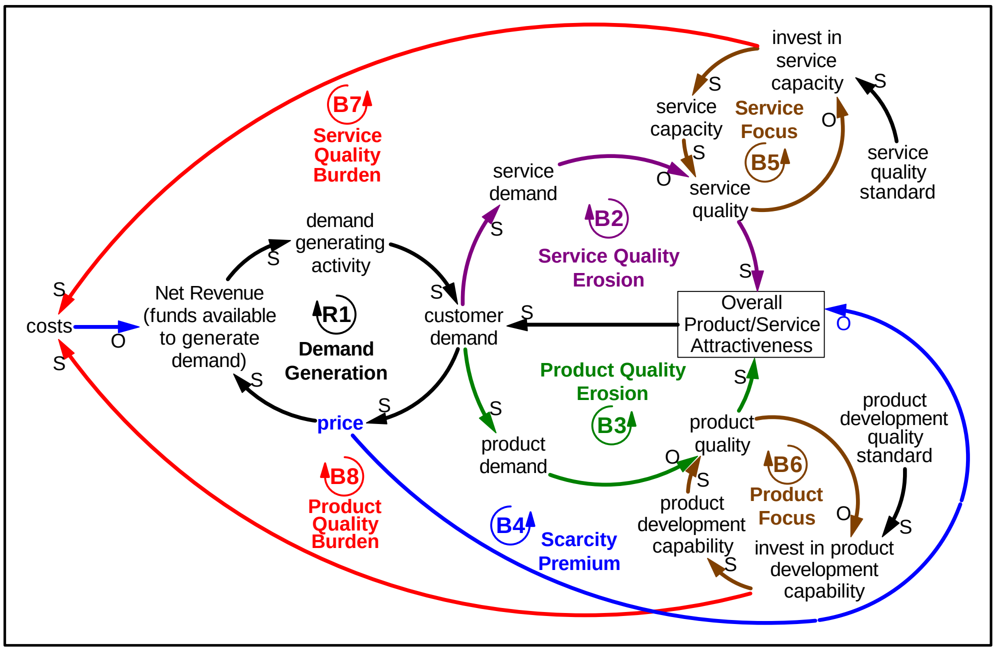
Drivers of Growth

"The Attractiveness Principle"

Every business knows that it cannot be "all things to all people." If it tries to have the highest quality product, the lowest cost and the best service (e.g., delivery time), it will be overwhelmed on at least one of these dimensions. A business must choose among the factors relevant to its business and focus on the ones that characterize what it wants to be. For example, every restaurant knows it cannot at the same time have the lowest prices, the highest quality food, and the best service. McDonald's makes the low prices and good service choices (with food quality not as good), while Outback Steak House makes the "quality food at reasonable prices" choice (with waits that can be very long). No organization can be best at everything; each must make a choice.

Figure 10. "The Attractiveness Principle" Systems Thinking Archetype



"The Attractiveness Principle" is a systems thinking archetype[15] that describes this dynamic (Figure 10).[16] It shows price, service quality, and product quality as the determiners of at-tractiveness. Attractiveness is the extent to which the product or service "attracts" customers. Customer demand is a result of demand generating activities (such as a sales force or advertising, which create a reinforcing feedback R1) and "Overall Product/Service Attractiveness." But for constant service or product development capacities, increased customer demand can lower service quality or product quality (B2 & B3). It requires investment in personnel to maintain service quality (B5); or it requires investment in plant, equipment and design staff to create more products of high quality (B6). These investments reduce the funds available for demand generating activities (B7 & B8). Another option is that prices can be lowered to again increase demand, but this also reduces the scarcity premium that can be charged and reduces funds available for demand-generating activities.

Just as no organization can be all things to all people, no region can be all things to all people. Applying this principle in the field of urban dynamics leads to the "theory of relative attractiveness" – Given free migration, no place can long remain more attractive in an overall sense than any other place. An attractive location attracts people from less attractive locations. In-migration continues until negative pressures arise to counterbalance an area's underlying attractiveness.[17]

This does not bode well for Colorado, because the region's underlying attractiveness is so high (e.g., mountain views). This means that other factors (traffic congestion, smog, housing prices, etc.) must get considerably more negative before people will stop emigrating from areas which they currently view as more undesirable than the Pikes Peak region. For example, housing prices tend to increase in an attractive region because of demand, whether the demand is from a naturally growing population, from people are moving there, or because incomes of a static population are increasing.

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[15] Readers can find descriptions of the common archetypes in *The Fifth Discipline* by Peter Senge (1990), but not this one. The "attractive-ness principle" archetype is one of the more complex structures not usually included in the basic set. It is related to the "limits to growth" archetype that shows how a reinforcing feedback that promotes growth can be subject to the limiting action of a balancing feedback. The "attractiveness principle" is essentially a "limits to growth" structure with multiple limits to growth.

[16] An "S" indicates an influence in the "Same" direction and an "O" indicates an influence in the "Opposite" direction.

[17] See Appendix I for a more thorough description of "the attractiveness principle."

It's important to understand that "attractive" does not mean "prettier." It means that there is a composite set of factors that attract. A location could be ugly and still "attractive," if other factors are favorable. The other factors could be the price of land, tax structure, cultural amenities, investment incentives or robust economic activity. In addition, attractiveness factors can be different for different industries. For example, once a critical mass of a given industry develops with a base of suppliers and customers, a region can be attractive for that economic cluster, even though it may not be attractive to other industries.[18]

Population overshoot

In addition, perception delays can cause population to overshoot, thus exaggerating the negative impact of growth. In-migration in response to *past* attractiveness differentials can lead people continue to move to an area after population growth, congestion, and housing affordability have already worsened. Other delays are introduced because development can be approved, producing early increases in economic activity that boost sales taxes and construction wages; but years later, when the residents move in, there is increased load on infrastructure (e.g., schools and roads) and we feel the negative impacts.

Such delays create what's known as "dynamic complexity" in a system. Even relatively simple situations can become dynamically complex when delays are introduced. For example, most individuals can drive perfectly well under normal conditions, but not when reflexes are slowed due to the influence of alcohol. Delays make economies and organizations difficult to manage for the same reason humans cannot safely drive when drunk. An urban example is the well-known cycle of boom and bust in the real estate industry. Market boom and bust cycles are a major problem that led John Sterman to title a chapter in *Business Dynamics* as, "The invisible hand sometimes shakes."

Business recruitment strategy

The Greater Colorado Springs Economic Development Corporation uses this relative attractiveness to recruit companies and people from California and other parts of the U.S. As noted above, this is a selling point as Colorado Springs is more attractive than LA, and other places from which people and companies come, but only as long as Colorado Springs is more attractive than the *other* locations.

A model on road building to relieve traffic congestion

The traffic problem in Colorado Springs is a local example of a national problem. The nation as a whole, including Colorado Springs, is in denial. Peter Schwartz describes the problem. He was a scenario planner at Royal Dutch/Shell Group and clearly a "systems thinker."[19]

> In Japan, I came to realize, people accepted their problems as challenges to be met. Through meeting them, people would grow and improve. I thought of the infrastructure problem in the United States, which most governments have ignored, hoping it would go away. Yet our highways and roads are literally disintegrating, and it will take hundreds of billions of dollars to repair the damage. We don't see that as a challenge to be overcome, as we did the space race, but as an ugly unsolvable problem to be denied.
>
> Predetermined elements [things that seems certain, no matter which scenario comes to pass] are fearful sometimes because people tend to deny them. The chickens coming home to roost is a predetermined element. So is the next payment on our loan, or a project deadline that we hoped might never arrive. Gridlock is also predetermined. To calculate the amount of gridlock in 2000, look at the number of people of driving age. Multiply it by the average number of cars per person in America. Then calculate the increase in highway mileage, based on construction projects started in the last five years. (It takes at least five years, and usually more, to build an urban highway.) Even if tomorrow the United States embarked on an unprecedented effort to build highways and mass transit systems, it would be too late; we can be certain that seven or eight large urban areas in the United States will be frozen with traffic gridlock.

A natural response to traffic congestion is to call for new roads and wider roads as a remedy. Linear thinking leads from the action, build roads, to the conclusion, less congestion. And that's that.

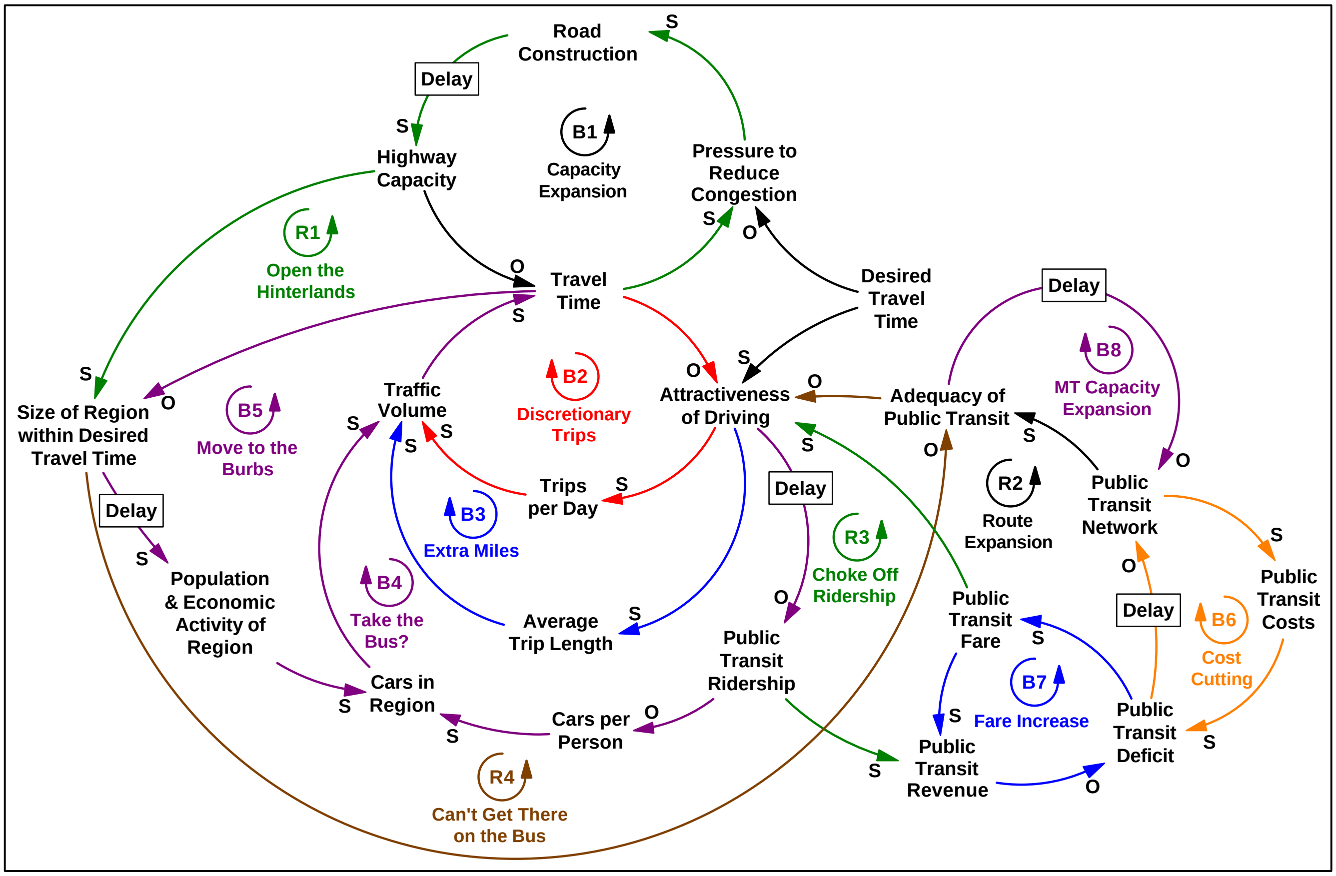
However, common experience, as well as economic and system dynamics studies, tell us that road building does *not* relieve congestion. We can't build roads fast enough to keep up with the new demands caused by increased traffic. That's because any temporary reduction in congestion by reducing travel time leads to *more* traffic and *more* congestion. This is called "in-

[18] Colorado Springs is focusing on developing several economic clusters to reinforce this attraction.
[19] Peter Schwartz, *The Art of the Long View, Planning for the Future in an Uncertain World*, 1991, p. 74 and p. 113.

duced" traffic. A 1995 econometric study of U.S. metropolitan areas showed that a 10% increase in capacity led to a 9% increase in traffic in 5 years. The time lags for many of the induced effects take even longer and eat up the remaining 1%.[20] Some roads even experience worse congestion when capacity is added by attracting more traffic than the capacity added. What road building actually controls is the number of cars on the road and the size of the metropolitan area. Road building is a driver of sprawl.

Figure 11 shows a relatively simple model that addresses the problem of traffic congestion.[21] Professor Sterman prefaces his discussion of this model with these observations: Americans spend 8 billion hours/year stuck in traffic. Lost productivity due to traffic congestion is $43B - $168B. We have road rage & shootings. "What went wrong?"[22]

Figure 11. Traffic Congestion and the Death Spiral of Mass Transportation



Loop B1 shows the basic attempt to regulate congestion by building roads to decrease travel time. However, an increase in the attractiveness of driving resulting from the decreased travel time leads people to take more trips (B2), take longer trips (B3) and not take the bus (B4). In addition, the decreased travel time leads people to move to the suburbs and increase the number of cars on the road (B5). Altogether, these four balancing loops act to counteract any decrease in travel time provided by new roads. These adjustments continue until commute times rise enough to stop the expansion into the suburbs. This is an example of what the field of system dynamics calls "policy resistance" … where we design a solution to a problem only to find that the system has compensating feedbacks that undermine the solution.[23]

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[20] Hansen, M., "Do new highways generate traffic?" Access 7, Fall 1995, 16-22. This is referenced in a new, 982 page textbook from the director of the system dynamics group at MIT. John D. Sterman, *Business Dynamics: Systems Thinking and Modeling for a Complex World*, Irwin McGraw-Hill, 2000, pp. 177 – 190.

[21] This model is built in stages in *Business Dynamics: Systems Thinking and Modeling for a Complex World*, John D. Sterman, 2000, Irwin McGraw-Hill, pp. 177 – 190. This causal loop diagram is also referenced in the section below on "The death spiral of mass transportation"

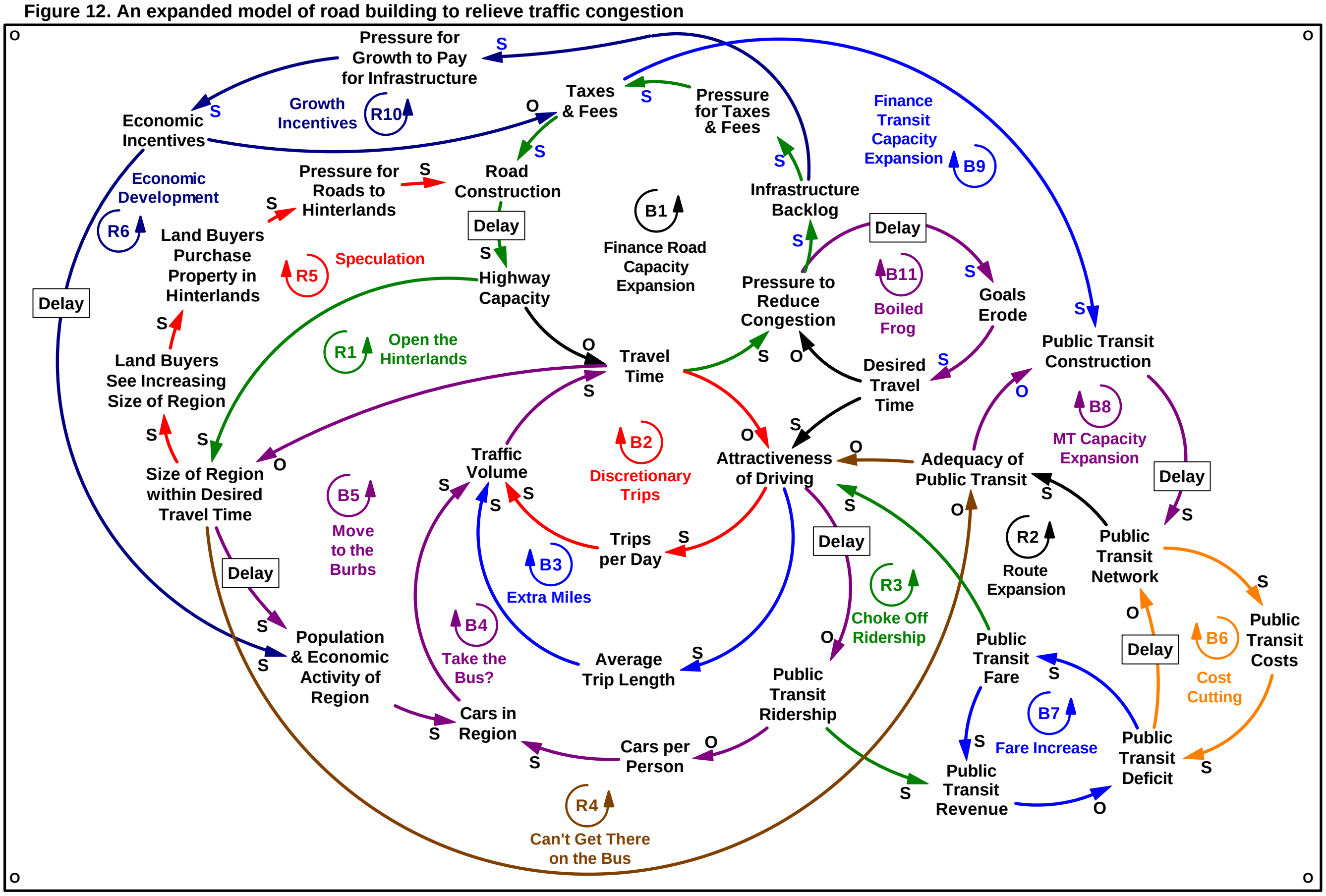
[22] John Sterman, *Business Dynamics: Systems Thinking and Modeling for a Complex World*, John D. Sterman, 2000 p. 178

[23] This is why change is so difficult in stable systems … there are so many balancing processes that counteract the change.

An enhanced model on road building to relieve traffic congestion

Figure 12 shows this structure expanded to include other loops relevant to the problem of traffic congestion. They include the loops: "Speculation" (R5), "Economic Development" (R6), "Finance Transit Capacity Expansion" (B9), "Growth Incentives" (R10), and "Boiled Frog" (B11). Below is a description of each of these feedback loops. Also, Loop B1 is expanded to explicitly show the links for the "Taxes & Fees" that are necessary for "Road Construction."

Figure 12. An expanded model of road building to relieve traffic congestion



B1: Finance Road Capacity Expansion

Intent: To regulate "Travel Time" … to keep it from rising too much above "Desired Travel Time" … we build more roads.

B2: Discretionary Trips

Intent: Drivers respond to lower "Travel Time" by taking more trips … counteracting the decrease in "Travel Time".

B3: Extra Miles

Intent: Drivers respond to lower "Travel Time" by taking longer trips … counteracting the decrease in "Travel Time".

B4: Take the Bus?

Intent: Drivers respond to lower "Travel Time" by reducing their use of Public Transit, using cars instead … counteracting the decrease in "Travel Time".

B5: Move to the Burbs

Intent: Shows that lower "Travel Time" increases the size of the region, which increases population and economic activity to increase the number of cars in the region … counteracting the decrease in "Travel Time".

R1: Open the Hinterlands

Intent: Shows that greater "Highway Capacity" increases the size of the region, population, cars & traffic volume and increases travel time … leading to more road construction and even more "Highway Capacity"

R5: Speculation

Intent: As speculators see the size of the region increasing, they purchase property and pressure government to build roads for better access … additional "Road Construction" further increases the size of the region.

R4: Can't Get There on the Bus

Intent: As a region gets larger, existing Public Transit becomes less adequate. This increases the attractiveness of driving, which leads to more & longer trips and more cars, again increasing pressure for more "Road Construction" to increase "Highway Capacity". This makes Transit even less adequate.

B7: Fare Increase

Intent: As Public Transit Ridership falls, revenue falls. Raising fares can provide more revenue.

R3: Choke Off Ridership

Intent: But raising transit fares makes driving relatively more attractive, further decreasing Transit Ridership.

B6: Cost Cutting

Intent: Intent: The transit system can respond to deficits by decreasing the size of the network to cut costs.

R2: Route Expansion

Intent: Intent: But downsizing network makes driving relatively more attractive, further decreasing Transit Ridership.

B8: MT Capacity Expansion

Intent: We can make Transit more attractive by more transit construction, but it takes lots of time and money.

B9: Finance Transit Capacity Expansion

Intent: Shows the alternative to "Road Construction" spending.

R6: Economic Development

Intent: As "Pressure for Taxes & Fees" mounts, there is more pressure economic incentives to promote growth to "pay for" infrastructure. After some delay, this increases the size of the region and the demand for more road construction.

R10: Growth Incentives

Intent: Incentives reduce funds available for infrastructure.

B11: Boiled Frog

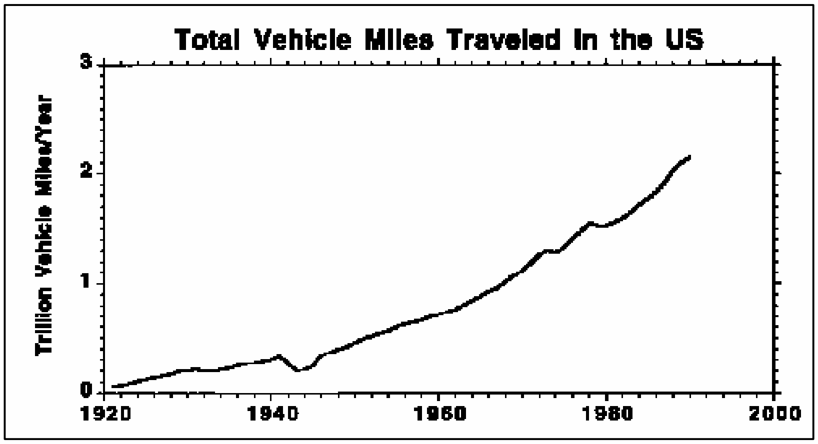
Intent: Shows that increasing "Desired Travel Time" is one way to close the gap. This captures the "eroding goals" dynamic.

Road building for access to the hinterlands

So road construction continues and increases the size of the region within the desired travel time to continue to create more economic activity and put more cars on the road (R1). Road building feeds a reinforcing feedback loop to drive the growth of a region and ever more road building. A characteristic of reinforcing (positive) feedback loops is that they create exponential increases as has been the case for miles traveled in the U.S. (Figure 13).[24]

Though one source of pressure for added road capacity is to make current resident's drive across town easier, it's not the only reason and possibly not even the major reason there's so much pressure for new roads.[25] There is also pressure from land speculators who want increased access to their property so it can be developed and its value will increase thereby (R5). When government builds a major thoroughfare to open up the hinterlands, it increases the value of the property in the hinterlands in that it's made more accessible to potential buyers. These reinforcing loops help make road building a "fix that fails."[26]

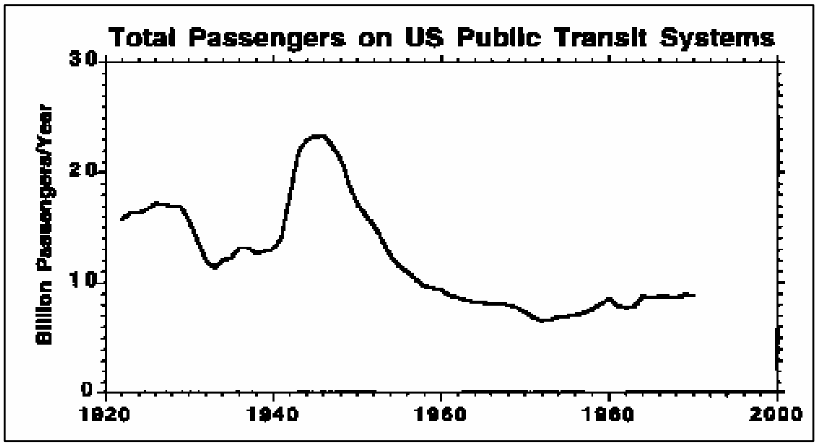
Figure 13. Exponentially Increasing Vehicle Miles Traveled



Low gas prices

Low gas prices make it possible to create more sprawling cities than would otherwise be the case. This carries considerable economic risk, because as gas prices increase the region could become economically not viable. It's already difficult for low wage workers to afford a car to get to work and the lack of viable public transportation would leave workers no alternative and jeopardize the businesses who depend on them. Numerous national and state policies are directed at keeping the price of fuel, as well as the tax consumers pay at the pump, as low as possible. These all contribute to the pattern of development we see in Colorado and the U. S., as opposed to the pattern in many industrialized nations with higher gas taxes and prices.

Figure 14. Exponentially Decreasing Use of Public Transit



The death spiral of mass transportation

Sprawl development and road building reduce the public's ability use mass transportation. In fact, it leads to a death spiral since 1943, as can be seen in Figure 14, showing the decline in use.[27] Referring to Figure 11, as a region expands it's more difficult for people to get to where they need to go by bus, which makes driving more attractive (R4). The more people drive, instead of taking the bus, the less transit system income and the more pressure to cut routes and trips (R2) and increase

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[24] Taken from *Business Dynamics* … source: *Historical Statistics of the US*, Kurian (1994)
[25] In the case of Colorado Springs to open up a major east-west thoroughfare.
[26] A "Fix that Fails" is a systems thinking archetype composed of a balancing loop "fix" that is counteracted by a reinforcing loop "failure." The delay associated with the reinforcing loop is longer than the delay associated with the balancing loop, even though the strength of the reinforcing loop may be greater. This allows us to see short-term improvement, but longer-term negative results that we don't connect to the original "fix."
[27] Sterman, *Business Dynamics*, p. 185 on "The Mass Transit Death Spiral." Data source: *Historical Statistics of the US*, Kurian (1994)

fares (R3). The more service is cut and fares are increased, the more people drive. This mass transportation death spiral contributes to more trips by car. Capacity could be expanded (B8), but the expense and delays are large and the payoff is years away.

We see this dynamic playing itself out in Colorado Springs as the percentage use of public transportation declines. Figure 15 shows data on what's happening here.[28] Figure 16 shows that, even though Revenue Miles actually increased approximately 22% from 1991 through 1999, Ridership/Population has declined by approximately 19%. If revenue miles had not increased, there could have been an ~40% decline in relative use. This relates to the public's unwillingness to approve ballot issues that fund mass transit and to the "cost crunch" on low-income workers who find transportation less and less affordable.

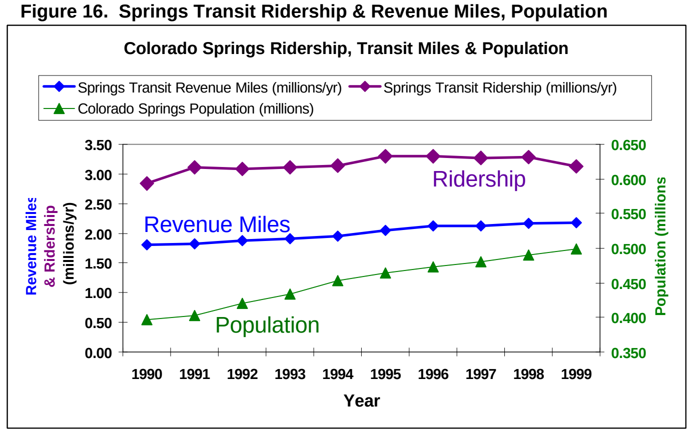


Figure 16. Springs Transit Ridership & Revenue Miles, Population

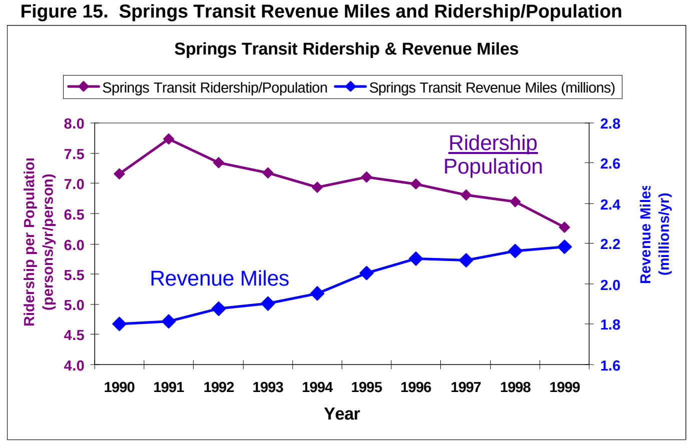


Figure 15. Springs Transit Revenue Miles and Ridership/Population

Transit systems are under stress as noted in the American Society of Civil Engineers' (ASCE) 2001 Report Card for America's Infrastructure [http://www.asce.org/].[29] Here is their evaluation of transit.

> Transit received a grade of "C-," down from a "C" three years ago, and airports received a "D," down from a "C-" in 1998. While funds have been made available through TEA-21 and AIR-21, appropriated to mass transit and aviation respectively, both systems are struggling to meet usage demands nationwide. Transit ridership has increased 15 percent since 1995, adding a strain despite unprecedented growth in transit systems and increased funding. Furthermore, existing public transportation systems, such as San Francisco's BART system and Washington's Metro system, are challenged by new commuter patterns that did not exist and were not anticipated when the systems were first designed and constructed.

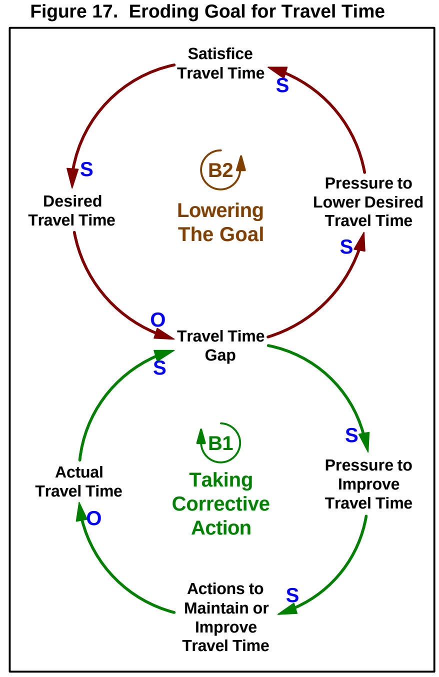
The Boiled Frog Syndrome

In Professor Sterman's model of "Traffic Congestion and the Death Spiral of Mass Transportation," the gap between "Travel Time" and "Desired Travel Time," creates the "Pressure to Reduce Congestion." The variable "Desired Travel Time" is treated as a constant.

However, this is an approximation. Over time we get used to the longer travel time. My sister, Linda, lives in Virginia and thinks nothing of driving for 45 minutes to an hour to get to a shop or restaurant, even though to me that seems like a long time. She's used to the traffic; I'm not. But I would get used to it over time.

Such behavior is characterized by the systems thinking archetype known as "Eroding Goals," which is responsible for the "boiled frog" syndrome (Figure 17). It shows there are two ways to resolve the tension between "actual" and "desired." One way to resolve the tension is to move toward the goal; the other is to lower the goal. The "Eroding Goals" structure is called the "boiled frog" syndrome because a frog will jump out if placed in a pot of hot water, but will not jump out if placed in cool water which is slowly heated to a boil.

Figure 17. Eroding Goal for Travel Time



[28] Source: Colorado Springs Transit, Sept. 2000
[29] ASCE Report Card