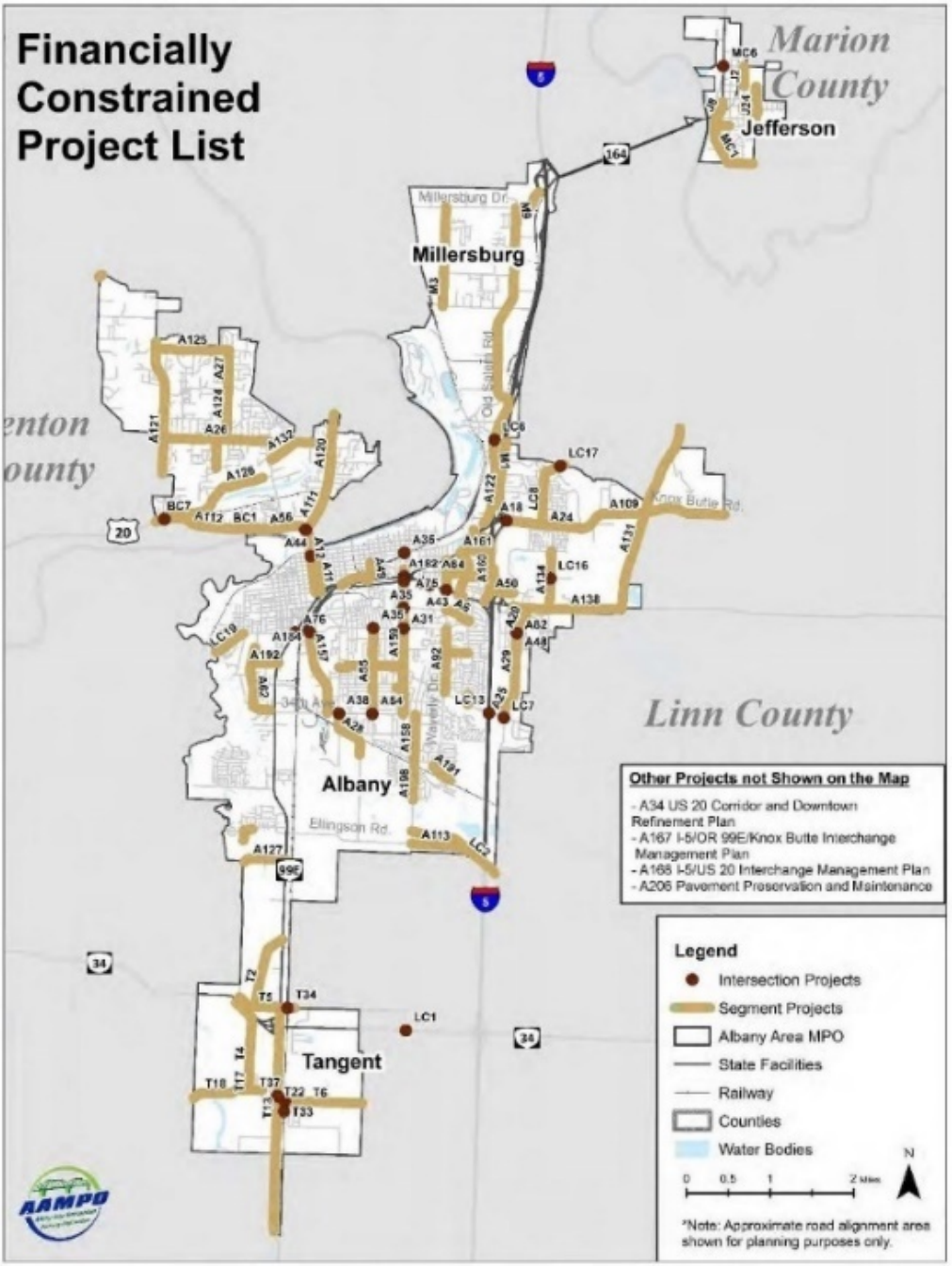
Figure 6.1 and **Figure 6.2** capture the forecasted change in population between a particular start year and the plan year (2040 and 2045). One example depicts this demographic information through a choropleth map while the other through a dot map. It can be argued that both quantitative map formats are acceptable. Both graphics excel at communicating relationships through color and symbology. The neutral colored background, paired with data in a vibrant color, allows the subject matter to stand out.

At face value, Figure 6.1, the weaker of the two examples, looks clean and appears to be easy to understand because of the simplistic legend, clean lines, and sequential coloring. However, when trying to understand the details of this map, it falls short. For example, the legend fails to inform readers whether the numeric values represent the number people, a percent change, or another value. There is no spatial context presented, other than what appears to be a river. Major roadways are not labeled, making it even more challenging to orientate oneself. It is also unclear what the grey polygons or lines represent; are they census tracts, blocks, roads, or other boundaries? Furthermore, the dashed lines in this map are also not labeled so it is unclear of their significance. There are several shortcomings of graphic depicted in Figure 6.1. It could be argued that having dots to represent the number of people, as seen in Figure 6.2, is a clearer way to depict population change. While Figure 6.2 is used as the stronger example, it lacks a credible data source. Despite their similarities and differences, both maps lack essential cartographic elements such as a scale and north arrow. In both instances, readers could benefit from additional context such as labels for cities or neighborhoods.

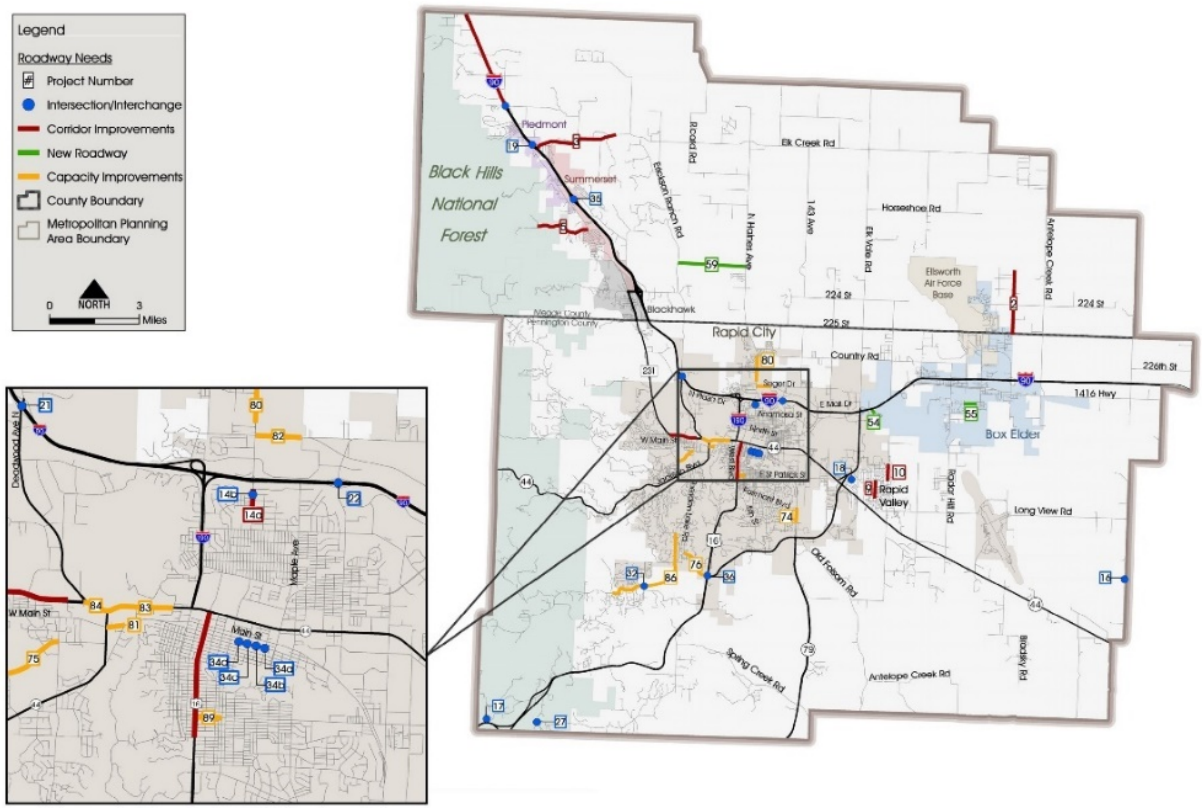
Selected Spatial Graphic Example 2 of 2

Figure 6.3: Weaker Fiscally Constrained Projects Example



Source: Albany Area Metropolitan Planning Organization (2018)

Figure 6.4: Stronger Fiscally Constrained Projects Example



Source: Rapid City Metropolitan Planning Organization (2015)

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Figure 6.3 and **Figure 6.4** represent the fiscally constrained project maps found within MTPs. Only 30 percent of MTPs have this information mapped, the remaining MTPs typically have this information in a table format. A combination of a map and a table format is ideal and it is exceptional that these MPOs mapped this information at all.

Figure 6.3 depicts twenty years of projects into one map and does not meet several checklist items for a thematic map as listed in Appendix A. The labels are especially difficult to read and the thick line width makes it difficult to understand detailed information of where the project is located. Figure 6.3 uses only one color to represent projects. Using one color to highlight projects can make it difficult to understand where one project stops and another project starts. In turn, Figure 6.4 does a better job at highlighting the different types of projects by differentiating them by color. All project labels correspond with a meaningful color, are easy to spot, and are horizontal. For this reason, projects are easy to locate and identify on the map. Figure 6.4 appropriately utilizes an inset map to clarify projects that were clustered on the regionally scaled map.

As Figure 6.4 does, it is important to communicate project information. One way to communicate this information is by creating separate maps. Many of the MTPs show prioritized projects by mode. For example, one map would address bicycle and pedestrian projects while another would address roadway projects. However, it is strongly encouraged that the transportation system maps include all modes of transportation. Having different maps for different modes does not provide a comprehensive view of the multimodal network. A more inclusive method to communicate this information is by creating separate maps based on a project prioritization for a particular time frame. This could look like a series of separate maps for short-term, medium-term, and long-term projects.

Numeric Graphics

Numeric graphics convey relationships among numbers. This includes graphs, charts, and other related figures to represent numeric and statistical data. When uncertain about selecting graphics, especially numeric graphics, the decision tree and five checklists found in Appendix A may be useful to aid decision making.

Essential Numeric Graphics

Table 6.3 provides a list of the thirteen essential numeric graphics. These graphics were selected not only because of performance measure requirements but also because they were pertinent to telling a basic MTP story. Nearly all MTPs communicated these essential ideas either in a graphic, table, or text format. On the right-hand side of the table there is a recommended chart format and a pie chart for each essential graphic listed. The recommended chart format is based on the decision tree found in Appendix A. To the right of the recommended chart, there is a pie chart that represents the number of MPOs that already include the listed numeric graphic in their MTP. For instance, 12 of the 20 MTPs already include a graphic of their historic and/or projected population. Table 6.3 is listed in the order of the highest number of MTPs that already include that graphic to the lowest.

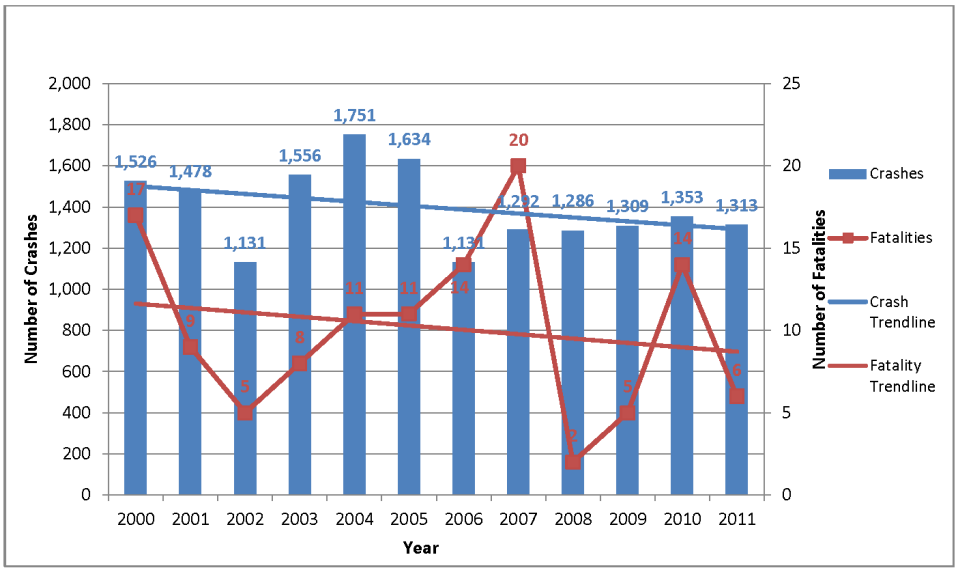
Table 6.2: List of Essential Numeric Graphics

Essential Numeric Graphics	Rcmd. Graphic	MTPs w/ Graphic
1. Existing and/or Projected Demographics (i.e. population, employment, age, etc.)		 75%
2. Applicable Performance Metrics (i.e. crash locations or system performance)	n/a	 55%
3. Trends (i.e. number of lane miles, miles of bicycle infrastructure, transit ridership, annual vehicle miles traveled (VMT) etc.)		 55%
4. Funding Allocation/Investments		 35%
5. Mode Share		 35%
6. Air Quality/Emissions (if applicable)		 30%
7. Public Survey Results (if applicable)		 25%

Selected Numeric Graphic Example 1 of 2

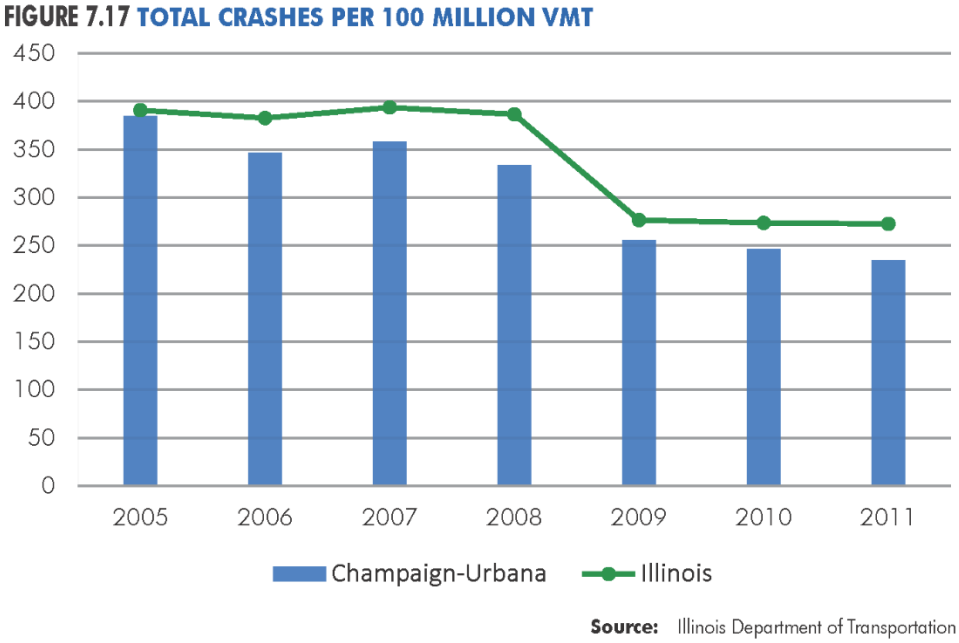
Figure 6.5: Weaker Performance Measure on Safety Example

Figure 3-12 Total Crashes and Fatalities in the FMATS Area by Year



Source: Fairbanks Metropolitan Area Transportation System (2015)

Figure 6.6: Stronger Performance Measure on Safety Example



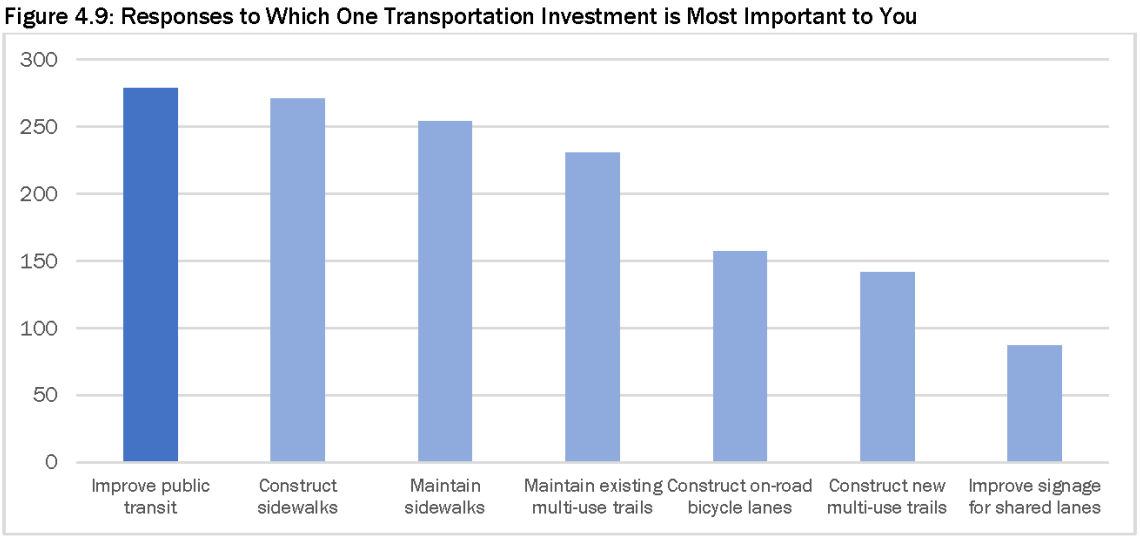
Source: Champaign Urbana Urbanized Area Transportation Study (2014)

Figure 6.5 and **Figure 6.6** each portray crash data. Regional crashes are considered a performance metric because many MPOs are trying to focus on eliminating serious injuries and fatalities on roadways throughout the United States. Figure 6.5 and Figure 6.6 are clearly labeled and provide this crucial information throughout a period of time. Figure 6.5 features one bar chart and five lines to address the number of regional crashes and fatalities. Despite the value of information provided, the two y-axis' on this chart can be confusing when trying to understand this information quickly. Another way to communicate this same information would be to separate the information into two separate charts. Additionally, Wong (2010) argues that when using warm and cool colors together, warm colors will visually overpower cool colors even when used in equal amounts. In this case, the red visually overpowers the blue. Additionally, it is best practice for bar charts to either include data labels on each bar or have a y-axis with horizonal lines, not both. Too much chartjunk, or unnecessary chart content (Tufte, 2001), can overwhelm readers which is why Figure 6.6 is more clear.

It can be assumed that the purpose of Figure 6.6 is to communicate that the annual crashes per VMT are relatively consistent at both a regional and state scale. Notice that Figure 6.5 covers a span of twelve years whereas Figure 6.6 covers only seven years. Reducing the number of years, or values on the x-axis, can make it easier for readers to understand trends. However, one thing found in Figure 6.5 that could be particularly helpful for Figure 6.6, is the use of a trend line to understand if crashes and serious injuries are increasing or decreasing. One critique of Figure 6.5 and Figure 6.6 is that they are depicted in both a chart and a line format. Bar charts must start at the zero baseline (Wong, 2010) and therefore it can be difficult to see differences between numbers. A line chart could clarify the range of crashes while still being able to communicate the same message.

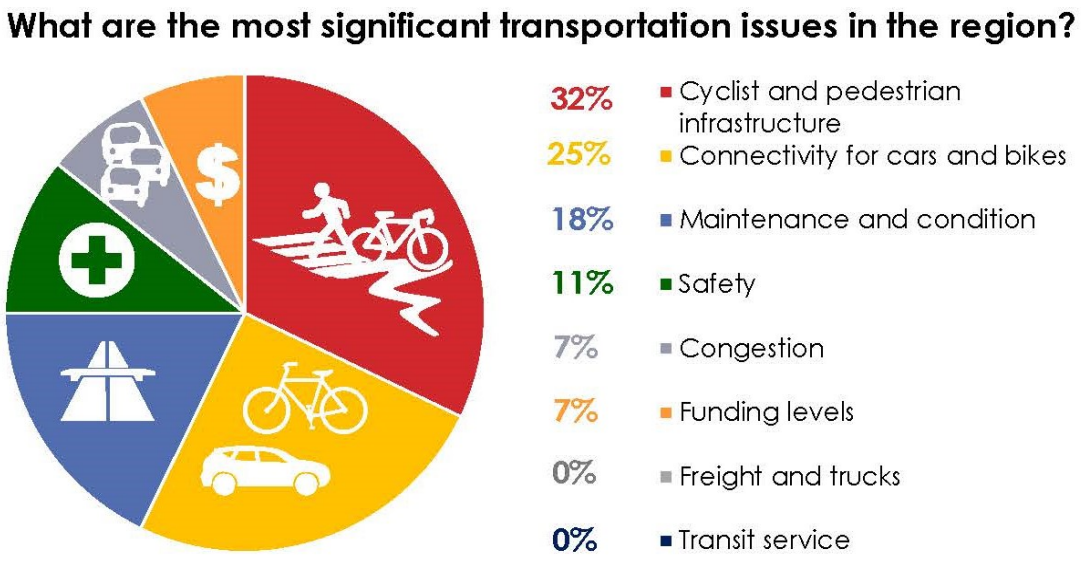
Selected Numeric Graphic Example 2 of 2

Figure 6.7: Weaker Public Survey Example



Source: Black Hawk County Metropolitan Area Transportation Policy Board (2018)

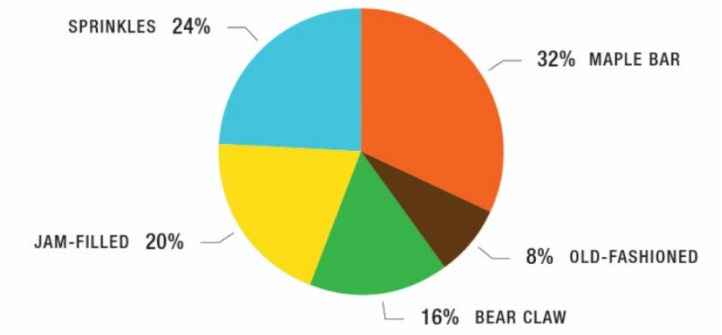
Figure 6.8: Stronger Public Survey Example



Source: Grand Valley Metropolitan Planning Organization (2014)

Figure 6.7 and **Figure 6.8** represent public survey results. Of the public survey graphics, these two ranked the highest on the checklists as found in Appendix A. Figure 6.7 depicts a clearly ranked order of survey results. Though this is not always the case, ranked graphics are commonly represented horizontally because the labels are easier to read and there is an evident visual hierarchy. If rotated horizontally, it could be argued that the grid lines are unnecessary and instead of labeling the chart with an axis, the bars could instead be labeled directly (Tufte, 2001; Wong, 2010). Figure 6.8 is considered the stronger graphic because there are icons to help readers comprehend the information in a more timely and memorable manner. Wong (2010) believes that good icons are simple, whole, symmetrical, and crisp; deeming this a good graphic. However, it is important to note that this chart format, a pie chart, is widely used but argued to be the least practical and most controversial chart (Zelazny, 2001). The checklist for pie charts found in Appendix A explains how to use them properly. However, the checklist does not provide a visual for how to arrange the parts of a pie chart for easy readability. The largest section should always go clockwise from twelve o'clock (**Figure 6.9**). The second largest section should always start at the top and go counterclockwise from twelve o'clock. Additional sections should be placed below the second largest piece (Lankow et al., 2012; Lewis, 2015; Wong, 2010; Zelazny, 2001).

Figure 6.9: Pie Chart Arrangement



Source: Lankow et al. (2012)

Concept Graphics

Concept graphics are comprised of graphics that range from photography to diagrams. These graphics are aspatial and non-numeric.

Essential Concept Graphics

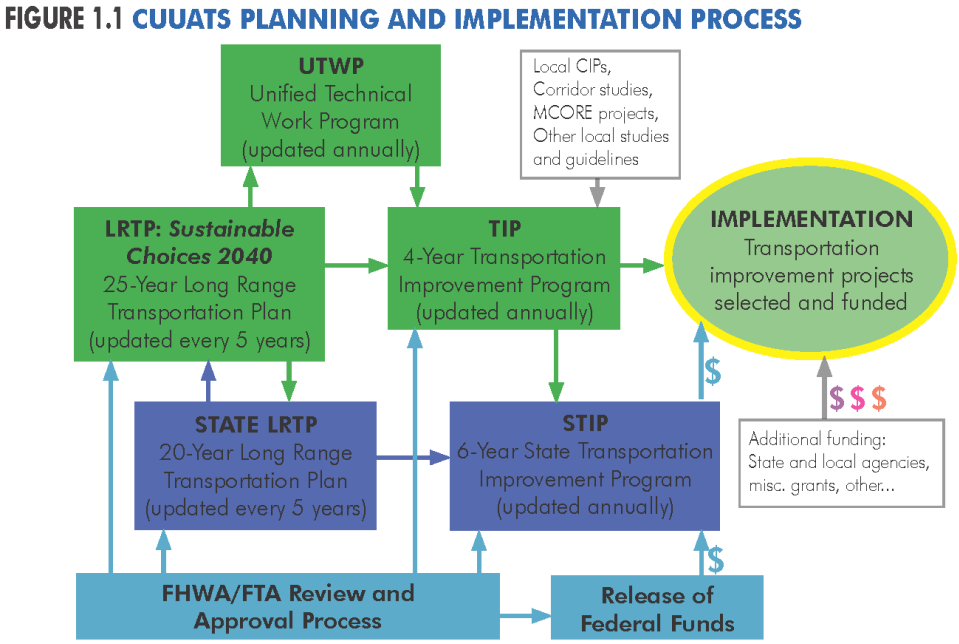
Table 6.5 provides a list of the seven essential concept graphics. These graphics were selected not only because they were common across the researched MTPs and are pertinent to telling a basic transportation story. On the right-hand side of the table there is an icon for the graphic format which is described in Chapter 4. To the right of these icons is a pie chart that represents the number of MPOs that already include the listed numeric graphic in their MTP. For instance, nine of the 20 or 45 percent, of the MTPs already include a graphic on the planning process. The chart is ordered from the most to least common graphic for each graphic format.

Table 6.3: List of Essential Concept Graphics

Essential Concept Graphics	Graphic Format	MTPs w/ Graphic
1. Your Community (existing infrastructure, public outreach, community programs/events, etc.)		 55%
2. Examples of Recommended Infrastructure (i.e. a bicycle lane, curb extension, road diet, etc.)		 40%
3. Partner Organizations (cities, counties, state, federal, or local/regional agencies)		 40%
4. Planning Process (general information or timeline)		 40%
5. Plan Goals (Regional, State, and/or Federal)		 30%
6. Proposed Condition (rendering or sketch)		 25%

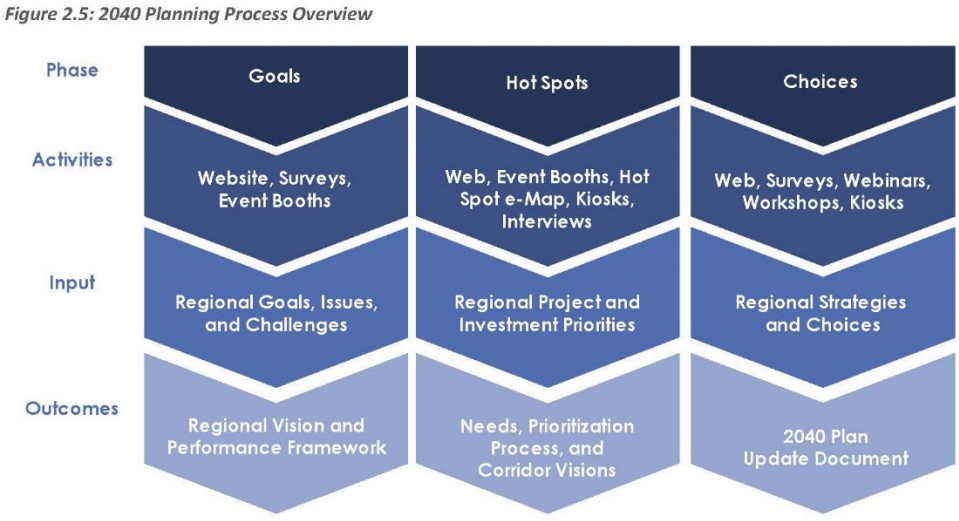
Selected Concept Graphic Example 1 of 2

Figure 6.10: Weaker Planning Process Example



Source: Champaign Urbana Urbanized Area Transportation Study (2014)

Figure 6.11: Stronger Planning Process Example



Source: Grand Valley Metropolitan Planning Organization (2014)

Figure 6.10 and **Figure 6.11** communicate the planning process. Each graphic demonstrates strong labeling, coloring, and provides readers with a clear understanding of the graphics' purpose. Figure 6.10 focuses on the planning process including implementation whereas Figure 6.11 focuses on the planning process for their MTP. The planning process is difficult to communicate to the public in a simple diagram, if done properly these graphics could be beneficial.

It can be argued that neither of these examples are the best way to communicate this information. These two examples were selected because they were of the better examples from the researched MTPs. Figure 6.10 meets most of the checklist requirements as found in Appendix A. However, there is a fundamental piece of the checklist that is missing: "all connections are made with hierarchy or direction." It is difficult to decipher the first step and proceeding steps of the process. Though planning process graphics are often show circular processes, like any other diagram, they need to be communicated with a logical sequence (Kosslyn, 2007). Another reason Figure 6.10 is considered weaker than Figure 6.11 is because there are several acronyms known internally within an MPO, but would not be known outside of the organization. Figure 6.11 does not necessarily provide a logical sequence either, but the word choice is jargon free and can be understood by the general public. The reasoning behind the planning process and the outcomes are clear in this graphic. The coloring of this graphic facilitates the direction of how a person is meant to read the graphic, from top to bottom.

Selected Concept Graphic Example 2 of 2

Figure 6.12: Weaker Proposed Condition Example

Source: Longview Metropolitan Planning Organization (2017)

Figure 6.13: Stronger Proposed Condition Example

Source: Champaign Urbana Urbanized Area Transportation Study (2014)

Figure 6.12 and **Figure 6.13** depict proposed condition graphics, also commonly known as renderings. These renderings are powerful because they provide a perspective image that visually illustrates a concept or scenario (Meisel & Baker, 2018). Figure 6.12 is shown as a sketch whereas Figure 6.13 appears to be a computer rendering. It can be argued that both examples are innovative for MTPs as only 25 percent of the MTPs provide a proposed condition graphic. Since MTPs are about presenting a vision for the future, these graphics are powerful in telling that type of story.

As indicated in the checklist for photographs found in Appendix A, it is unclear if Figure 6.12 was provided for any other reason than to look pretty. The text does not directly address this graphic and therefore it is unclear what the specific purpose of this graphic may be or where this proposed condition graphic is expected to take place. On the other hand, Figure 6.13 is considered a stronger graphic because it is clearly labeled and displays a before and after scenario for a particular corridor highlighted in the MTP. Readers who are or are not familiar with this corridor would be more likely to understand the proposed changes to the physical environment in this graphic format in comparison to a graphic that is represented in plan view.

Plans with Essential Graphics

In total, there are 26 essential graphics listed for this research. 13 of which are essential spatial graphics, 7 are numeric graphics, and 6 are concept graphics. Given the lists of essential graphics for each graphic type, it is important to understand a few key findings. As depicted in **Figure 6.14**, there is a strong correlation between the total number of graphics found within an MTP and the number of essential graphics. For example, the Black Hawk County MPO has the highest total count of graphics with 200 graphics. This MPO also had the highest count of essential graphics. On the other hand, the Adams County MPO had the lowest total count of graphics with 9 graphics. This MPO had the lowest count of essential graphics as depicted in **Figure 6.15**. This correlation is logical because with a higher count of graphics there is a higher probability of having an essential graphic. Despite the quantitative evidence supporting MTPs based on the highest to lowest number of essential graphics, this by no means determines if the plans who ranked highly had clearly communicated graphics.

Figure 6.14: Correlation Between Total Graphics & Essential Graphics

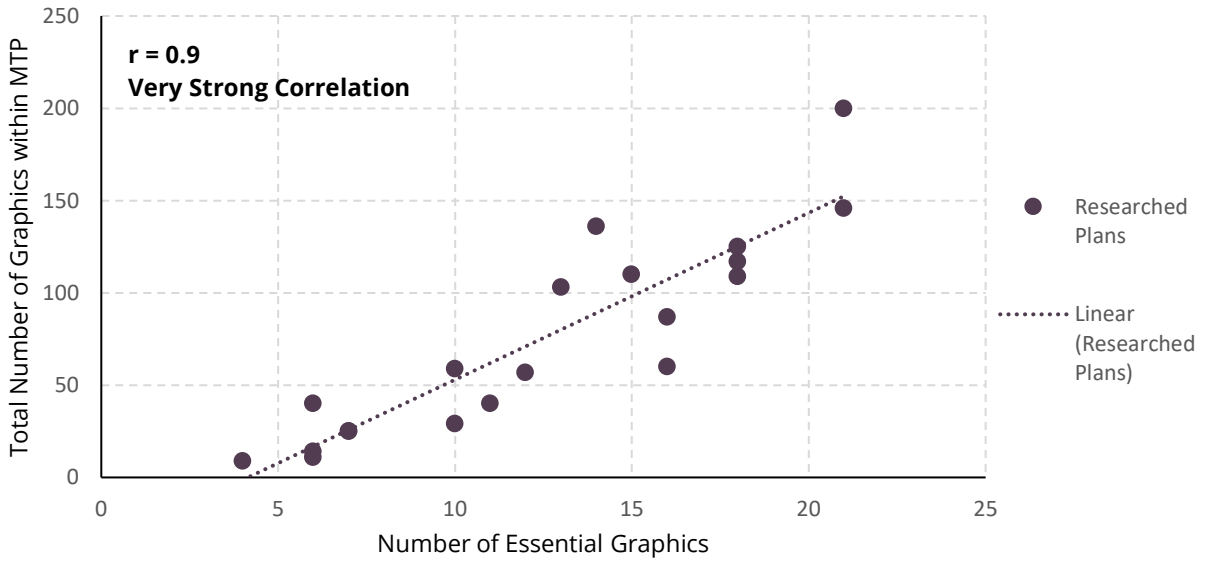
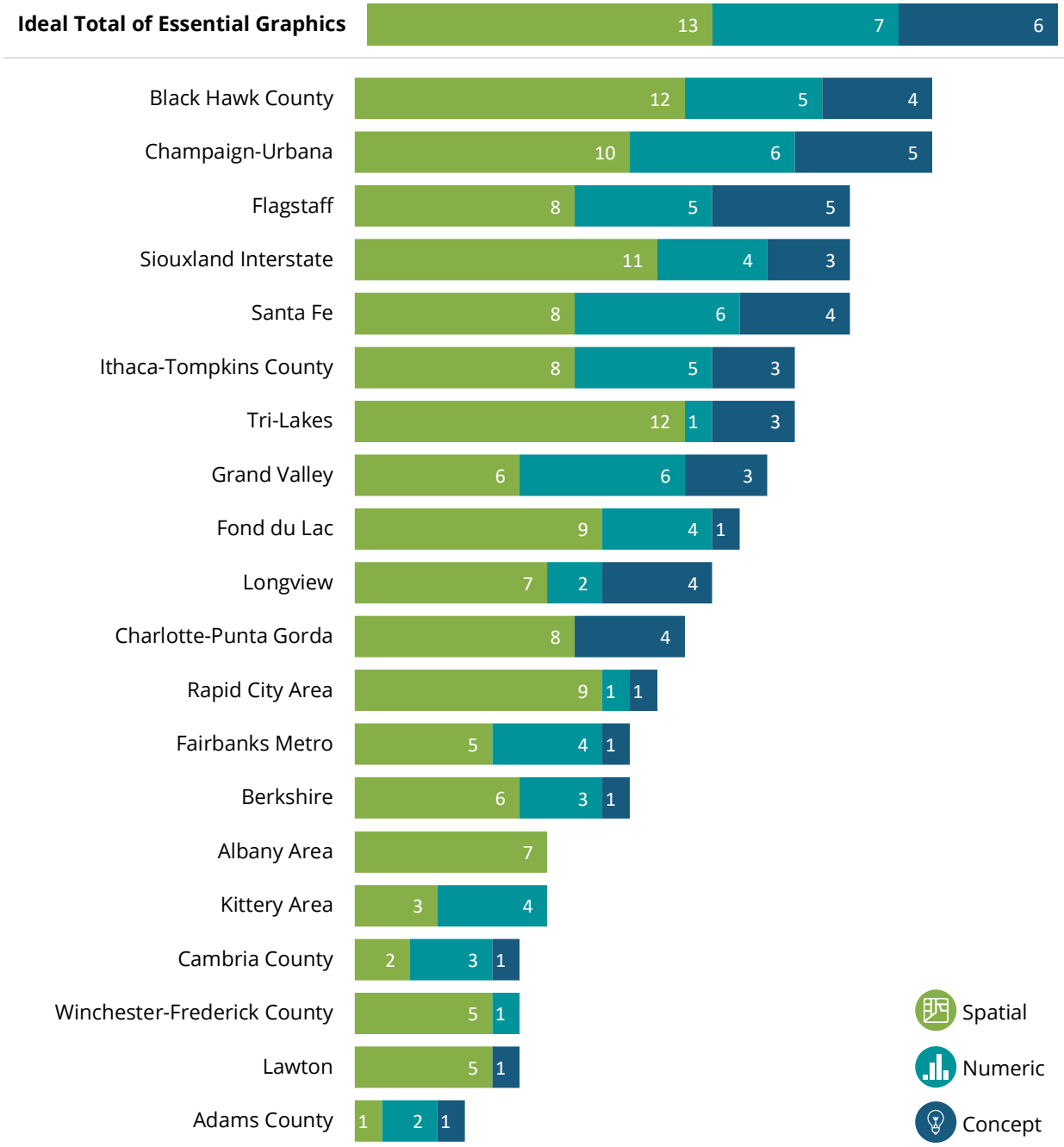


Figure 6.15: Ranking of Plans with Essential Graphics



CHAPTER 7

CONCLUSION

There are gaps in the way that Metropolitan Planning Organizations (MPOs) communicate their Metropolitan Transportation Plan (MTP). The Florida Department of Transportation (2013) was one of the first to identify that MTPs are failing because they are less than citizen-friendly. Graphics were selected as one of four best practices to make these federally required documents more engaging and effective. Inspired by this work, this research delves into the existing and best practices for graphics within MTPs in regions with less than 200,000 people. This research provides transportation planning professionals with a general understanding of 1) general graphic communication principles in which they can apply by utilizing the checklists found in Appendix A; 2) an understanding of common practices and themes within existing MTPs; and 3) a list of essential graphics to include in future MTPs.

In order to understand the 'what are the best graphic practices for Metropolitan Transportation Plan documents?', over 1,500 graphics were evaluated and coded across twenty randomly selected MPOs. MPOs of this small size were evaluated because they are often understaffed, underfunded, and complete most MTPs in-house. This inductive research found that there is a vast difference in the way that graphics are used in MTPs. Certain MTPs have few graphics while others are filled with unimportant filler graphics. Due to this range in existing practice, a list of

essential graphics for MTPs was created as means to better graphically communicate important ideas to the public, stakeholders, and public officials. Essential graphic lists were divided by the three types of graphics found within MTPs: spatial (maps), numeric (charts & graphics), and concept (illustrations) graphics.

In addition to the existing practices and essential graphics, this research informs best practices through relevant graphic communication and graphic design principles at both a document wide and graphic specific scale. Factors such as colors, chart orientation, text size and selection, and word choice can all determine if a graphic is clearly communicated or not. Graphics are critical but it is also important to maintain a well-rounded focus of an MTPs vision, graphics, clarity, and length (Florida Department of Transportation, 2013).

Study Limitations

There are over 400 MPOs in the United States and nearly half are considered small MPOs, having a population under 200,000 people. Given this current climate, only 5 percent of MPOs were evaluated for this research. When deciding to evaluate small MPOs, there was a preconceived notion that there would be a handful of exemplary MTPs. In practice, this ended up being inaccurate. It was found that certain MTPs excelled in either one of the three graphic types, but rarely more than one. Many graphics found within the researched MTPs failed to meet important criteria established by the checklists (Appendix A). This left the research to feel as if it provided a general understanding of existing practice rather than an understanding of the best graphic practices for MTPs.

Future Research

Larger MPOs

Graphics are critical for MTPs because they are able to appeal to the general public, stakeholders, and elected officials by clarifying difficult concepts or communicating ideas. This research provides transportation planning professionals with an overview of the existing and recommended practice for MTPs in MPO regions with less than 200,000 people. Due to the small size of the researched MPOs and different federal requirements, similar research for larger MPO regions has potential. Research at a multitude of scales and across a broader spectrum of MPOs could provide professionals with an understanding of innovative and clear graphics.

Public Preference Studies

Another type of research that could transform the way MTPs are communicated, would be research that involves surveying the public on their graphic preferences. It appears that the majority of research on graphic communication is derived from expert opinion and there is little to no research on what the general public believes is a clearly communicated graphic. In order to legitimize this research, there would need to be a large and diverse group of participants from throughout the country. Graphics used in this preference study would have to be based on the same topic and slightly varied in their presentation format.

Beyond Transportation Plans

Though this research is focused on transportation plans, a similar process could be applied to a broader professional audience within planning and beyond. Planners use graphics to communicate information and similar research on a different topic could be applicable and beneficial to the profession in general such as an analysis on comprehensive plans, websites, or planning infographics.

APPENDIX A

CHECKLISTS

The decision tree and checklists on the following pages provide metropolitan planning organizations (MPOs) with the core graphic communication principles related to maps, charts, photographs, diagrams, and other graphics. These figures are meant to serve as a resource to be utilized by MPOs or consultants when developing a Metropolitan Transportation Plan (MTP). Each checklist is generalized so that there is room for graphic creativity while still being able to add the core principles of graphic design that are easy for readers to understand. All checklist items for thematic maps originate from various web and written sources on cartography and map making. All numeric and concept graphic checklist items are derived from graphic design principles by various credible sources. There are no checklist items added by the researcher. Each checklist is color coded. The light green color represents the checklist for spatial graphics; the teal color represents the checklists that relate to numeric graphics; and the dark blue color represents checklists that relate to concept graphics.

Figure A.1: Graphic Decision Tree

Figure A.2: Thematic Map Checklist

Thematic Map

Used to graphically express spatial patterns and relationships. Maps assist with three general tasks: illustration/explanation, navigation, and analysis.

General Principles

Clear Communication

- ☐ There is neither more nor less detail than required for the point to be made.
- ☐ Map proportions are scaled accurately (ie. no cartograms).
- ☐ An unfamiliar person would be able to interpret the map in 30 seconds or less without any additional information.
- ☐ Map layers are logical with background features located in the back and key elements located on top.
- ☐ Optional: there is a small inset map used to show the region in the context of a larger-scale or in more detail.

Essential Map Elements

- ☐ The legend is legible and depicts relevant symbols and colors while looking clean with items aligned to the left.
- ☐ Legend symbols are ordered by points, lines, and polygons.
- ☐ The map is oriented with an accurate north arrow.
- ☐ A scale bar is shown with natural labels (ie. 5, 10, 15, 20 miles).
- ☐ The map year(s) are identified in either the source, legend, or title.
- ☐ Data source (if available) is clearly labeled (ie. not a weblink).

Labeling

- ☐ The title of the map is simple, informative, and eye-catching.
- ☐ The title is bold or a couple of font sizes larger than the remaining labels.
- ☐ The map is labeled with contrasting type from the background.
- ☐ There are no overlapping or blurry labels.
- ☐ Spell check has been applied.
- ☐ The title and surrounding labels are serif or sans-serif font and sentence case.

Color & Symbology

- ☐ The background of the map is simplified to white, grey, or cream.
- ☐ Common colors reflect a purpose. For example, blue represents water features and green represents park space.
- ☐ The main feature(s) are colored by vibrant saturated colors that are clear to read.
- ☐ When using ordinal data, the darkest color should the feature that is most important (ie. a population change map should represent the largest change in the darkest color).
- ☐ Location markers are consistent in size and vary only by color when necessary.
- ☐ There are few colors & textures.

Sources: Frank (2003); GISGeography (2015); Kosslyn (2007); Lewis (2015); Penn State University Department of Geography (n.d.)

Figure A.3: Vertical Bar Chart Checklist

Vertical Bar Chart

Used when illustrating differences between specific point values such as comparing changes over time, analyzing parts of a whole, or ranking values.

General Principles

Clear Communication

- ☐ The chart is ordered either: alphabetically, sequentially, or by value.
- ☐ The baseline of the chart starts at zero.
- ☐ There are five or less categorical subdivisions.
- ☐ The chart is 2D and there is no shadowing.
- ☐ The space between bars (gap width) is approximately half the width of the bar.
- ☐ There is not a border around the chart.
- ☐ Data source is available and clearly labeled (ie. not a weblink).
- ☐ A person unfamiliar with the data would be able to interpret the chart in 30 seconds or less without any additional information.

Labeling

- ☐ The title of the chart is simple, informative, and eye-catching.
- ☐ The title is bold or a couple of font sizes larger than the remaining labels.
- ☐ The chart is labeled: by each section, at the min/max, or on the emphasized bar.
- ☐ If labels are close together or overlapping, select a different way to label.
- ☐ The x-axis and y-axis are labeled succinctly if necessary.
- ☐ The title and surrounding labels are sans-serif font, sentence case, and horizontal.
- ☐ Black type on a light background or white type on a dark background is used.
- ☐ Large numbers 1,000 and above have a comma separator.

Timeline Bar Charts

- ☐ Time values are on the x-axis and quantitative values are on the y-axis.
- ☐ X-axis increments are natural and equal (ie. 00'-05' & 06'-10' vs 05'-06' & 07'-10')
- ☐ Y-axis increments are natural (ie. 0, 5, 10).

Color

- ☐ Chart colors are visibly dark on a light background.
- ☐ Grid lines (optional) are thin and light grey.
- ☐ The same color is used to represent the same variable with an exception for the focal point in which a darker shade or different color is used.
- ☐ Chart colors are either graduating shades of the same color or are colors on the same side of the color wheel.

Sources: Few (2004); Frank (2003); Knaflic (2015); Kosslyn (2007); Lankow et al. (2012); Tableau Software (n.d.); Tufte (2001); Wong (2010); & Zelazny (2001)

Figure A.4: Horizonal Bar Chart Checklist

Horizontal Bar Chart

Used virtually the same as a vertical bar chart however, horizontal bar charts are used only to view parts of a whole and show a ranking of values. These charts are never used to compare a change over time.

General Principles

Clear Communication

- ☐ The chart is ordered either: alphabetically, sequentially, or by value.
- ☐ The baseline of the chart starts at zero.
- ☐ X-axis increments are natural (ie. 0, 5, 10).
- ☐ There are no gridlines on the x-axis.
- ☐ The chart is 2D and there is no shadowing.
- ☐ The space between bars (gap width) is approximately half the width of the bar.
- ☐ There is not a border around the chart.
- ☐ Data source is available and clearly labeled (ie. not a weblink).
- ☐ A person unfamiliar with the data would be able to interpret the chart in 30 seconds or less without any additional information.

Labeling

- ☐ The title of the chart is simple, informative, and eye-catching.
- ☐ The title is bold or a couple of font sizes larger than the remaining labels.
- ☐ The chart is labeled: by each section, at the min/max, or on the emphasized bar.
- ☐ If labels are close together or overlapping, select a different way to label.
- ☐ The x-axis and y-axis are labeled succinctly if necessary.
- ☐ The title and surrounding labels are sans-serif font, sentence case, and horizontal.
- ☐ Black type on a light background or white type on a dark background is used.
- ☐ Large numbers 1,000 and above have a comma separator.

Color

- ☐ Chart colors are visibly dark and bold on a light background.
- ☐ The same color is used to represent the same variable with an exception for the focal point in which a darker shade or different color is used.
- ☐ Chart colors are either graduating shades of the same color or are colors on the same side of the color wheel.

Sources: Few (2004); Frank (2003); Knaflic (2015); Kosslyn (2007); Lankow et al. (2012); Tableau Software (n.d.); Tufte (2001); Wong (2010); & Zelazny (2001)

Figure A.5: Stacked and 100% Stacked Bar Checklist

Stacked Bar Chart

Used when there is a need to show multiple part-to-whole relationships from discrete or continuous data. The stacked bar is used to make nominal comparisons while the 100 percent stacked bar focuses on the comparison of each part.

General Principles

Clear Communication

- ☐ There are five or less categorical subdivisions.
- ☐ The chart is 2D and there is no shadowing.
- ☐ There is not a border around the chart.
- ☐ Data source is available and clearly labeled (ie. not a weblink).
- ☐ A person unfamiliar with the data would be able to interpret the chart in 30 seconds or less without any additional information.

Color

- ☐ A dark or bright color represents the most important data series. All other data series are shades of one color.
- ☐ All grid lines are omitted.

Labeling

- ☐ The title of the chart is simple, informative, and eye-catching.
- ☐ The title is bold or a couple of font sizes larger than the remaining labels.
- ☐ Each segment is directly labeled. These labels are centered on the inside end of the bar category.
- ☐ There are no overlapping labels.
- ☐ The x-axis and y-axis are labeled succinctly if necessary.
- ☐ The title and surrounding labels are sans-serif font, sentence case, and horizontal.
- ☐ Chart is labeled with black type on a light background.

Vertical Stacked Bar

- ☐ The stacked bar is vertical for easy absolute value comparison.
- ☐ Y-axis labels are a quantitative value.
- ☐ Y-axis increments have outside tick marks and are natural (ie. 0, 5, 10).
- ☐ If there are large numbers above 1,000, there is a comma separator.
- ☐ If the chart is looking at a change over time, the time values are on the x-axis and quantitative values are on the y-axis.

100% Stacked Bar

- ☐ The 100% stacked bar is horizontal for easy comparison unless comparing changes over a period of time, in which see the 'Vertical Stacked Bar' checklist.
- ☐ Labels are a whole percentage leading to a sum of 100% (ie. 15% not 15.3%).
- ☐ X-axis increments have outside tick marks and are natural (ie. 0, 5, 10).
- ☐ If the chart is looking at a change over time, the time values are on the x-axis and quantitative values are on the y-axis.

Sources: Few (2004); Frank (2003); Knaflic (2015); Kosslyn (2007); Lankow et al. (2012); Tableau Software (n.d.); Tufte (2001); Wong (2010); & Zelazny (2001)

Figure A.6: Line Chart Checklist

Line Chart

Used to show a trend by displaying a continuous data series or discrete values over a period of time.

General Principles

Clear Communication

- ☐ There are four or less categorical subdivisions. If there are five or more categories, paneling is used to show individual charts at a constant scale.
- ☐ All lines are solid, not too thick or too thin.
- ☐ Time values are on the x-axis and quantitative values are on the y-axis.
- ☐ X-axis increments are natural and equal.
- ☐ Y-axis increments are natural (ie. 0, 5, 10).
- ☐ The y-axis is scaled so that the line chart takes up two-thirds of the total y-axis scale.
- ☐ There is only one y-axis.
- ☐ The chart is 2D and there is no shadowing or shading underneath the line.
- ☐ There is not a border around the chart nor a distracting background.
- ☐ Data source is available and clearly labeled (ie. not a weblink).
- ☐ A person unfamiliar with the data would be able to interpret the chart in 30 seconds or less without any additional information.

If Adding Points

- ☐ Points are at least twice as thick as the line.
- ☐ Data markers are all circular (ie. not symbols such as ■♦×)

Labeling

- ☐ The title of the chart is simple, informative, and eye-catching.
- ☐ The title is bold or a couple of font sizes larger than the remaining labels.
- ☐ Lines are labeled directly. If this is not possible due to tight spacing, the legend is ordered to match the ranking of the end points.
- ☐ Labels are a few words or one concise sentence at most.
- ☐ There are no overlapping labels.
- ☐ The x-axis and y-axis are labeled succinctly if necessary.
- ☐ The title and surrounding labels are sans-serif font, sentence case, and horizontal.
- ☐ Chart is labeled with black type on a light background.
- ☐ Large numbers 1,000 and above have a comma separator.

Color

- ☐ The darkest or brightest line represents the most important data series. All other data series are shades of one color.
- ☐ Grid lines (optional) are thin and light grey.

Sources: Few (2004); Frank (2003); Knaflic (2015); Kosslyn (2007); Lankow et al. (2012); Tableau Software (n.d.); Tufte (2001); Wong (2010); & Zelazny (2001)

Figure A.7: Pie Chart Checklist

Pie Chart

Used to make part-to-whole comparisons with continuous or discrete data.

General Principles

Clear Communication

- ☐ The sum of all subcategories equals 100 percent.
- ☐ There are five or less slices.
- ☐ The largest segment is located to the right of the 12 o'clock position and the second largest segment is on the left of the 12 o'clock position; the remaining slices follow counterclockwise. Yet, if all slices are close in value, the largest segment is located at the right of the 12 o'clock and the slices proceed clockwise from largest to smallest.
- ☐ The most important slice is highlighted either by one dark color or it is pulled out from the chart, not both.
- ☐ There is not a border around the chart.
- ☐ Data source is available and clearly labeled (ie. not a weblink).
- ☐ A person unfamiliar with the data would be able to interpret the chart in 30 seconds or less without any additional information.

Labeling

- ☐ The title of the chart is simple, informative, and eye-catching.
- ☐ The title is bold or a couple of font sizes larger than the remaining labels.
- ☐ Pie slices are labeled directly and are located in the center of each segment.
- ☐ Bold text is used on the highlighted piece.
- ☐ Pie slices are labeled with black type on a light background or white text on a dark background.
- ☐ The title and surrounding labels are sans-serif font, sentence case, and horizontal.

Color

- ☐ All pieces of the pie are the same color with an exception for the highlighted slice.
- ☐ The highlighted slice is the darkest color of the chart.
- ☐ Excluding the highlighted slice, all slices are one color or of the same

  Chart colors are either graduating shades of the same color or are colors on the same side of the color wheel.

Sources: Few (2004); Frank (2003); Knaflic (2015); Kosslyn (2007); Lankow et al. (2012); Tableau Software (n.d.); Tufte (2001); Wong (2010); & Zelazny (2001)

Figure A.8: Photograph Checklist

Photograph

Used when trying to evoke an emotion, present evidence, or increase reader retention.

General Principles

- ☐ The photograph is integrated into the report because it either evokes a specific emotion, presents evidence, or increases reader retention; not to look pretty.
- ☐ The text references the photograph.
- ☐ Credit is given to the photographer.
- ☐ The photograph is high-resolution & clear.

Sources: Frank (2003) & Kosslyn (2007)

Figure A.9: Resource & Logo Checklist

Resource & Logo

Used to inform readers of an additional website, plan, report, or organization.

General Principles

- ☐ The resource graphic is integrated into the report because it informs readers of how a decision was made or informs them of a tool that they can seek out on their own.
- ☐ The text references the resource.
- ☐ The graphic is high-resolution & clear.
- ☐ Website: there is a screenshot of the webpage. Browser tabs and the search bar have been removed from the image.
- ☐ Report: there is an image of the report cover when discussing the report in general, or there is an image of a full page spread when discussing a specific idea.

Source: Kosslyn (2007)

Figure A.10: Diagram Checklist

Diagram

Used to convey general ideas, interactions, timelines, and relationships.

General Principles

Clear Communication

- ☐ All information is visible and on one page.
- ☐ The information goes from left to right or top to bottom.
- ☐ All connections are made with hierarchy or direction.
- ☐ Every shape is the same size as is the spacing between them. They have the same outlines and are aligned uniformly.
- ☐ Lines overlap only when necessary.
- ☐ The chart or diagram has a clear purpose.
- ☐ The text references the graphic.
- ☐ The graphic is high-resolution & clear.
- ☐ A person unfamiliar with the graphic would be able to interpret the chart in 30 seconds or less without any additional information.

Labeling & Color

- ☐ The title and surrounding labels are serif or sans-serif font.
- ☐ All text is sentence case or each word is capitalized.
- ☐ There are no overlapping labels.
- ☐ Spell check has been applied.
- ☐ Colors are neutral or analogous with an exception for a few vibrant colors when used for emphasis.
- ☐ Data source (if available) is clearly labeled (ie. not a weblink).

Sources: Frank (2003); Kosslyn (2007); Lewis (2015); Passera (2017); & SmartDraw (n.d.)

APPENDIX B

EXAMPLE ESSENTIAL GRAPHICS

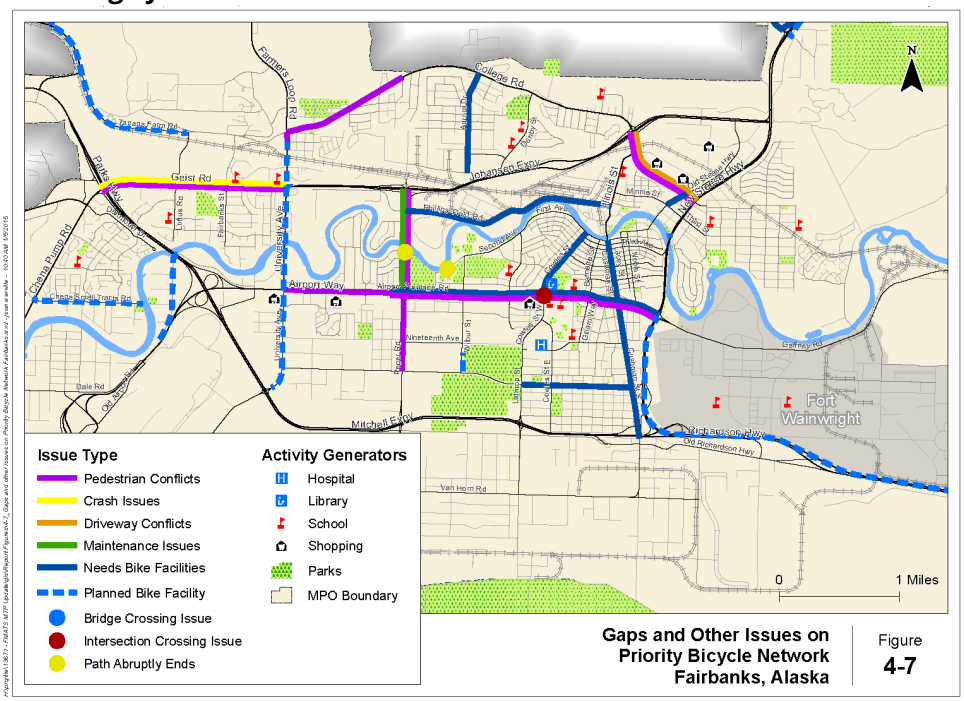
This section should be used for a general understanding of what essential graphics may look like. This section does not serve as a guide for best practice.

Spatial Graphic Examples

Table B.1: List of Essential Spatial Graphics

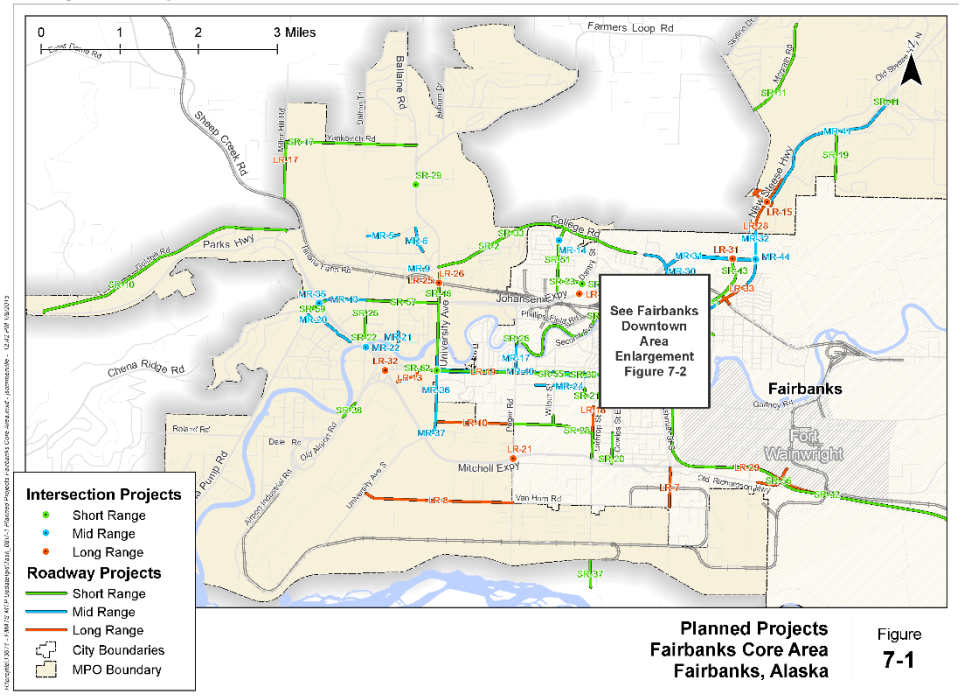
Essential Spatial Graphics	MTPs w/ Graphic	
1. Existing System		100%
2. Proposed System		85%
3. Metropolitan Planning Area Boundary		80%
4. Level of Service		70%
5. Population Demographics		65%
6. Applicable Performance Metrics		65%
7. Employment Demographics		50%
8. Environmentally Sensitive Areas (if applicable)		50%
9. Environmental Justice Areas		45%
10. Fiscally Constrained Projects		45%
11. Scenario Planning/Modeling		30%
12. MPO Location Within the state(s)		15%
13. Air Quality		10%

Figure B.1: Existing System



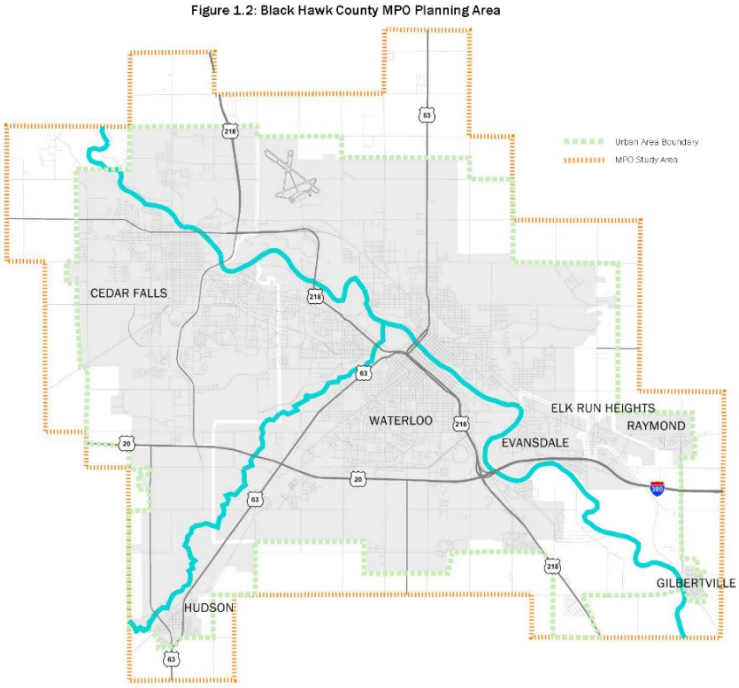
Source: Fairbanks Metropolitan Area Transportation System (2015)

Figure B.2: Proposed System



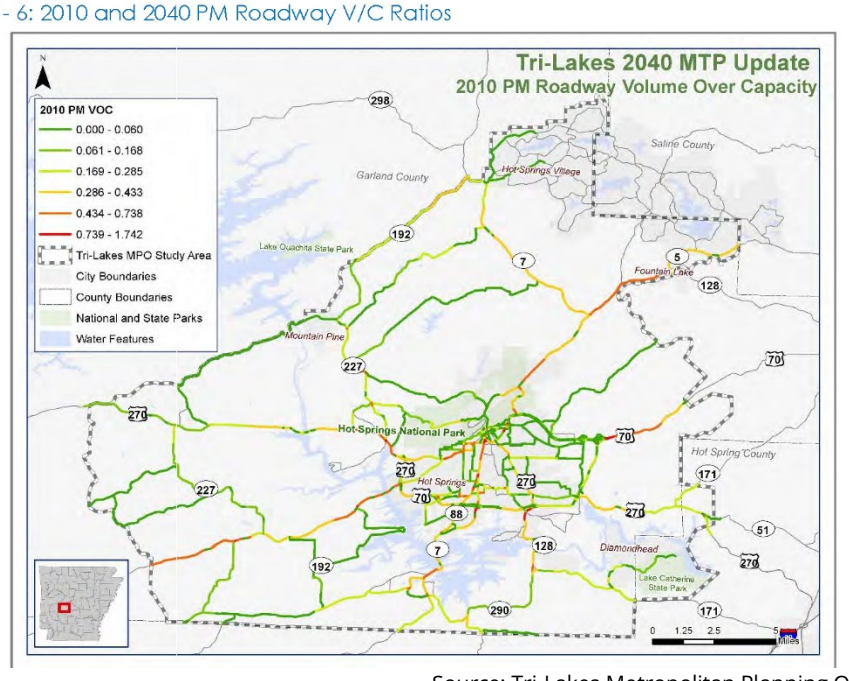
Source: Fairbanks Metropolitan Area Transportation System (2015)

Figure B.3: Metropolitan Planning Area Boundary



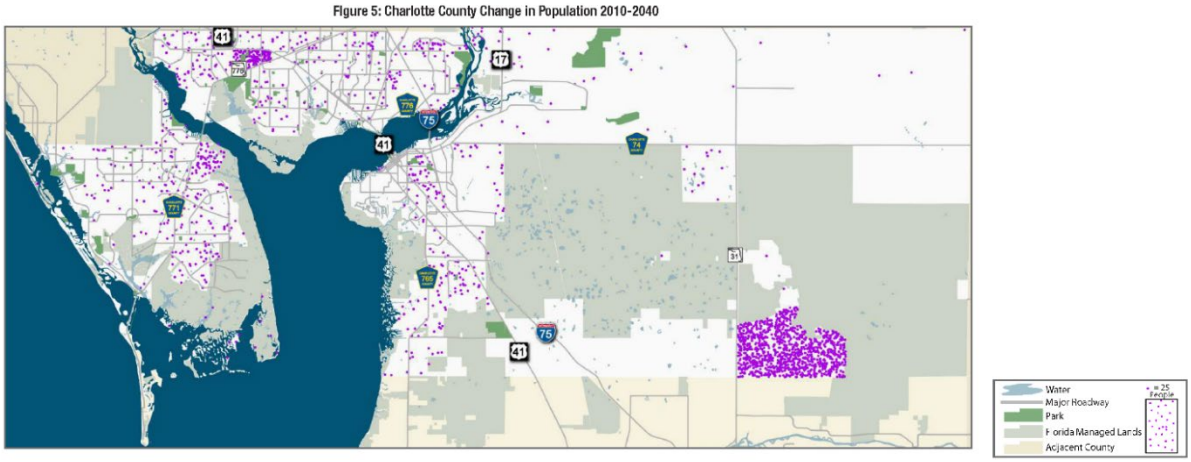
Source: Black Hawk County Metropolitan Area Transportation Policy Board (2018)

Figure B.4: Level of Service



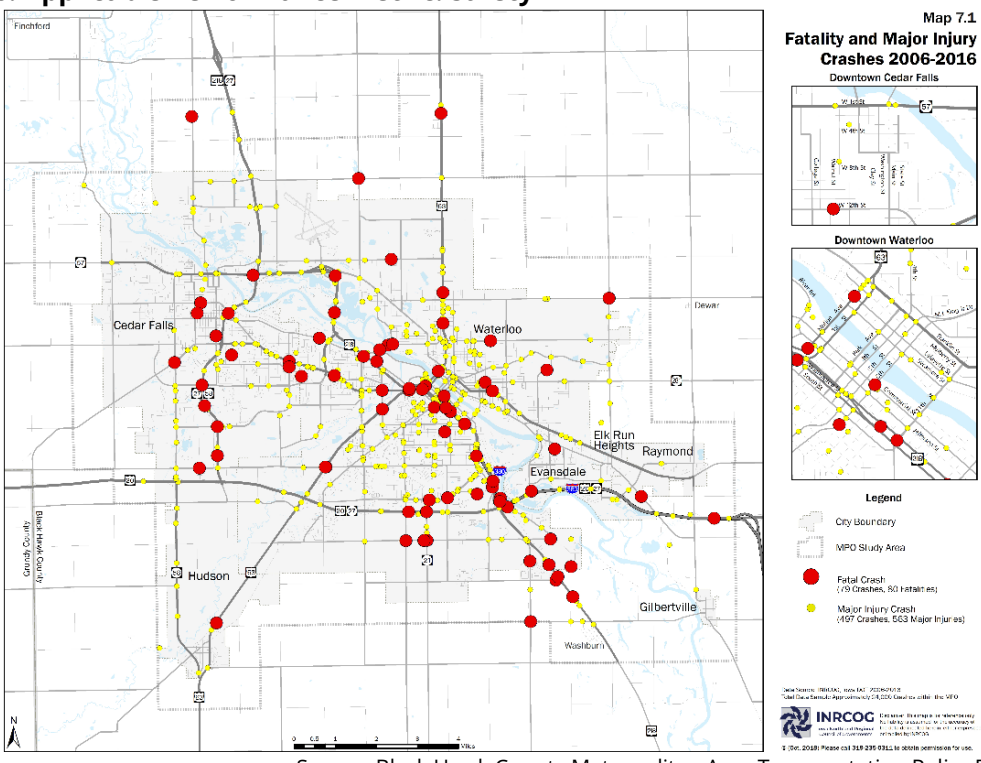
Source: Tri-Lakes Metropolitan Planning Organization (2015)

Figure B.5: Population Demographics



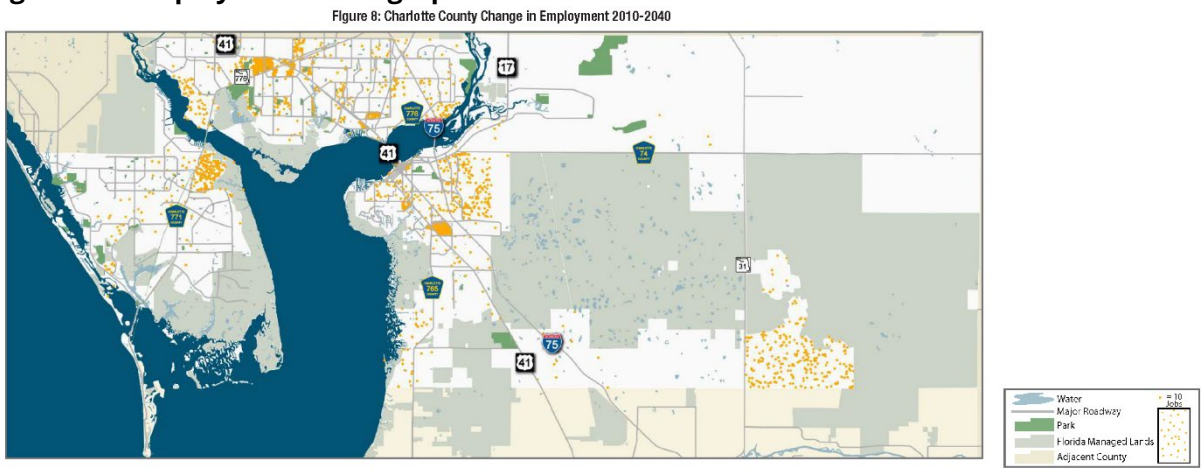
Source: Charlotte County-Punta Gorda Metropolitan Planning Organization (2015)

Figure B.6: Applicable Performance Metric: Safety



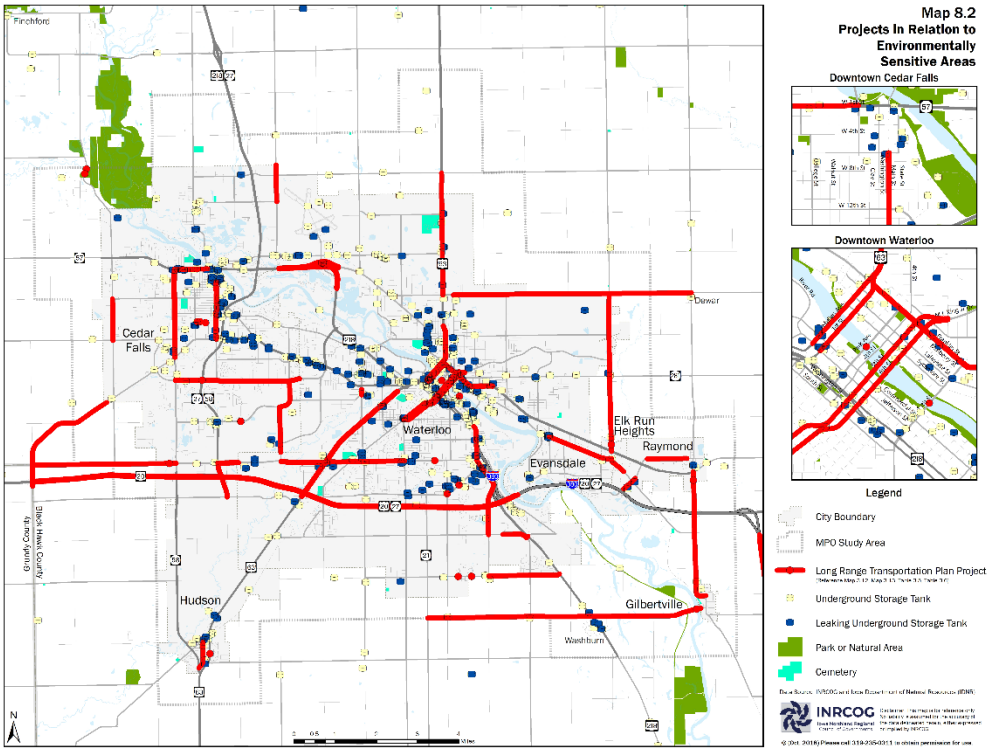
Source: Black Hawk County Metropolitan Area Transportation Policy Board (2018)

Figure B.7: Employment Demographics



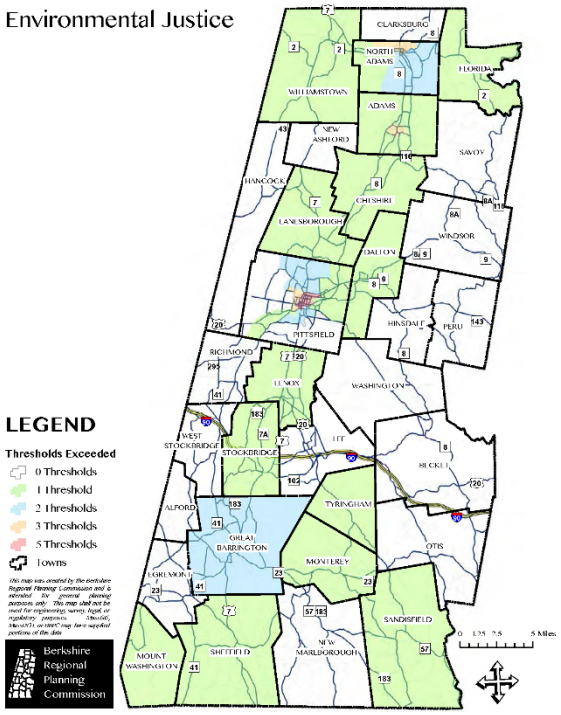
Source: Charlotte County-Punta Gorda Metropolitan Planning Organization (2015)

Figure B.8: Environmentally Sensitive Areas



Source: Black Hawk County Metropolitan Area Transportation Policy Board (2018)

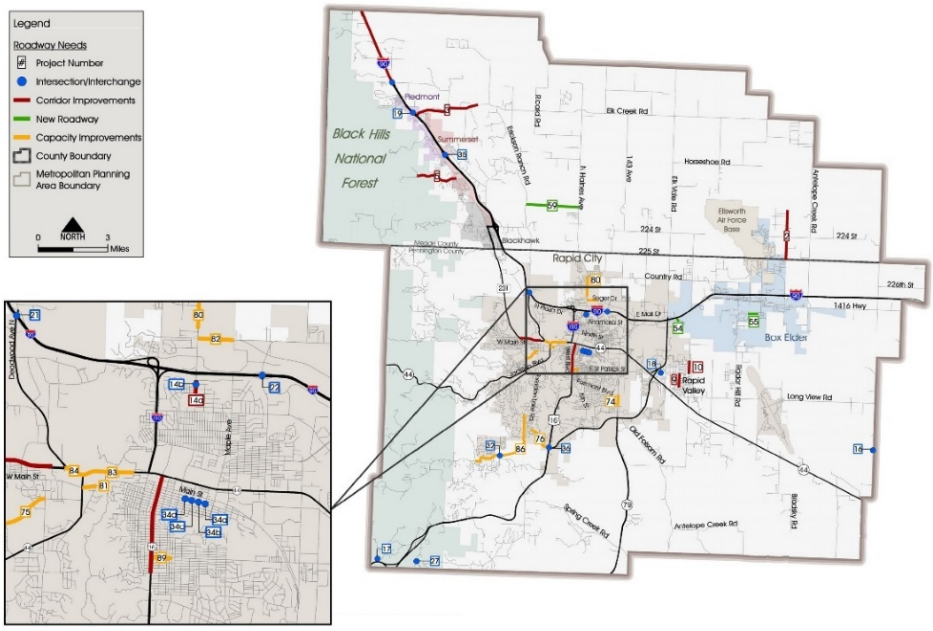
Figure B.9: Environmental Justice Areas



Source: Berkshire Metropolitan Planning Organization (2016)

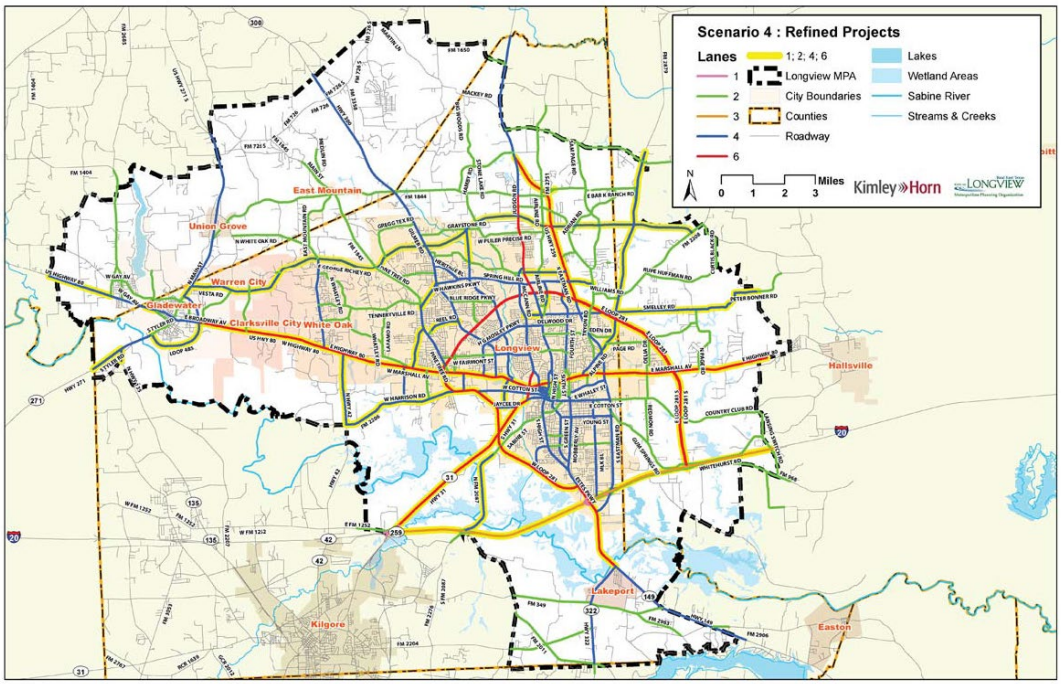
Figure B.10: Fiscally Constrained Projects

Figure 24. Roadway Fiscally Constrained Plan



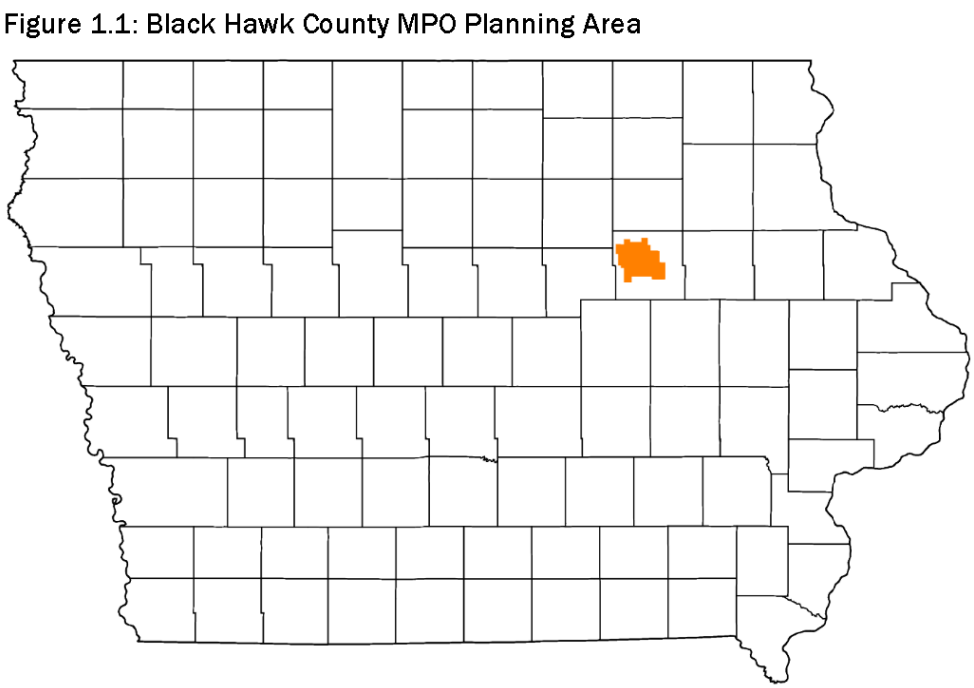
Source: Rapid City Metropolitan Planning Organization (2015)

Figure B.11: Scenario Planning/Modeling



Source: Longview Metropolitan Planning Organization (2017)

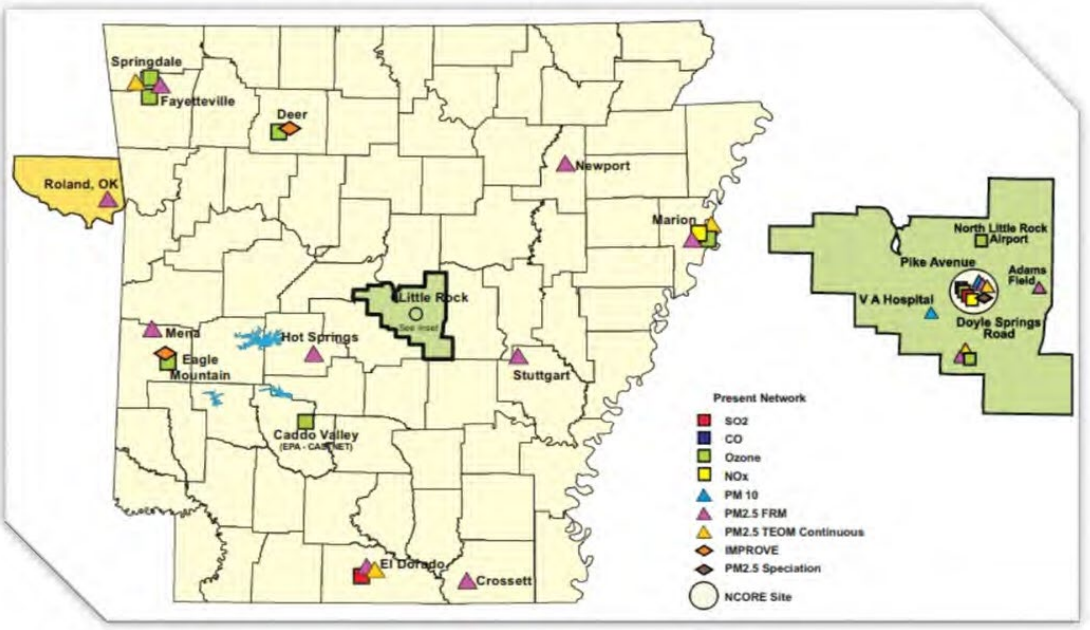
Figure B.12: MPO Location Within the state(s)



Source: Black Hawk County Metropolitan Area Transportation Policy Board (2018)

Figure B.13: Air Quality

Figure 5 - 3: Arkansas Ambient Air Quality Monitoring Network



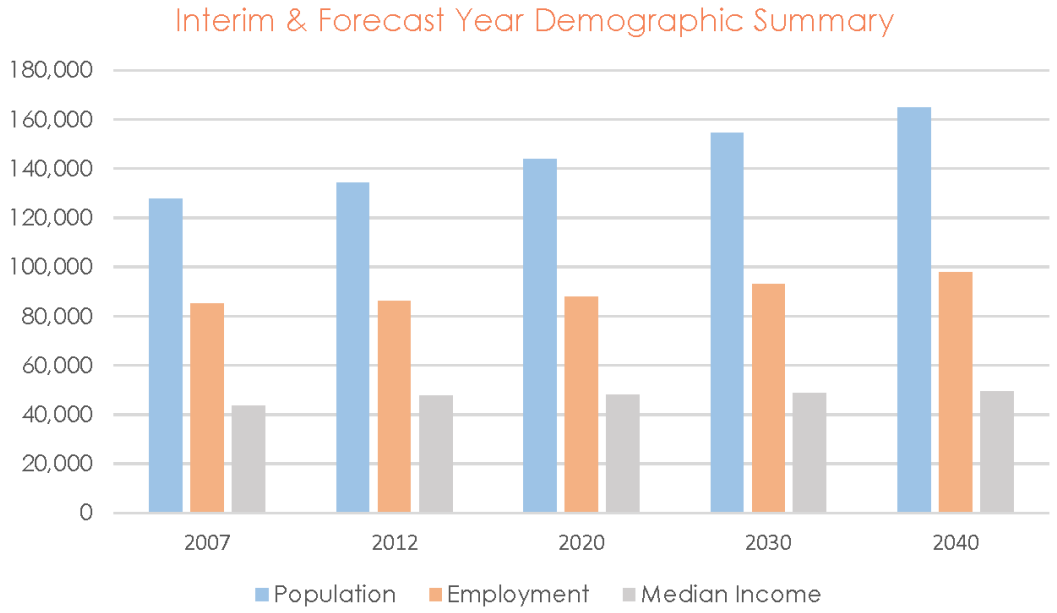
Source: Tri-Lakes Metropolitan Planning Organization (2015)

Numeric Graphic Examples

Table B.2: List of Essential Numeric Graphics

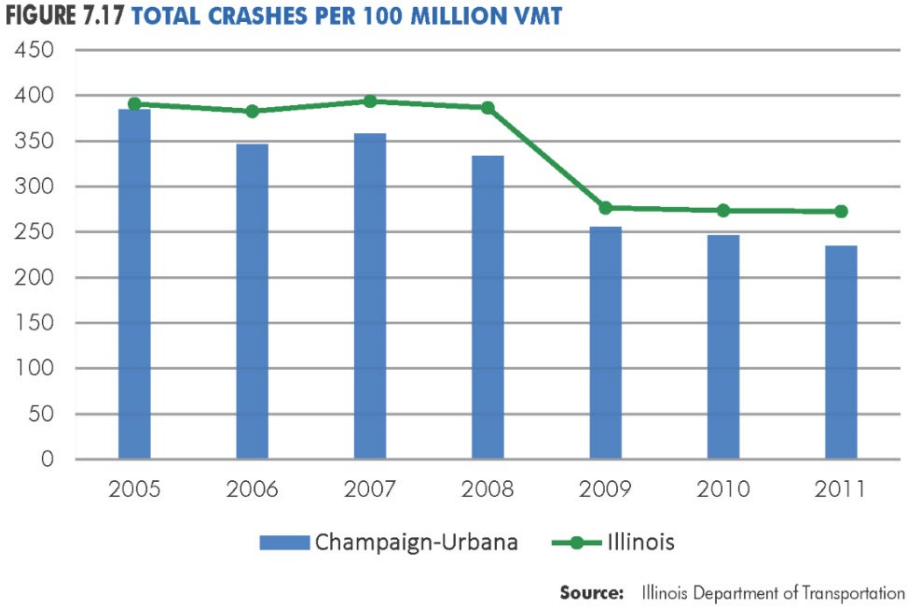
Essential Numeric Graphics	Rcmd. Graphic	MTPs w/ Graphic
1. Existing and/or Projected Demographics		 75%
2. Applicable Performance Metrics	n/a	 55%
3. Trends		 55%
4. Funding Allocation/Investments		 35%
5. Mode Share		 35%
6. Air Quality/Emissions (if applicable)		 30%
7. Public Survey Results (if applicable)		 25%

Figure B.14: Existing and/or Projected Demographics



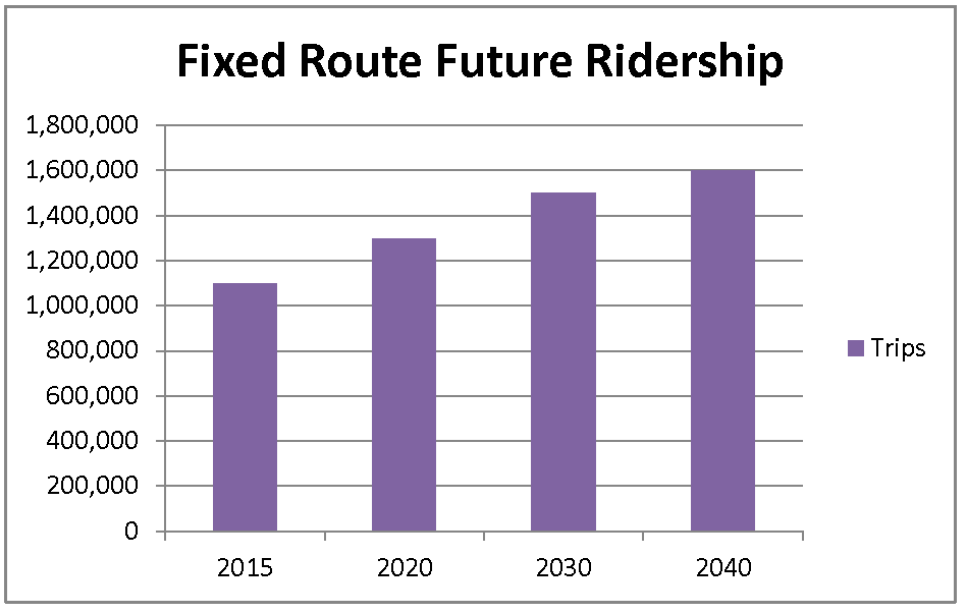
Source: Longview Metropolitan Planning Organization (2017)

Figure B.15: Applicable Performance Metrics: Safety



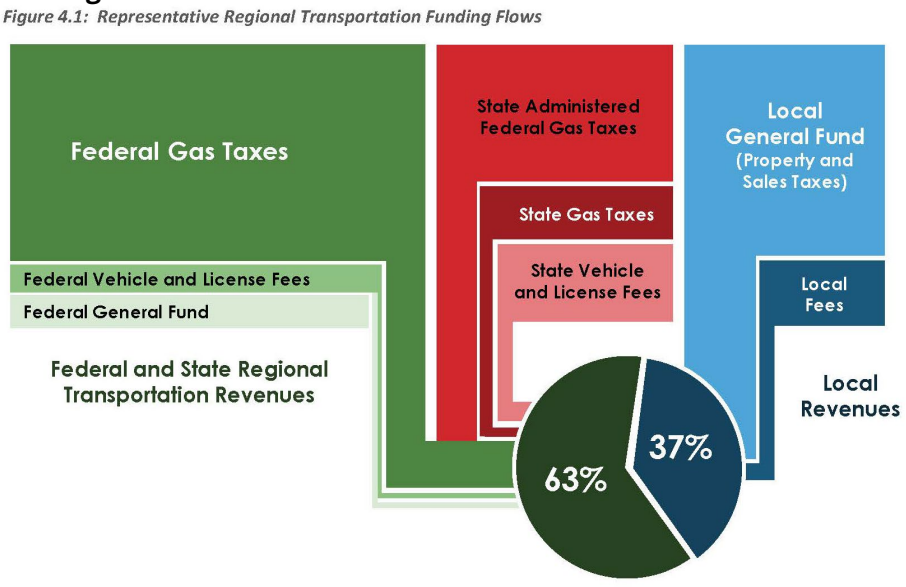
Source: Champaign Urbana Urbanized Area Transportation Study (2014)

Figure B.16: Trends



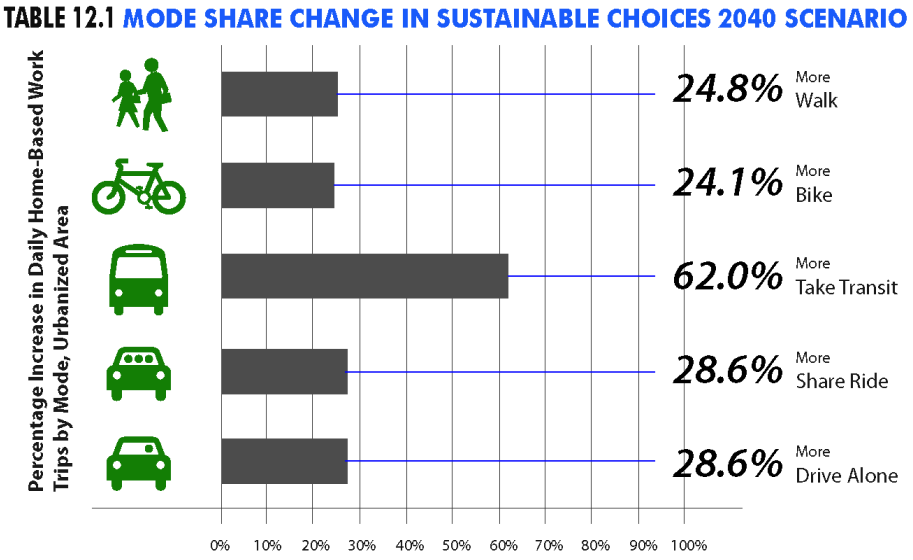
Source: Siouxland Interstate Metropolitan Planning Council (2016)

Figure B.17: Funding Allocation/Investments



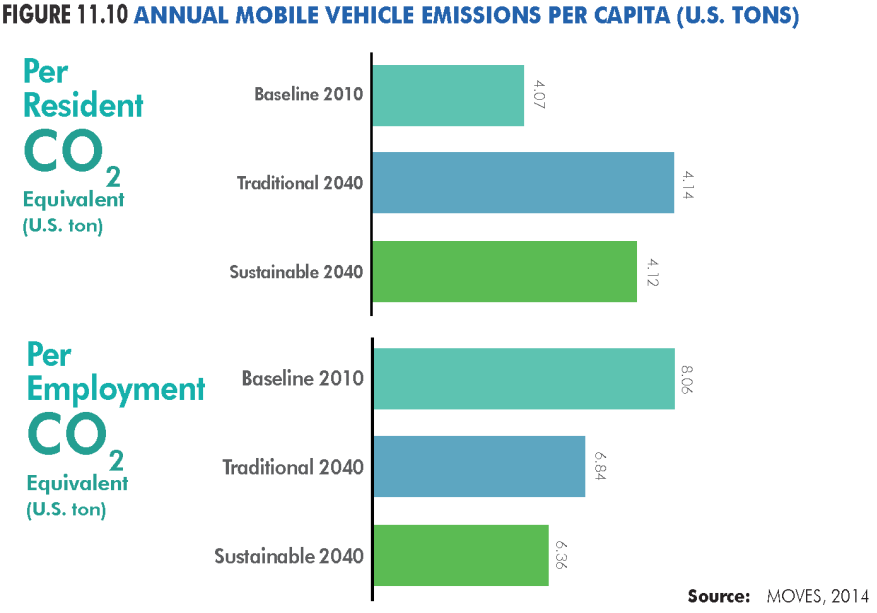
Source: Grand Valley Metropolitan Planning Organization (2014)

Figure B.18: Mode Share



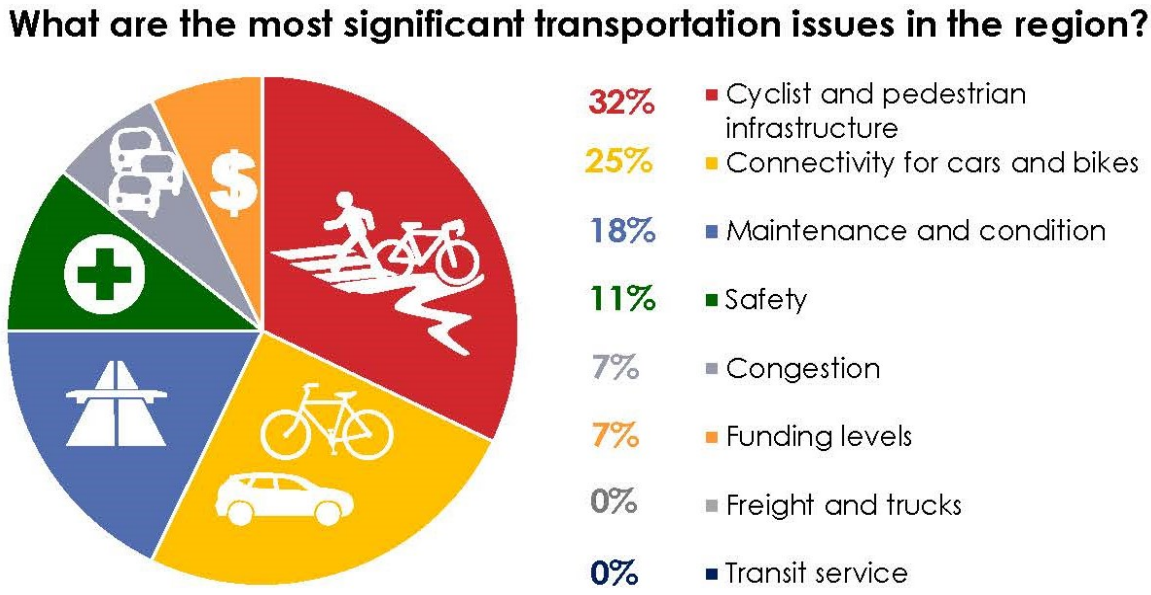
Source: Champaign Urbana Urbanized Area Transportation Study (2014)

Figure B.19: Air Quality/Emissions



Source: Champaign Urbana Urbanized Area Transportation Study (2014)

Figure B.20: Public Survey Results



Source: Grand Valley Metropolitan Planning Organization (2014)

Concept Graphic Examples

Table B.3: List of Essential Concept Graphics

Essential Concept Graphics	Graphic Format	MTPs w/ Graphic
1. Your Community		55%
2. Examples of Recommended Infrastructure		40%
3. Partner Organizations		40%
4. Planning Process		40%
5. Plan Goals (Regional, State, and/or Federal)		30%
6. Proposed Condition (rendering or sketch)		25%

Figure B.21: Your Community

Source: Charlotte County-Punta Gorda Metropolitan Planning Organization (2015)

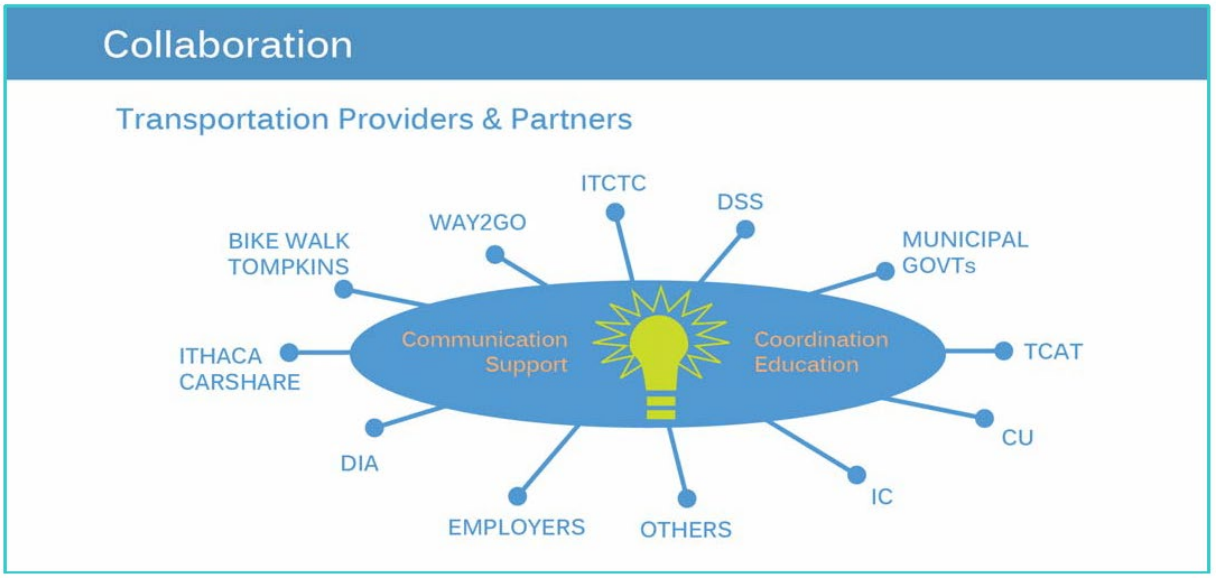
Figure B.22: Examples of Recommended Infrastructure

Figure 6-2 City of Portland pedestrian cut-through.

Source (copyright): https://rayatkinsonplans.wordpress.com/2014/08/03/signs-for-bikes-and-peds/

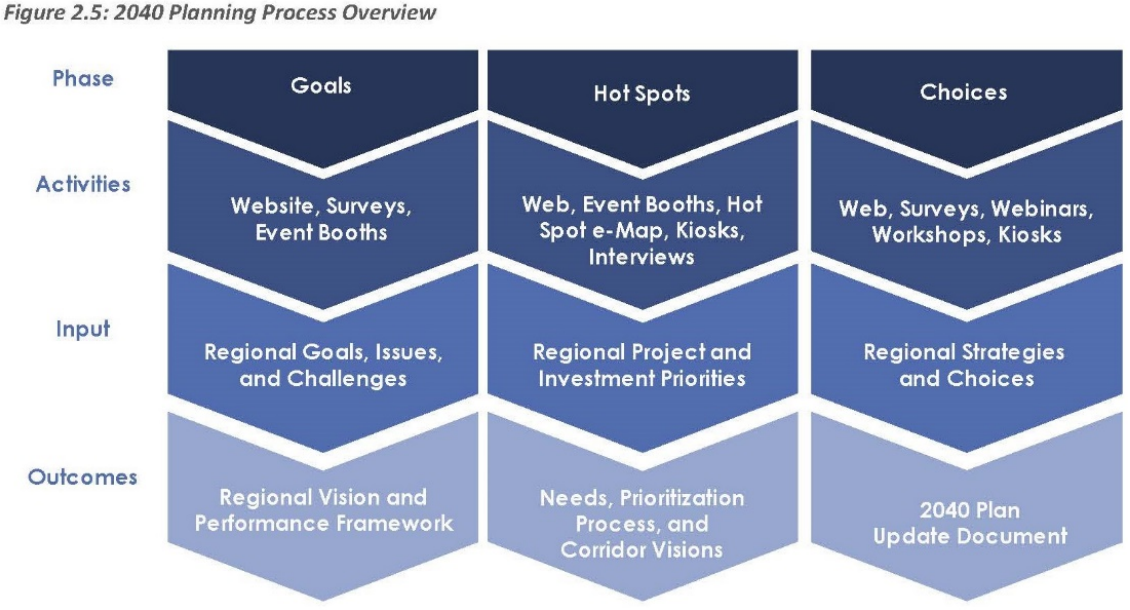
Source: Flagstaff Metropolitan Planning Organization (2017)

Figure B.23: Partner Organizations



Source: Ithaca-Tompkins County Transportation Council (2014)

Figure B.24: Planning Process



Source: Grand Valley Metropolitan Planning Organization (2014)

Figure B.25: Plan Goals

Source: Grand Valley Metropolitan Planning Organization (2014)

Figure B.26: Proposed Condition

Source: Champaign Urbana Urbanized Area Transportation Study (2014)

APPENDIX C

RECOMMENDED GRAPHICS

In addition to the list of essential graphics found in Chapter 6, this section provides a list of recommended graphics. The lists of spatial, numeric, and concept recommended graphics are made available because in addition to the essential graphics, they could strengthen the overall story of local transportation systems.

Table C.1: List of Recommended Spatial Graphics

Recommended Spatial Graphics
1. Existing & Future Land Use
2. Major Employers
3. Projects completed from previous plan

Table C.2: List of Recommended Numeric Graphics

Recommended Numeric Graphics	Rcmd. Graphic
1. Average Travel Time to Work by Mode (if applicable)	
2. Passengers or Cargo Deplaned/Emplaned (if applicable)	

Table C.3: List of Recommended Concept Graphics

Recommended Concept Graphics	Graphic Format
1. Relationship Between Transportation & Land Use	
2. Access Management	
3. Transportation Accolades (i.e. bicycle friendly community status)	
4. Document Navigation Graphics	

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APPENDIX D

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