# Collaborative Development of Narratives and Models for Steering Inter-Organizational Networks

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***Abstract***
*The power to direct and manage change within metropolitan areas is increasingly dispersed among a loosely interconnected set of mostly local organizations, agencies and actors that form a special type of urban inter-organizational network. Increasingly, the quality of metropolitan regional governance depends upon IO network capacity to articulate systemically insightful urban development strategies, i.e., to exercise a capacity for network steering. We outline an IO network steering capacity-support process that combines collaborative learning, narrative storytelling, and system dynamics modeling with the goal of deepening insights into urban human/biophysical processes and securing greater resilience in metropolitan regional governance. Our process promotes comprehension of complex urban processes through stories about past trajectories and future growth scenarios that frame issues within collaborative learning workshops for deliberation by local opinion leaders. This initiative is part of a larger research study on greenhouse gas emissions in relation to human and biological activities within metropolitan areas.*

**Keywords:** Collaborative learning, narratives, system dynamics, steering inter-organizational networks

## Introduction

As our conception of government and its capacity for societal guidance changes, so too, does our approach to planning and decision-making. Increasingly, we recognize that the power to guide and direct change is dispersed among a variety of loosely interconnected organizations, agencies and actors. Within an urban context, we recognize organizational networks. Network members are typically aligned around a common set of concerns or functions, interact with regular frequency and adjust their sense of the possible one relative to the other in a pattern of mutual interdependency. This occurs, for example, in the pubic welfare community as state and local welfare agencies interact frequently with not-for-profit and charitable welfare service providers, welfare client advocacy groups, state legislative sub-committees and corporate-sponsored advocates for more limited government. We refer to these constellations of relationships as networks of inter-organizational (IO) relations or IO networks (see Ebers, 1997).

As the governance of regionally organized political communities depends increasingly upon the capacity of IO networks to initiate and consolidate concerted action, the question of network steering looms ever-more present. The question of

network steering is fundamentally an epistemological question: how and in what manner does an inter-organizational network come to know its own best interests? What capacity does it have to monitor, envision, analyze and assess its options for the future? What means does it have to surface hidden assumptions, uncover covert agendas and negotiate differences of persuasion? How does it frame issues, expand or collapse the temporal and spatial scope of issue delineation, and delineate the inclusion or exclusion of relevant stakeholders? How does it contain the tendency to over-simplify reality to better privilege selected interests? How does it reach beyond the grip of linear thinking to conceptualize its domain as a domain of uncertainty, complexity, and non-linearity?

We raise these issues against the background of a specific set of circumstances. As investigators on a National Science Foundation Biocomplexity Program grant, we are developing a framework through which to better understand the formation and sequestration of urban trace gas emissions in Utah's Salt Lake Valley, the core urban center of a metropolitan region strung linearly along major north-south valleys at the western face of the Wasatch Mountains, a high mountain desert region of 1.2 million urban inhabitants living in what is know locally as the Wasatch Front.

The Urban Trace-gas Emissions Study (UTES) seeks to understand the dynamics of urban development that shape future trajectories of global greenhouse gases such as carbon dioxide, water vapor and volatile organic compounds. We are developing a system dynamics model of urban growth and change and tuning it to local historical observations on indicators of urban system performance. The model is enabling us to experiment with alternative long-term urban land use and transportation policy options to learn how policies affect urban land consumption, traffic congestion, atmospheric emissions and other indicators of urban system performance.

In concert with model development, we are engaging local decision makers and opinion shapers in collaborative learning (Stahl, 2000). Our goal is to explore the degree to which a group-mediated dynamic systems modeling activity might facilitate the emergence of a more complex and foresighted consensus about the operation of and future options within this policy domain.

Engaging decision makers and opinion shapers leads us to focus on the set of IO relations organized around issues of urban growth and development. In particular, we are interested in the subset of agencies and IO relations associated with land development and transportation facility investments. These include departments of transportation at all levels of government, the state transportation commission, the metropolitan planning organization, the state quality growth commission, the regional public transit authority commission, leaders of regional growth visioning projects, a cluster of smart growth and balanced transportation advocacy groups, an assortment of construction and engineering firms, a home builders association, a local board of realtors, a local organization of urban planners and plan commission members, and several key mayoral staff members (see Table 1).

We approach these two initiatives with specific research questions in mind. Can an urban systems simulation model help researchers articulate a compelling storyline about how cities work? Can the resulting narrative storyline be instrumental in engaging the imagination of decision makers and opinion shapers? Can we collaboratively design an iterative process for a mutual accommodation between (1) an urban narrative that will be generally accepted by network members and (2) a system dynamics model we mutually

rely upon for policy exploration? Will a mutually accepted urban narrative serve to effectively empower an inter-organizational network to consolidate purpose and initiate concerted action?

This is the background to a complex research challenge that should lend insight into the roles that collaborative learning, system dynamics modeling, and narrative storytelling might play in answering unresolved question about how to secure a degree of coherent regional governance through inter-organizational network steering.

**Approach**

UTES is not only the acronym for the research project called Urban Trace-gas Emissions Study, it is also the name of a local Indian tribe whose native territory the State of Utah derives its name. The study is a three-year inter-disciplinary effort that involves researchers from seven different colleges on the University of Utah campus.

The three thrusts of the research include measurements, process studies and community involvement. Measurements seek to distinguish anthropogenic and biogenic sources of $CO_2$, define the chemical composition and source of volatile organic compounds, measure the concentration and size distribution of particulate matter, identify the rates of vehicle and building-based fuel consumption within specific neighborhoods, and to track thermal and gaseous fluxes emerging from neighborhood-scale observations.

Process studies include three related efforts. The first effort seeks to delineate how trees and urban forests influence, through shade and evapo-transpiration, both urban temperatures and urban humidity levels. The second effort seeks to simulate the self-reinforcing feedback relationships between urban land development, urban transportation system investments, land developmental density declines and per capita vehicular use. Developing an understanding of these relationships enables us to explore the implications of alternative policy choices on fuel use, atmospheric emissions, public health, environmental remediation and basic sector job formation. Finally, the third effort seeks to understand the dynamics of urban heat fluxes and simulate the long-term effects of urban morphologic change on the build-up and dissipation of heat in urban areas and subsequent effects on fuel consumption and atmospheric emissions. All three efforts are to be merged into a single urban dynamics simulation model focusing on the interactions between human and biophysical dimensions of an urban ecosystem.

The community involvement phase will test the social significance of scientific measurements, process studies and simulation models. Here the basic questions are straightforward. Does any of this research matter? Will it change opinions about what needs to be done to better manage urban affairs? Can we develop a process that will lead to urban policy choices that reflect observations and insights developed through research on urban human and biophysical processes?

Multiple strands of social theory and intentions guide us with regard to this last question. From Anthony Giddens (1984) and Patricia Healey (1997), we draw upon an "institutionalist" conception of the simultaneous interdependence and joint determination of both institutional practices and individual choices. This provides a window on the way both institutionalized social and political relations as well as personal choices influence current patterns of land use, transportation planning, fuel use and atmospheric emissions. These authors help one to see the work of participants in local governance as part of an

ongoing process that shapes both urban planning decision practices and individual choices and behaviors within the city.

We draw on Habermas's Theory of Communicative Action (1984) and its intellectual derivatives in urban planning (Forester, 1999; Innes, 1995) to better understand discourse ethics and the normative principles for evaluating the quality of communications that under-gird planning decisions.

State and local governments are under continual pressure to reorganize the principles and practices of metropolitan regional planning. We rely on the insights of Sassen (1991), Peirce (1993) and Orfield and Rusk (2000) regarding the increasing obligations of metropolitan governance structures to secure for their regions a viable role within an emerging global hierarchy of competing city-states. We see in this literature a way to link the concerns of local urban policy decision makers with a variety of global-scale processes issues including greenhouse gas emissions.

Castells (1996) draws attention to the diminishing role of semi-autonomous bureaucratic authority in pubic governance and the increasing devolution of governing powers to diffuse networks of individuals, agencies and organizations. Geerling (1999) employs this trend in his discussion of planning as network steering within IO networks focused on the management of urban affairs. We rely on both for comprehending opportunities for the integration of research findings and collaborative deliberation procedures into the steering function of an urban IO network.

We draw on Richmond (1992) and Ford (1999) for instruction on the design and development of system dynamics models. We combine these skills with insights on urban dynamics from Newman and Kenworthy (1989) among others to construct a dynamic urban system simulation model. The model's dynamic organizing principle is grounded in the observation that most cities, when faced with traffic congestion, build more roadways that induce more urban land development at increasingly lower densities thus generating increasingly more traffic for which increasingly more roads need to be built. This self-reinforcing process causes urban land consumption, traffic generation and urban road building to greatly outpace underlying population and employment dynamics (Emmi, 2003). If not successfully dampened, the feedback mechanism leads to fiscal, human health and environmental effects that undercut the region's continued capacity for basic job formation. After a slow overshoot-and-collapse, lowered rates of basic job formation drop the region to a new equilibrium at a lower standard than could have been otherwise obtained.

Donald Michael (1973) provides inspiration regarding the possibilities of organizational learning. Checkland (1990) and Peter Senge (1990) tie systems thinking and the construction of mental models to the organization's learning process. Daniels and Walker (2001) show how collaborative learning can be used to resolve conflicts within and among organizations. Vennix (1996), Stave (2002) and Peterson et al. (2004) combine these and proceeding ideas together for instruction on group mediated dynamic simulation modeling as an approach to environmental consensus building.

Finally, our thinking is informed by the work of Throgmorton (1996) and Beauregard (2003) on the importance of persuasive, locally grounded, urban narratives. These authors suggest that persuasive urban narratives might be transformative devices for helping protagonists in a planning process re-envision the systems they seek to manage and the broader effects of their management preferences on both the welfare of others as well as

their collective futures. Yet, because of the contributions of Scott (1998) and Flyvbjerg (1998), we remain alert to the way power seeks a self-serving simplification of urban narratives. In defense of this possibility, we recognize the need to frame urban narratives, as Lakoff (1997) instructs, in a language that is not automatically off-putting to those whose most invested in simplified narratives.

**Computer-Aided Story Telling and its Role in Consensus Building**

We are implementing the approach outlined above as a central effort within the UTES community involvement initiative. First, we develop and tune a systems dynamic model of the Salt Lake Valley to capture the essential dynamics governing urban sprawl and congestion. We ensure that it replicates accurately historic observations. We explore alternative urban policy options. We define baseline and alternative policy scenarios as well as their effect on the management of congestion and sprawl as outlined by Emmi and Forster (2003) and Emmi (2003). We attach to the basic model the extensions needed to capture urban fiscal management, fuel use and atmospheric emissions that are associated with different transportation regimes and land developmental densities. We infer the implications these have on fiscal capacity, public health and environmental remediation and indirectly on basic job formation within the region.

Second, we rely on our urban systems modeling experience to draft an urban narrative about the region's recent history and possible future. At first the narrative is impenetrably mechanistic and heavily burdened with statistics. The sequential progression of the story is driven by a disembodied logic and fails to frame the essential issues in terms and metaphors that correspond to local values.

Third, the narrative is re-cast to be more effectively transformative. Main objectives are to preclude the over-simplification of urban realities, project the vision of a manageable future, identify the existence of a mutually beneficial solution set, and point out the benfits of consensus around workable strategies for addressing pressing problems. This is done with conscious awareness of the need to evoke both a rational and an emotional response. The sequential progression of the story is advanced so that it begins with the end, that is, with a threat to the continued economic vitality of the region. The language of the story is reframed in metaphorical terms to represent the city as a difficult and dangerous place that must be made good through the application of discipline and moral authority or else be cut free to face the discipline of a callously competitive world (Powell, 2003). This "strict father" metaphor accurately reflects the model's dynamic organizing principle and thus the narrative's underlying message while framing that message in terms acceptable to most members of the local IO network. The resulting urban narrative is reproduced in Appendix I.

Fourth, we confront the likelihood that, while we may have a message, we are not the right messengers. So we intend to organize a group of five to seven local opinion leaders with whom we can work collaboratively to re-draft an urban narrative that will be accessible to a broad range of decision makers and policy shapers. We expect that this may require group exploration of our urban system dynamics model, and we are prepared to engage in that if needed. We hope this will produce an even more transparent version of the narrative supported by more extensive visual and graphical representations of the

basic argument. Since the region has produced a core of opinion leaders who are forward thinking on these matters, we are confident that a suitable panel can be assembled.

Fifth, we will identify roughly twenty decision makers and opinion leaders to participate in workshops focused on learning about the future of our local region. These people will be drawn from larger lists of individuals, agencies and organizations influential locally in urban land use and transportation planning (see Table 1).

**Engaging Opinion Leaders and Decision-Makers in Collaborative Learning**

The UTES team is in the process of engaging local opinion leaders and decision-makers through a series of five, one-half day workshops intended to develop an improved understanding of how their planning/management decisions might affect urban atmospheric emissions. We will be using a collaborative learning/mediated modeling process that helps opinion leaders and decision-makers appreciate more fully the roles they play in urban processes. In doing so, we trust they will tend increasingly to endorse actions that respond to a deepened view of urban dynamics and will lead to a series of beneficial results.

The first workshop will be held in Salt Lake City on July 18, 2004. We will report preliminary results from this workshop in our oral presentation.

One of the main purposes for the workshops is to create an environment that facilitates joint learning among all participants (including the research team), and that builds political capital by laying the foundation for additional collaborative learning (on any topic) among local opinion leaders and decision makers. The workshops are designed to accomplish the following objectives:

1. Inform participants about the reasons why atmospheric trace gas emissions reductions should be considered,
2. Relate trace gas emissions to the co-produced criteria pollutants that are more central to the planning/management issues of concern to the participants,
3. Involve participants in joint discovery of cost-saving advantages of emissions reduction, and
4. Integrate the diverse perspectives of the participants who all play a role in making decisions that impact emissions reduction in the region.

The 5-workshop series begins with an assessment of the knowledge base of the participants. Assessment results will be used to develop subsequent workshop learning/modeling activities. The workshops will incorporate the diverse perspectives of participants and present balanced information that illustrates the importance of emissions reduction in both technical and practical terms. In addition, the difficulties and benefits of implementing emissions reduction strategies will be outlined and the need to develop interactive relationships between participants will be surfaced.

Our workshop strategy focuses on collaborative learning between the UTES team and workshop participants (Daniels and Walker, 2001). UTES team members will be involved as presenters and observers who exchange ideas with the community participants. This approach provides opportunities for participants to discover common ground and negotiate mutual benefits. By working within a learning format, participants

with varied values, interests, and insights can establish a common understanding with diminished fear of practical, political impacts. This encourages participants to integrate individual perspectives with systemic views to everyone's mutual benefit.

Participants in the workshops will include decision-maker and opinion leaders recruited from the businesses, agencies and organizations given in Table 1. The first workshop will serve five primary functions: participants will (1) identify and discuss the interests and concerns; (2) discuss the value of taking a systemic perspective toward complex problems and how collaborative learning helps all to do so; (3) receive training to facilitate collaborative discussion skills; (4) collaboratively decide what further information will be needed, who might provide that information, and at which future workshop it would be presented and (5) self-select for participation in subsequent workshops.

An urban narrative outlining urban human/biophysical processes and alternative urban development strategies will be distributed to inform prospective workshop participants during the recruiting process and will play a key role in the collaborative learning process. We expect to some degree during every session that an evolving urban narrative will serve as a vehicle for integrating systems theoretic concepts with the adoption of shared labels, language and meanings and the comprehension of urban and biophysical processes.

These three narrative-based processes will help achieve ongoing objectives with respect to participants developing a common knowledge base on major issues, gaining conceptual sophistication about urban processes, and collectively deepening the urban narrative itself. These functions will also help participants instruct research team members on how to enrich both the urban narrative's constructs as well as the urban simulation model's treatment of narrative constructs.

In the 2nd workshop we will draw upon the urban narrative to create conceptual system maps of how the urban region works and how the parts interact to create an urban dynamic that is not easily known without a systems view. In the 3rd workshop we will refine the conceptual model maps created during the second workshop. Decision makers will send the research team away with requests for the assimilation of their ideas into a quantitative model. The team members will bring the requested model to workshop # 4. Workshop # 4 will require access to computer workstations and will be a modeling workshop. This session will include learning to work with the system model's user interface to explore the outcomes of various developmental alternatives. Participants will suggest revisions of all sorts including new alternatives they might see as important. If they ask for things the modelers know are not possible to produce, the modelers will say so, and will explain why. Workshop # 5 also will require the workstations for the continued collaborative design of experiments in urban development and emission reduction strategies.

During the final workshop, participants will work with the modelers to design and simulate experiments that will answer questions about the consequences of various urban planning/management strategies. Participants will present the results of their explorations to each other and UTES team members. We hope that growing competency will enable the participants to learn how to use the systems model independently from UTES team modelers. This, in turn, should enable them to simulate scenarios associated

with planning/management alternatives that are of particular interest to their parent organizations and their constituencies.

Throughout, workshop participants will continue developing their communication skills and their knowledge base while contributing to successive revisions of the narrative. In addition, they will work with modelers from the research team to develop and test a simulation model for urban activity levels and trace gas emissions.

Participants will work together to refine a succession of narratives and systems maps, developing them as guides for systems modeling. This will involve translating narratives and maps represented linguistically and diagrammatically into iconographic representations that collectively form the quantitative systems model. This translation, or quantification, will be grounded in theoretical concepts, data, empirical correlations and expert opinion. Modelers from the research team will lead participants through this translation and make participant-induced adjustments between successive workshops (Fig. 1).

The revisions need not capture a collective perspective; probably they won't; instead revisions will reflect the participant's diverse perspectives. Also, because the model they are building will have multiple alternatives, and the continual possibility to develop new alternatives, it should serve well to mediate between differences among participants with substantially diverse interests and perspectives regarding urban processes and atmospheric emissions.

The systems-modeling process and the urban narrative revision process complement one another. Both facilitate collaborative learning among participants and UTES team members enabling all to share their learning with others (Vennix, 1996).

These complementary processes should deepen participants' understanding of the impacts that various urban policies have on the region's future trajectory. This should be beneficial for participants as they interact with their agency staff and their constituents and lead, in turn, to a sense of ownership over the process. Should these things occur, it would make the modeling process and the political capital it builds substantially more important than the model itself (Peterson, Kenimer, and Grant, 2004).

After the workshops are done, the resulting urban narrative will be distributed throughout the IO network. A description of how it evolved will accompany the narrative. Comments and critiques will be invited and responded to. The narrative, comments and responses thereto will be both re-distributed and forwarded to the relevant governmental agencies for assimilation into their plans and project designs. These will specifically include the region's metropolitan planning organization, its regional transit authority, the state transportation commission, the state department of transportation, the state quality growth commission and concerned county and municipal leaders.

**Discussion**

The approach taken here represents a variation on emerging practice in mutual learning through group-mediated model building. It seeks to deploy the proposed variation as a way to engage in collaborative inter-organizational network steering. The variation emphasizes the importance of both collaborative learning and narrative story telling. Drafting an initial urban narrative is closely linked to the power of systems thinking and system dynamics model building. Successive revision of a persuasive, in-

depth and broadly reviewed urban narrative represents good practice in collaborative learning and is advanced as a means for creating participant ownership over the deliberative process. Ownership is assumed to be necessary for the adoption of deeper understandings by opinion leaders and acceptance by IO network members. (Participant ownership over the evolving urban simulation model is indirect. Participants will understand that the model and the narrative tell the same story yet they will not be asked to nor should they prepared to "own" the model.)

On the critical side, the process takes lots of time. We expect that the use of an urban narrative will shorten the time it typically takes, since the narrative will serve both workshop participants and IO members as a vehicle for integrating systems theoretic concepts with both the comprehension of urban human and biophysical processes as well as the adoption of shared terms, language and meanings.

The ongoing UTES project admittedly deals with powerful actors and is embedded in a deeply political context. We are not dealing with technocrats, mid-level bureaucrats nor under-funded representatives of public interest advocacy groups. Our corroborators are instead senior-level policy decision makers and well-regarded public opinion leaders. These are "people of substance" whose time and patience is limited, people who are accustomed to defining agendas and not having them set a priori. These are not people who should be expected to follow a detailed line of reasoning into the interstices of a system dynamics model. In their world, analysis and reason are weak tools. To an important degree, we will need to de-politicize the workshop environment by emphasizing its focus on collaborative learning. But most will both expect and understand that important political issues are just beneath the surface. Correspondingly, the urban narrative will need to be de-politicized by representing it as a statement in advancement of the public interest.

In this regard, our project is clearly hazardous and should not be tried at home. To the degree that our chances of some success are better here, it can be attributed, in large part, to regional contextual variables. The issues we are addressing have been under discussion regionally for over eight years. Proponents of extreme positions have been largely isolated. There is a strong sense of community and a genuine desire to address the issues. There is a strong tradition of political cooperation so long as alternative resolutions remain within pre-established bounds and existing authorities remain intact. We have yet to learn whether our project will explore solutions within these bounds or be thought of as disregarding them. To an important degree, sensitivity to boundary issues is more important than sophisticated collaboration techniques.

## Conclusions

We have outlined a complex project of research and community involvement that envisions the collaborative development of urban narratives and dynamic urban simulation models as an approach to meeting two goals – deepening insights into human and biophysical processes in urban environments and securing a degree of coherent metropolitan regional governance through inter-organizational network steering. We rely on collaborative learning workshops with opinion leaders and decision makers from the inter-organizational network to better mediate among divergent perspectives on how urban regions should be planned and managed. We rely on narrative story telling because

narration is the approach humans use to explain and rationalize action in complex social and political contexts. We observe the frequent use of over-simplified narratives often leads to ill effect. We think more complete and dynamically complex stories will improve both process understanding and regional governance. We think reliance upon narratives will be more efficient than otherwise and that they will serve to integrate systems theoretic concepts with both the comprehension of urban human and biophysical processes as well as the adoption of shared terms, language and meanings.

Initially, we employ system dynamics modeling to assist in the collaborative exposition of a dynamically complex narrative. Later, we iterate between system dynamics modeling and narrative exposition to explore and enrich the internal structures of both story and model. Upon completing the workshop series, we circulate the urban narrative among IO members together with a description of how it was derived, invite comments, and respond to each. The narrative with comments and responses is redistributed with a directive that its elements be incorporated into public plans and project designs – a procedure that resembles an environmental impact review process as specified by regulations pursuant to the National Environmental Policy Act of 1969.

Our research team brings a history of practical public involvement, mediation experience, modeling competency, scientific measurement capacity and planning theoretical insight to the project's design. The project itself must be regarded as an experiment. Its outcomes will be known, in part, by the quality of its product and the ownership participants take in the process. These can and will be assessed. But the ultimate impacts on our goals for deepened process insights and improved regional governance will be discerned only slowly through time by the unreliable means of anecdotal evidence and individual assessment.

**Acknowledgement**

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## Appendix I – Urban Narrative

### Development Strategies for Utah's Wasatch Front: Toward a 'Win-Win' Urban Future[1]

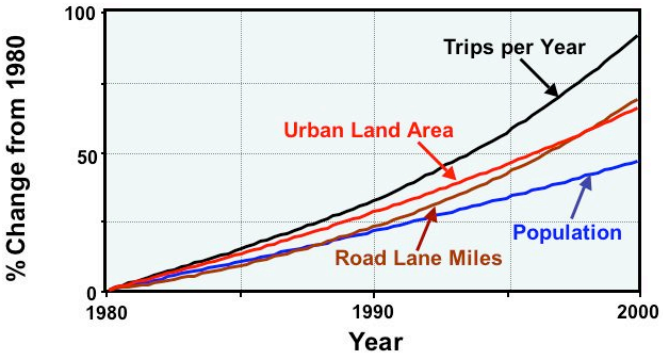
National recessions reveal strengths and weaknesses in regional economies. During the previous three recessions, the economy of Utah's Wasatch Front showed remarkable resilience. Yet during the most recent recession, a new pattern emerged that shows the area's recession-based job losses to be concentrated among higher-paying industries.[2] As a possible precursor, the National Science Board notes that between 1995 and 1999, Utah lost science and engineering jobs, dropped in patents production and experienced a 26% decline in the proportion of U.S. patents filed locally.[3]

We are a people demonstrably concerned about quality growth. Do these changes suggest that the Wasatch Front may be loosing its ability to create, attract and maintain quality jobs and quality industries?

Trends in urban system performance suggest that, if this is not now so, it may soon be so. Consider changes in the urbanized parts of the Salt Lake-Ogden metropolitan area across the most recent two decades. For every 2 urban dwellers, there are now three – an increase by one-half. Urban land use and urban roads miles have increased by two-thirds. Vehicle trips have nearly doubled, and the road gap – the difference between actual and desire road capacity –is up by a factor of five.[4]

Breaking the Cycle of Sprawl and Congestion. We have modeled these changes mathematically with a high degree of accuracy and verified the existence of a self-reinforcing feedback mechanism that slowly but inexorably impels this region toward declining developmental densities, increasing road densities, and growing traffic congestion. These trends portend more extensive atmospheric emission control technologies, growing public service costs and increasing local taxes.

Yet these same models show that it is possible to avoid this consequences with policies that constrain sprawl and defeat congestion. Four things must be done in close concert to succeed. (1) Reduce by one-fifth the proportion of daily trips made alone in private cars. To meet this objective, use car pools, reliable transit services, light rail, commuter trains, taxies, road tolls, bike paths, usable walkways and real parking fees. (2) Increase by one-tenth the traffic capacity of existing roads. Synchronize traffic lights, control on-street parking, limit left-hand turns and control the timing of freeway on-ramp entry. Link up local streets, collector and arterial roads where interrupted by geography, land use or jurisdictional boundary. Make the existing grid street system truly functional. (3) Increase developmental densities by 20 percent. On the land where five new buildings would otherwise be built, build six. To do this, substitute within each square mile one 80-unit garden court project for one 10-acre low-density subdivision. For greater proximities, vary densities and mix up land uses. For greater connectivity, articulate nodal points and corridors where related urban activities are concentrated and easily linked. For greater efficiency, mix in housing and jobs nearby one another. For greater equity, intermix single homes, condominiums and garden apartments. This will also lower trip frequencies, shorten trip lengths and save on municipal infrastructure costs. (4) Having reduced the sprawl-related propensity to increase trip making, respond more quickly to the need that remains. Meet the now reduced need for new roads by building in



three years what would normally take five. This will reduce traffic congestion due to road-building response lags.

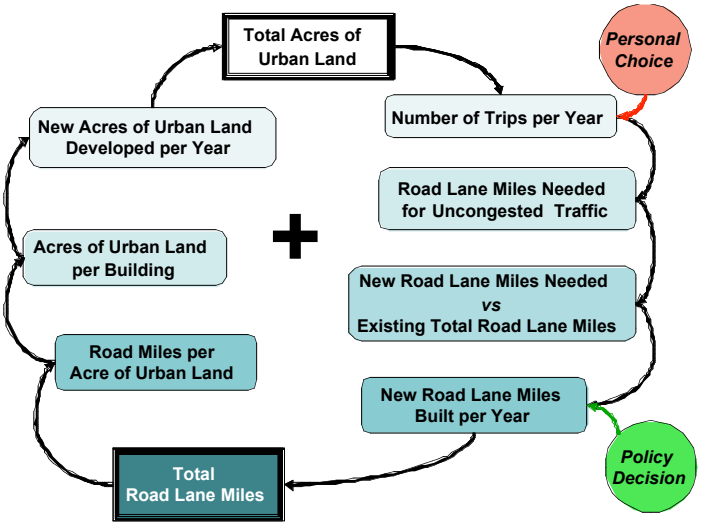
Our simulations show that implementing these measures over a six-to-eight year period will slow urban density declines by half and return congestion delays to levels last seen in the mid-1990s. Our simulations demonstrate that imposing this discipline breaks the cycle of urban sprawl and traffic congestion.

The Structure of Self-Reinforcement. The needed discipline in urban policy implementation is increased by an awareness of what the alternative entails. A continuation of current trajectories portents a baseline urban future where sprawl and congestion that:

- undercuts the region's economic and fiscal vitality;
- exerts an effective drag on the region's ability to attract and retain footloose industries, skilled professionals and amenity-oriented residents; and
- draws its community and corporate interests along increasingly divergent paths.

Sprawl and congestion relate to one another as a self-reinforcing feedback loop articulated through the processes of urban land development and urban road construction. As is well know, new urban land development generates new trips. New trips congest existing roads and add to the demand for more roads. New roads induce declines in urban land developmental densities so that the next round of urban land development generates even more new trips and adds to the demand for even more roads.[5] The dynamic is more readily understood when the individual steps of the process are unpacked.

The population of the Salt Lake –Ogden SMA has been growing at a rate of 1.9% per year compounded annually over the period 1980 - 2000. This population required an average of 2.6% more land per year compounded annually for homes and workplaces. These places generated traffic at a rate of 3.3% per year compounded annually. To ease congestion, we built roads at the rate of 2.7% per year compounded annually. Part of the reason trips grew faster than roads is because the new roads facilitated further land development, always, slowly, at lower densities than before resulting in an overall density decline of 0.7% per year compounded annually. This is consistent with national empirical studies that suggest a 0.25% decline in developmental densities for every 1% increase in urban road lane miles.[6] Model simulations suggest that had developmental densities not declined, traffic would have grown at the less rapid rate of 2.6% per years compounded annually and would not have outpaced the rate of road building.




So with every new road lane mile, households and jobs are located a bit further away from one another. The density of opportunities declines in both city and suburb. People have drive a bit further to get things done. They use the car a bit more often to make

needed trips. They need more roads to handle the added traffic along side of which they build more buildings at still lower densities and travel still further to get to and fro.

A one percent growth in road lane miles encourages a quarter percent decline in developmental densities and a quarter percent increase in traffic. With the effect of declining densities added to underlying increases in people and jobs, traffic grows faster than does overall roadway capacity. Drivers need more travel time to deal with congestion, more money for proximate housing and reliable transportation, more workers per household to meet the costs, and for each worker at least one car. So the conclusion begins to dawn: it makes little sense to build more roads and develop more land without plans to keep each from requiring more of the other.[7]

Baseline Scenario. Since Utah County established the state's first Planning and Zoning Commission in 1941, the counties and cities of Utah have committed substantial resources to urban planning. This has helped considerably at the neighborhood and municipal scales. But the state's largest urban region has no *coordinated* land use and transportation plan that functions at the metropolitan regional scale. It has no plans for land use that do not presume more roads, none for urban roads that does not presume more ever-lower density urban land development, none that seeks to limit both sprawl and congestion, none that creates closely coordinated transportation and land use choices and promise an end to increasing transportation, housing and environmental costs. As a result, current trajectories will likely continue into the future.

Here in brief is what our model says current trajectories will be. From 1980 to 2020, urban population in the Salt Lake-Ogden area increases by 110% - more than doubling in forty years. Urban land increases by nearly 200%. Urban roads – everything from highways to local streets - increase by more than 250%. Vehicle-trips increase by more that 300%. With local traffic circulation made difficult by the design and layout of residential subdivisions, a growing proportion of vehicular traffic shifts toward highways and arterials. Sometimes the highways are fast, but they also become increasingly unreliable as weather, accidents and congestion render then inoperable. Traffic congestion will get to be five times as bad as in 1980. These trends give raise to thoughts on related issues of energy consumption and atmospheric emissions.

A Poorly Hedged Bet. Big lots, big cars and big roads play roulette with air quality, federal highway dollars and urban economic futures. The assimilative capacity of the region's urban air shed is nearly used up. The air shed edges on non-compliance with several federal ambient air quality standards.[8]

With rapid growth in vehicular traffic, following the current trajectory places a poorly hedged bet on continued technologic progress in reducing vehicle emissions. Given an urban air shed at the margin of non-attainment, *continued development along current trends implies a bet that emission rates will decline faster than vehicle use increases.* Continuing along the current path bets that air quality standards will not become more stringent even as scientists learn more about the health and environmental effects of atmospheric emissions. And it does so while indirectly encouraging, through ever lower-density development patterns, the continued growth in vehicular traffic. Any gambler will tell you that *this is a poorly hedged bet.*

A poorly hedged bet limits future options. This one entails an expensive commitment to an air emissions technology fix. Without one, growing vehicular traffic will overwhelm the region's air shed.

Unconstrained sprawl and congestion portend other consequences of concern to both public and private actors. Davis County expects to use up all available land for development by 2030. In Salt Lake and Weber Counties, little land will be left to develop that is not remote from employment centers. Those who can only afford residing in remote locations will see their household transportation costs go up. Others will find more proximate housing bid up substantially. The less wealthy will be most affected. Under the current path, the proportion of income needed for housing and transportation will grow even more rapidly and affect an ever-larger majority of Wasatch Front families.[9]

School districts will close more central-city schools, open more suburban schools, and charge more taxes to get the job done.[10] Suburban municipalities will find it evermore costly to provide infrastructure and services to increasingly lower-density neighborhoods, while inner city municipalities will endure the premature obsolescence of existing infrastructure.

Hoping to capture more revenues and to put off an inevitable property tax rate increase, municipalities will compete more vigorously with one another to encourage business relocations to sites near newly built highway interchanges. They'll do so without acknowledging that both the highway interchange and the relocated businesses will attract additional residential development which, with low densities and high service requirements, will fail further to pay their own way. [11]

Competition among municipalities will create additional inequities between newer and older urban areas. Inter-jurisdictional competition will exacerbate municipal fiscal problems. For most municipalities, it will result in higher local taxes and fees, inefficient municipal service expenditures and lower public services. The local success of a few municipalities will undercut the region's overall ability to maintain quality service and development throughout.[12]

Congestion, pollution, health concerns, housing costs, transportation costs, and taxes – after some time lag, the region's reputation for providing a high quality of living may diminish. Skilled professionals, footloose entrepreneurs and amenity-oriented residents may be reluctant to come. Some of those already here may consider moving elsewhere. The high quality of the region's labor pool and its employment opportunities may be harder to maintain. Business may regard this place as offering an increasingly less favorable business climate. Households may grow concerned about issues of community livability. A region that now enjoys an excellent reputation may no longer compare so well with competing urban regions.

Those concerned about such matters may find themselves in 10 to 15 years cut free from the good regard of fellow Americans to face the discipline of the outside world. Jobs would grow more slowly. Unemployment, long below national averages, might move up to and then above national averages. Out-migration would increase. Population growth would slow. If so, employment in the construction industry would decline. Real estate sales would do likewise but even more rapidly. Hard limits would prevail. Budget discipline would unravel under the pressures of short-term concerns. The region would establish a new economic equilibrium but at a lower quality of life than otherwise could have been attained. And no one in particular could be held responsible.

A Harmonization of Interests. These untoward events need not be endured. The recommended urban policy measures will move this region along a happier path. The

recommended measures are not new. Many organizations have been advocating them for years. What's new is the recognition that they must be implemented comprehensively, in concert and with discipline.

Historically, Americans have sought unsuccessfully through an evermore-fervent schedule of road building to attain the ever-receding goal of congestion relief. We now understand and can mathematically demonstrate the futility of this approach. We also understand and can demonstrate that doing concertedly and unrelentingly what others have advocated piecemeal *will* work to contain sprawl and congestion to the benefit of all with sacrifice from none.

All win-win strategies entail a degree of mutual discipline. We must work within a framework designed to solicit local cooperation where unconstructive competition has historically prevailed. This requires a reform of municipal finance and a strengthening of county and municipal collaboration at the metropolitan regional scale. It requires a politics of mutuality that mobilizes the will to act regionally. It requires an opening up of the political agendas and a broadening of the constituencies participating in land use plans and infrastructure investments. It requires a deepening of ongoing regional visioning processes. It requires an enduring commitment to plain, honest speaking, trustworthy behavior, transparent intentions and comprehensible actions. Securing these objectives will bring not only a better quality of life to the region but also a greater harmonization of interests across diverse sectors of our urban society.

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[7] William Fulton explores how growth patterns differ across the U.S. from 1982 to 1997. A growing metropolitan region like Atlanta had its expansion of urban land exceed growth in population by 134% while its density declined by 11%. Yet Pittsburgh with regional population declines of 8% still grew in urban land consumption by 43% while declining in densities by 36%. This demonstrates a clear disconnect between population growth and growth in urban land consumption. Fulton, W. et al. 2001. Who Sprawls Most? How Growth Patterns Differ Across the U.S. Washington D. C.: Brookings Institute.

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ago. Nineteen school districts, 16 special districts, 5 water districts, 13 cities and 4 counties sought tax increases in 1999." Emmi, P.C. 2000. The fiscal burden of growth: Memo to Salt Lake City Mayor and City Council Members.

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**Table 1. Selected Agencies, Organizations and Associations Influencing Decisions that Affect Atmospheric Emissions, Salt Lake Metropolitan Area, Utah.**

<u>Federal Government</u>
- EPA Region VIII
- U.S. Army Corps of Engineers
- US. Dept. of Transportation

<u>Utah State Government</u>
- Department of Environmental Quality: Division of Air Quality
- Governor's Science Advisor
- Utah Air Quality Board
- Utah Department of Transport
- Utah Energy Office
- Fleet and Physical Plant Operations
- Utah's Quality Growth Commission
- Utah Transportation Commission

<u>Salt Lake County Government</u>
- Fleet and Physical Plant Operations
- Salt Lake County Council
- Salt Lake County Council of Governments
- Salt Lake Valley Health Department

<u>Municipal Government</u>
- Salt Lake City
  - Airport Operations
  - City Council
  - Environmental Affairs
  - Fleet and Physical Plant Operations
  - Planning Department
- 14 Other Cities/Towns
- >6 Unincorporated Towns & Townships

<u>Metropolitan Planning Organizations</u>
- Wasatch Front Regional Council
- Utah Transit Authority

<u>Other</u>
- Opinion Leaders (prominent business, religious, and other community leaders)
- County Residents

<u>Key Businesses With Emissions</u>
- 2 Oil Refineries
- Kennecott Corporation (Copper Mine)
- Questar Gas
- Pacificorp (Electricity Production)

<u>Real Estate Development Services</u>
- Church of Jesus Christ of Latter Day Saints
- Cowboy Partners
- Kennecott Land Development Corporation
- Sorenson Development

<u>Public Interest Advocacy organizations</u>
- Envision Utah
- Friends of Great Salt Lake
- National Energy Foundation
- Nature Conservancy, Great Basin
- Salt Lake Clean Cities
- Sierra Club, Utah Chapter
- Tree Utah
- Utah Clean Energy Association
- Utahns for Better Transportation
- Utahns for Clean Water, Clean Air and Quality Growth
- Utah Industry Environmental Coalition
- Wasatch Clean Air Coalition

<u>Industry and Professional Associations</u>
- Utah Association of Realtors
- Utah Home Builders Association
- Ski Utah
- Utah Trucking Association
- Utah Mining Association
- Utah Manufacturer's Association
- Utah City Engineers Association
- Utah Petroleum Association
- Structural Engineering Assoc of Utah
- Intermountain Utility Contractors
- Intermountain Contractor
- AIA/APA, Utah Chapters

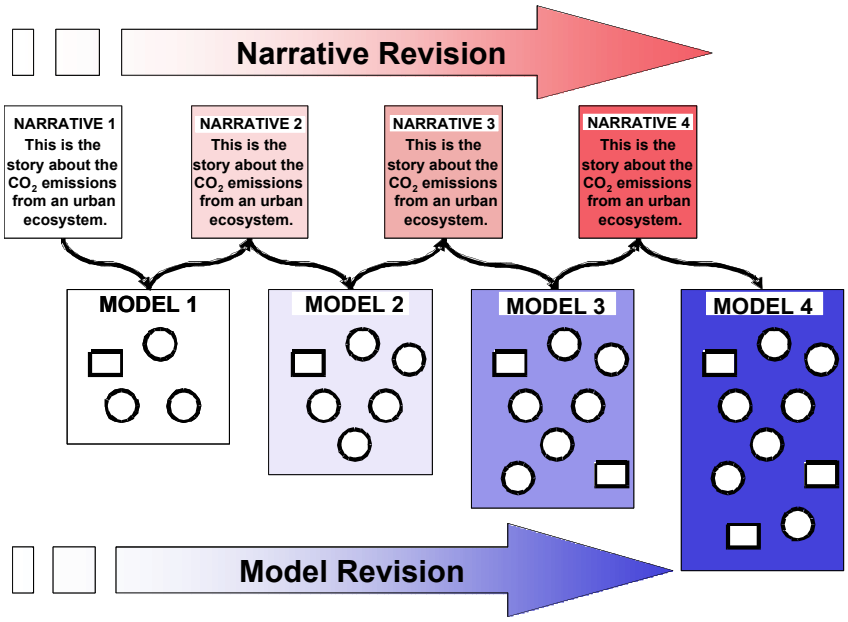


Figure 1. Flowchart for narrative/model revision during workshops.

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