

# System Dynamics Shapes Informed Transportation Plans

Exploring how system dynamics is enhancing collaborative trend analysis for Southern California Association of Governments (SCAG)

September 8, 2022



**TODAY**

**FUTURE**

Establishing a system-wide vision is an increasingly complex activity for transportation organizations. Today, worldwide disruptive events and multiple influential trends must be considered when developing long-range policies and plans that support ambitious visions for transportation systems around the world.

The pandemic and remote working continue to affect transportation patterns and needs. The global urgency to decarbonize requires accelerated shifts toward alternative fuels and fleet electrification. Technological advancements are enabling greater connectivity and automation. The future of fuel prices and revenue streams remains unknown. These and other societal factors add uncertainty as agencies strive to shape plans and strategies that support equitable, sustainable and resilient transportation systems.

How can transportation agencies prepare holistic plans in the face of disruptive events and multiple influential trends? In the following Q&A, Richard Chavez—Vice President, Advisory Services, and National Long-Range and Strategic Planning Lead, WSP USA—explores how system dynamics, through a pilot project, is helping Southern California Association of Governments (SCAG) conduct multidisciplinary trend analysis to inform policies and plans. SCAG is the largest metropolitan planning organization in the United States, representing six counties, 191 cities and more than 19 million residents.

## How does the system dynamics process bring value relative to the traditional planning process?

**Richard Chavez** – As transportation and land-use planning become more and more complex, the need for better planning tools grows. Communities, stakeholders and decision-makers are demanding robust analysis these days. And the truth is, we know very little about the trends that will affect our ability to achieve decarbonization, equity, resilience and other societal goals. System dynamics helps teams organize complex trends and better understand their interrelationships. I see many transportation agencies immediately jump to travel demand modelling (TDM) for the right answers, and unfortunately it rarely works out. TDM is great for understanding car, truck and transit travel patterns based on a fixed set of assumptions, but the quality of those assumptions is key; so, there must first be greater understanding and consensus around the assumptions that become input for the models.

With so much uncertainty out there today, system dynamics is a great way to organize, collaborate and build consensus on the assumptions that go into TDM and the policy recommendations that guide long-range plans.

“WSP's system dynamics process has really helped us to better understand the interrelationships between complex trends. It has enabled our planners and modellers to collaborate and get to the center of issues. I feel we are now better equipped to deal with our most difficult policy and modelling issues.”

**Bayarma Aleksandr, Ph.D.**  
ABM Program Lead, Modelling  
& Forecasting  
SCAG

The WSP Scenario Planning Toolbox enables decision-makers to test how different assumptions can impact future transportation in cities and places around the world. The interactive system dynamics analysis tool, which can be adapted to local and regional conditions, allows multidisciplinary teams to collaborate on the interrelationships of trends for improved understanding, consensus-building and decision-making in the development of transportation systems.

The tool—developed by an international team of WSP experts in data and system analysis, transport modelling and system dynamics modelling—addresses questions such as the following:

- What decisions are needed today to guide the adoption of electric vehicles (EVs), connected and automated vehicles (CAVs), and shared mobility services?
- How effective can road-use charging strategies be for reducing congestion and emissions and creating sustainable revenue streams?
- Will increases in telework reduce freeway congestion but create more localized congestion due to increases in home-delivery services?
- How do these and other trends interact and influence each other?
- What transportation investment strategies will be most effective at creating better access to opportunity and a more equitable transportation system?

## What is the scope of the SCAG pilot project and how is system dynamics helping the organization to achieve its goals?

**Richard Chavez** – The pilot project with SCAG has been eye-opening. We [SCAG and WSP] started off with a bunch of unorganized transportation trends on a white board. We selected trends to investigate based on agreement that they were important topics of the day with some degree of interrelationship. The trends we settled on were electric vehicle adoption, telework, road usage charging, equity, revenue and emissions.

Next, we started organizing the trends using the WSP system dynamics platform to try to better understand their interrelationships. After discussion, trial and error, modifications, and guidance from our platform expert, the multidisciplinary team, including myself, began to better understand the complexities of the trends and their relationship to each other. We applied a set of quantitative assumptions, some from SCAG and some from WSP, to get 30-year trendline output from the system dynamics platform. It is important to restate that this was a pilot project and much more work will need to be done to get fully usable results, but we started to understand the relationships and tensions that exist between these trends and how they can be organized and evaluated. In addition, we achieved a high level of meaningful collaboration, which is often overlooked as a critical part of the process. Importantly, now the modellers and planners better understand each other's challenges, and this clarity sets the stage for improved long-term solutions.

“As modellers, we depend on good direction from the planners. There is not always common understanding of the technical issues, the capabilities and limitations of travel demand modelling, and the effectiveness of various strategies for goals like reducing emissions. System dynamics has been very useful in getting us on the same page.”

**Hsi-Hwa Hu, Ph.D.**  
Manager, Modelling  
& Forecasting  
SCAG

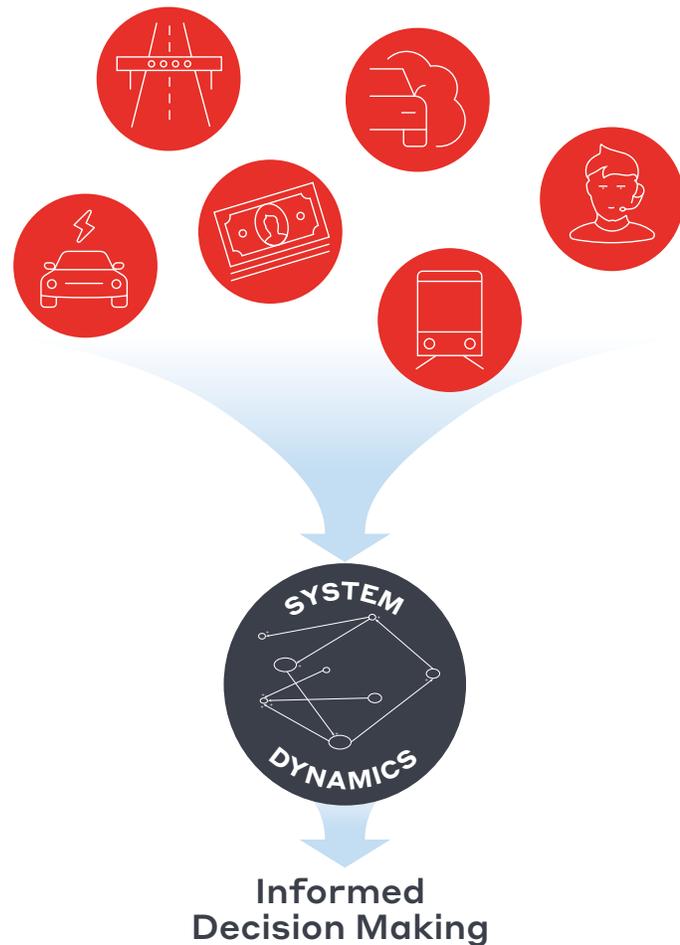
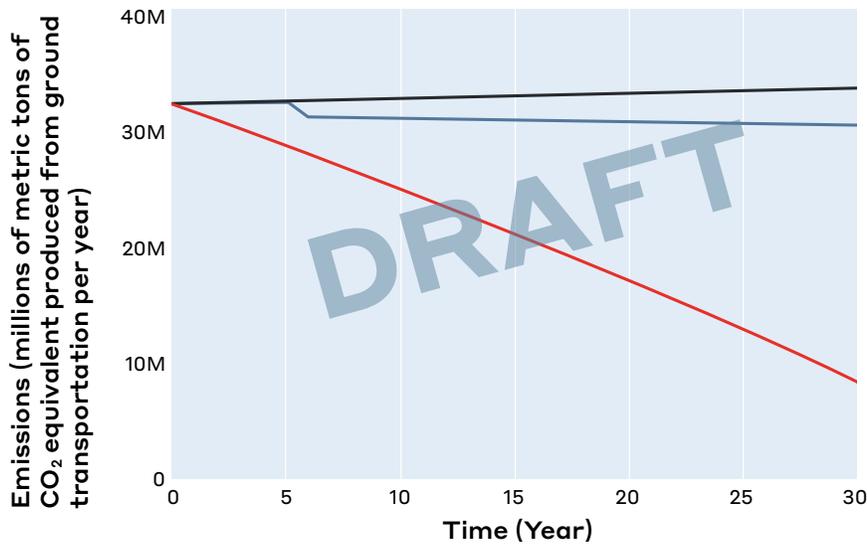


Figure 1 – Graphical representation of the system dynamics process

## When is the best time to incorporate system dynamics in planning, and how often should the process be carried out?

**Richard Chavez** – In my experience, system dynamics should be used, at a minimum, every LRTP [long-range transportation plan] update cycle, which is typically every four to five years. But exercises should also be done when there is a significant change-inducing event like a major shift in policy direction or when current strategies are not working out.

New trends and disrupters are occurring more and more frequently these days. As a result, there are many disciplines that are becoming more and more specialized and therefore more isolated and siloed. This situation creates the need for better ways to help us [transportation planners and modellers] collaborate and periodically update our thinking if we want to create adaptive long-range plans.



“WSP’s system dynamics process provides a way to understand and communicate the impact of different strategies, which will help to better direct our work as planners and improve decision-making in our region.”

**Sarah Dominguez**  
Program Manager II,  
Planning Strategy  
SCAG

Figure 2 – The draft chart represents the emissions reduction potential of various combinations of transportation strategies for the Greater Los Angeles region using demonstration data and the system dynamics platform; additional analysis would be required to verify results.

## In addition to enabling improved collaboration, how can system dynamics help achieve decarbonization goals and equitable outcomes in transportation?

**Richard Chavez** – Through the system dynamics work WSP has done internationally and now begun with SCAG, we have a large body of work on the cause and effect of various decarbonization strategies. We bring this knowledge to the table when working with organizations to help them understand the effectiveness of various decarbonization efforts. The nimble system dynamics platform helps fine-tune carbon reduction strategies before conducting time-consuming and expensive TDM modelling, which will bring even greater value when the inputs are well considered.

There is much work to be done to create more equitable transportation systems. To start, it is a challenge just understanding what an equitable transportation system might look like and what goals, policies and investments are needed to get there. The beauty of system dynamics is that the process is adaptive to any environment. System dynamics has been used by the military and business community for many years to plan, prepare and implement courses of action. I have great hope that system dynamics will help us solve some of our most daunting transportation challenges by creating more flexible and better-informed policies and plans—policies and plans that can benefit from new insight and help us to achieve more equitable transportation systems for the generations to come.

- ▶ Continue [here](#) to learn how WSP’s EV:Ready tool facilitates the strategic implementation of charging infrastructure.



**Richard Chavez – Vice President, Advisory Services**  
**National Long-Range and Strategic Planning Lead**  
**WSP USA**  
GlobalT&I@wsp.com