Planning Process Bundle Case Study

Deploying Visualization and Analysis Tools to Support Local Visioning, Informed Infrastructure Priorities & Performance Measures

Denver Regional Council of Governments

The SHRP2 Planning Process Bundle (PPB) is a collection of techniques and resources for increased collaboration in transportation planning, programming, project development, and decision making. For more information on all bundle products, visit the [Planning Process Bundle website.](#)

Executive Summary

Local governments in the Denver region wanted to see a significant portion of growth and development occur in locally identified and regionally designated urban centers. While such growth aspirations are important locally, in aggregate, they also help achieve a variety of cross-jurisdictional goals related to transportation and quality of life.

To advance progress toward this desired local and regional outcome, the Denver Regional Council of Governments (DRCOG) sought to improve the understanding of the value and importance of urban centers, while also providing scenario analysis capabilities. These capabilities could help local governments explore the capacity of their urban centers for growth and the potential impacts of such possible changes.

Implementation of SHRP2 products from the Planning Process Bundle – Performance Measures for Highway Capacity Decision Making (C02) and Transportation Visioning for Communities (C08) – gave DRCOG the opportunity to:

- Create measures of urban center performance for ongoing monitoring.

- Develop and refine questionnaires, summary formats, and other worksheets to help the agency engage local government members and develop testable what-if questions related to small area visioning and planning.

- Foster local government interest in the ability of DRCOG's predictive forecasting tools to help explore the development capacity of their urban centers, as well as other growth aspirations within the context of a rapidly growing region.

- Engage local governments to improve feedback on small area forecasting methods.

- Develop a custom software application to test the feasibility of future scenarios on the fly.

Project Snapshot

- Blended predictive regional forecasting tools into a normative, small area scenario analysis exercise.

- Created a custom software application to visualize potential futures by modifying assumptions about local regulations and real estate market dynamics.

- Piloted a process to encourage local government and regional agency collaboration on planning and visioning.

- Demonstrated the role of urban centers in the Denver region with a set of replicable performance measures.

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Agency's Challenge

Local governments in the Denver region, through DRCOG's Metro Vision plan, collectively decided to direct a significant portion of growth and development to urban centers to reduce greenhouse gas (GHG) emissions, improve community livability, enhance economic competitiveness, and focus a portion of the region's limited transportation funding in areas with potential for the greatest local and regional impact.

Local governments choose where and how to support and plan for urban centers. The challenge for DRCOG was to find opportunities to put additional support behind these local efforts while continuing to contextualize how important success in these places is to other regional goals related to transportation and quality of life.

Out of more than 50 member local governments that make up DRCOG, 25 have designated 104 urban centers throughout the region.

Such aspirations and visions are not enough. Land use decisions are a matter of local control. These public and private local decisions directly influence regional travel demand and, consequently, future need for regional transportation investments. However, the scope of information involved when supporting or opposing such decisions is local, or even hyperlocal. That is, it focuses on an area within a local jurisdiction, such as a neighborhood, or even a single block or set of neighboring properties. At the same time, local governments have limited ability to provide the same level of information about the regional economy that will ultimately shape growth and demand in this location.

DRCOG has conducted regional scenario analysis periodically over the last 25 years that demonstrates the relative regional benefits of focusing growth in urban centers. Such work has leveraged the agency's investment in data, as well as travel and land use forecasting models as a part of the regional transportation planning process.

These regional scenario analyses have helped establish and maintain the presence of urban centers as a part of DRCOG's Metro Vision plan for over 20 years. However, they provide little information for local staff, officials, and residents to employ in the local land use decision-making process, limiting the region's ability to achieve its shared, center-oriented growth strategy. To collectively reach the region's targets for urban center growth, all parties need actionable local information about current and potential future urban center performance.

Complicating this need is the fact that urban centers across the Denver region are diverse. Some urban centers already exist, but continue to evolve. Other urban centers are only just now beginning to see vertical development. Still other urban centers exist only as local plans. Consequently, understanding their collective and individual performance can prove problematic. Thus, in addition to the desire for information at the local level, the DRCOG Board of Directors continues to seek a better understanding of urban center performance as they debate regional transportation plans and improvement programs that place funding priority on these areas.

Product Implementation

Performance Measurement Framework for Highway Capacity Decision Making (C02)

DRCOG staff used the framework outlined in C02 to identify a set of performance measures by which to evaluate urban center performance. Staff maintained the goal to identify measures throughout the five broad topics of transportation, environment, economics, community, and cost. The steps are outlined below.

Step 1: Identify the most relevant factors within each topic or area to this application. The framework includes 18 factors spread out over the five topic areas. Staff knew that some factors would have more relevance in the urban center context than others that could have more relevance in the framework's intended contexts: individual corridor studies, project evaluation, or regional transportation plans. The potential value of pursuing measures under other factors was also diminished by concerns over data availability at a scale of 100-1,000 acres, while often ignoring boundaries of summary geographies, such as census tracts or traffic analysis zones.

Step 2: Brainstorm measures to pursue under the selected factors. The framework includes example measures for each factor. Staff considered, but did not remain limited to, such measures during this brainstorming

exercise.

Step 3: Refine list of measures. Staff considerations included feasibility, balance, applicability to urban center context, overlap or correlation between measures, and legibility to the DRCOG Board of Directors and other decision makers.

Step 4: Iteratively pursue data for each measure; refine or substitute measures as needed. DRCOG maintains access to significant amounts of data at various scales for use throughout the regional transportation planning process. Compiling this information by urban center was the primary source of many measures. The project included limited acquisition of additional data. Staff efforts to circulate a questionnaire among local staff of communities with urban centers were limited by a low response rate.

Step 5: Compile data on measures where possible and report. DRCOG staff compiled the information on measures where data pursuits were successful for the first round of analysis, while preparing the dataset for future reporting through online visualizations.

The steps outlined above progressively required more investment of time. Steps 1 and 2 were accomplished with little preparation and limited discussion. Experience with the urban center strategy, as well as potential audiences for this information, provided sufficient experience. Steps 3, 4, and 5 required an understanding of data availability, as well as the ability to research, evaluate, acquire, and/or adapt data sources. Labor required included geographic information systems (GIS) specialists and other data analysts. Existing DRCOG investments in platforms to help with data visualization and communication were helpful for Step 5.

Transportation Visioning for Communities (C08)

DRCOG staff focused on a portion of the visioning process outlined in C08 to use as the guide for collaborating with local government stakeholders as the agency explored how its existing investments in regional models and data could be applied in smaller area scenario analysis. For DRCOG, urban centers were the logical place to start. Components of the Vision Guide in C08 helped open the dialogue to uncover the questions local governments were trying to answer about these places, and compare those

questions to the types of questions scenario tools have the capability to answer.

Step 1: Assess capabilities of existing scenario planning investments. To allocate the regional population and employment forecast to traffic analysis zones, DRCOG relies on UrbanSim, which is a series of real estate development and location choice models. For regional travel forecasting, DRCOG relies on Focus, a 30-step, activity-based model built specifically for the Denver region by DRCOG and consultants from Cambridge Systematics.

The DRCOG implementation of UrbanSim required significant ongoing investment in parcel- and building-level data, as well as staff expertise in programming, statistics, land use regulations, and economics. Similarly, Focus required significant data for calibration and validation, as well as staff expertise in programming and travel demand modeling. The questions remaining for staff at the conclusion of this step concerned the sensitivity of these modeling investments to smaller changes.

Step 2: Unlock the predictive power of UrbanSim in small area scenario analysis. UrbanSim developers identified that the pro forma developer model could be a helpful tool in small area, sketch planning exercises. Other small area sketch planning tools rely on a normative approach to the future. That is, tool users conducting the exercise assert the development-related what-ifs for an area (e.g., building scale, use mix, and place type). This component of UrbanSim tests the feasibility of such assertions with the considerations a developer would use.

DRCOG built an online platform, Scenario Manager, that allows the user to change parcel-by-parcel assumptions related to zoning regulations, which are informed by local decisions, and real estate rents or costs, reflecting the role of the larger market. The platform connects to the square foot pro forma through the UrbanSim application programming interface (API), allowing the user to test building and redevelopment feasibility on the fly, rather than asserting that a given building could be produced. This brings a part of the predictive power of UrbanSim to what would otherwise be a normative exercise, helping blend the two approaches. It instantly visualizes a basic 3D building form on that parcel.

Step 3: Lead local government staff through an urban center visioning/scenario development exercise. DRCOG found five local governments with an urban center willing to help pilot this approach. DRCOG relied on key steps and questions throughout C08 to help derive the what-if questions to be tested with Scenario Manager. DRCOG developed and led a small group of each pilot government staff through a scoping and issue discovery questionnaire. Out of this information, DRCOG drafted a problem summary. Local feedback then allowed for DRCOG staff to focus in on the key what-if scenario questions to test, as well as desired scenario metrics with the creation of a scenario worksheet.

Step 4: Testing of what-if questions. After proceeding through the what-if question discovery process, DRCOG focused Scenario Manager efforts on the three local governments that had questions that best fit the tool's capabilities. DRCOG staff adjusted the baseline UrbanSim results with more input from local governments about their local plans and their what-if questions about growth and zoning regulations using Scenario Manager and ran the results through the Focus travel demand model.

The steps above represent a significant investment of staff time and expertise to develop the software tools needed to bridge the capabilities of predictive regional forecasting tools and a normative, small area scenario exercise. The project also required labor from staff with experience in land use planning to help understand and interpret the issues local government staff were bringing forward and translating them into testable what-if scenario questions.

Stakeholder Collaboration

Stakeholder collaboration for this project focused on the work around C08, deploying transportation-related visioning in local communities.

DRCOG initially engaged five local governments who had identified urban centers and designated them regionally through DRCOG and Metro Vision.

These local governments volunteered their time and insights to allow DRCOG to test their scenario analysis tools with DRCOG-jurisdiction collaboration. This collaboration was guided by the decision support research of C08 and PlanWorks.

Stakeholder collaboration primarily involved local government staff involved with planning, economic development, and infrastructure decisions at the local level. In all three cases that proceeded to the pilot phase, these local staff members had conducted public and stakeholder outreach, planning, and visioning that had resulted in prior plans, visions, or land use entitlements.

For a variety of reasons, these local governments wanted DRCOG to test the normative assumptions behind these prior plans and visions with predictive scenario tools.

One of the products of this collaboration was the creation of a problem summary to capture some of the answers to key questions in C08's Vision Guide. This included the identification of those with a stake in the outcome of a given urban center, divided into primary (key decision makers) and secondary (others affected) stakeholders. Many of these stakeholders had been engaged in previous local planning or visioning efforts, and were identified again as a potential audience for scenario analysis results.

DRCOG developed Scenario Manager to support the work of C08. The tool helps communities visualize feasible buildings in context (Figure 1).
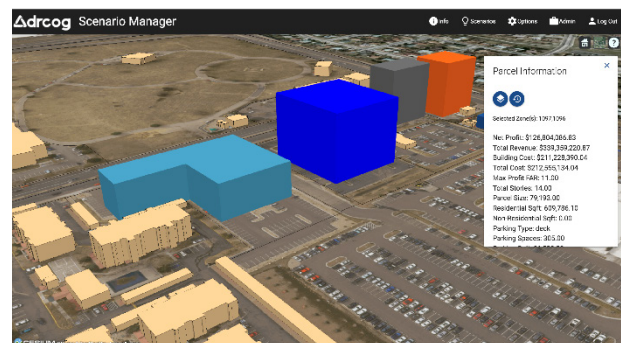

Figure 1: Screenshot taken from Scenario Manager displaying information for a selected parcel

Key Outcomes

• DRCOG staff identified 16 candidates for ongoing performance measurement of urban centers to help improve regional and local understanding of the role of these areas. Eight of these 16 candidates had a high likelihood of ongoing feasibility as longitudinal performance measures.

• DRCOG staff established a decision tree to create

and replicate a table or crosswalk to allow data aggregated by others at small area geographies (e.g., such as census blocks and traffic analysis zones) to be joined to custom urban center areas for use in performance measurement.

• DRCOG staff developed and worked through pilot testing with local governments to refine questionnaires, summary formats, and other worksheets to help the agency engage local government members. These materials were critical to developing testable what-if questions related to urban center visioning and planning. They will likely have ongoing agency value in urban centers and other small areas.

• Local governments and their DRCOG board members have a growing interest in the ability of DRCOG's predictive forecasting tools. This pilot work helped demonstrate demand for employing DRCOG's existing efforts to help inform their local planning and visioning decisions.

• DRCOG staff developed a custom software application, Scenario Manager, which was the first tool to interface with the UrbanSim API to access its square foot pro forma feasibility model. This allows a user to test zoning or rent assumptions as part of a scenario. The user can see feasible buildings options and instantly visualize one.

• DRCOG staff demonstrated the Scenario Manager tool among other metropolitan planning organization (MPO) land use modeling staff.

• DRCOG staff developed a more systematic approach to improve its land use modeling through interactions with and feedback from the pilot communities.

Lessons Learned

The landscape of software and tools to conduct scenario analysis is rapidly changing and evolving. For example, DRCOG had to develop Scenario Manager in-house after another tool that would help leverage UrbanSim failed to deliver a usable version to market.

Another sign of this rapidly changing landscape includes the emergence of sketch-based tools to estimate vehicle miles traveled (VMT). Such tools, as they mature, may become more viable alternatives to the multi-step, activity-based regional travel model at this scale of analysis.

For other reasons, the focus on such tooling may be premature. Few tools can really be billed as "off-the-shelf." While some normative tools do offer built-in defaults that can speed application, extensive exploration, testing, and/or "hacking" may be necessary to understand if such tools can work in each case, or with the given data inputs. This can be quite challenging when collaborating with a group of stakeholders that is creating their own set of what-if questions to test with these tools, and is further complicated by attempting to bring in more predictive analysis.

These predictive and regional tools, like UrbanSim and Focus, also showed limitations to explore small areas. DRCOG questioned the statistical soundness of using tools calibrated on regional data to predict housing and commercial developments and transportation behaviors around only a few parcels.

While other aspects of C08 focus on process and guiding questions, there are few aspects related to scenario planning software offered to help answer the Vision Guide's higher-level questions of "Where are we going?" and "Where do we want to be?"

In this context, software and tools are offered as menu choices. More guidance could focus on the techniques of data science and analysis development that are tool agnostic. Additional resources could help answer practitioner questions, regardless of tool at hand, such as:

• What are the types of questions one can test with confidence?

• How can one turn a question about the future into a testable hypothesis?

• What are the types and sources of assumptions required to explore different scenarios?

Next Steps

DRCOG is considering the following steps to continue advancing this work and integrate it in other agency practices:

• Create online, interactive visualizations utilizing the compiled urban center performance measure data.

• Collect additional observations of urban center

performance measures to test their feasibility as longitudinal metrics.

• Seek additional resources to help implement the extensive backlog of improvements and other desired features of Scenario Manager identified during pilot testing.

• Share agency experience with the Scenario Manager application with other interested agencies.

• Advocate for the role of predictive tools, such as UrbanSim, among a cohort of other regional planning agencies seeking to improve sketch-based scenario planning tools.

• Explore the potential to integrate the impact analysis generated by other sketch-based scenario tools (e.g., CommunityViz and Envision Tomorrow), which requires connecting the building forms generated by the UrbanSim and the building types or place types employed by these tools.

• Educate internal and external audiences on the benefits and limitations of predictive and normative tools when engaging communities.

• Generate and improve processes that facilitate exchange of information between DRCOG and local governments; demonstrate that better understanding of local aspirations helps inform regional changes; and, ultimately, improve local investments.

Connections to PlanWorks

Decision Guide

This work most closely connected to the corridor planning phase of the Decision Guide. Steps of this work most closely aligned with:

• *Approve Scope of Corridor Planning Process* (COR-1);

• *Approve Problem Statements and Opportunities* (COR-2); and

• A combination of *Approve Range of Solution Sets* (COR-6) and *Approve Plan Scenarios* (LRP-7) from the long-range transportation planning phase of the Decision Guide.

Applications

Three PlanWorks applications would have the most information relevant to ongoing work in this area:

• Land use
• Performance measures
• Visioning and transportation

Library

This work relied on two resources available in the PlanWorks Library:

• *Performance Measurement Framework for Highway Capacity Decision Making*

• *Linking Community Visioning and Highway Capacity Planning*

This work was also shaped by another resource in the PlanWorks Library: *Scenario Planning and Visualization in Transportation.*

For more information

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Resources

• Metro Vision
• Economics and Land Use at DRC