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Intelligent Transportation Systems

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Intelligent Transportation Systems

by

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Dedication

To Sandra Ramson who supported me during my time of greatest transportation challenges with more rides than I could possibly count, each time telling me with a smile, "You're home safe."

Abstract

Intelligent Transportation Systems

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Many transportation systems used today are costly, slow, fragmented, and dangerous. This paper explores the inefficiencies and negative impacts associated with our current transportation systems. Simple to technologically advanced solutions are explored along with how to integrate these methods for all users in a sustainable fashion. The vision proposes a blend of scientific method, technological advancement, and common sense which is environmentally aware and integrated for all users by using the Dutch Regional and Sustainable Traffic Management Process.

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Introduction

Many transportation systems used today are costly, slow, and fragmented. Some transportation systems are even dangerous. In this paper, I will explore the inefficiencies and negative impacts associated with how our current transportation systems move people from one place to another along with exploring more intelligent alternatives.

My inspiration to study and write about transportation originates from studying and living in The Netherlands the summer of 2010. I spent a month at The University of Groningen taking a course called "Society, Environment, Transportation and Space: The Dutch Experience." The Netherlands has been called "an ideal testing ground" by IBM for intelligent transportation systems because it is a small, densely populated country (1,008 people per square mile) with its fair share of traffic (Huitema) (Facts about the Netherlands). Even though the Dutch are known for their significantly high bicycle usage, their bike fatalities are the lowest in the world and one third of that in the US (Block). The Dutch methods apply to more than just bicycles. One author writes, "While the US traffic fatalities have fallen by 15 percent, Holland's have fallen by 75 percent. And, thus, the headline assertion: If America had matched Dutch fatality rates, we would have had only 15,000 deaths on our roads last year instead of 37,000." (Reed) Accordingly, I will use The Netherlands as a point of reference for key ideas in this paper.

Problems and Negative Impacts with Our Current Transportation Systems

Longer commute times are directly correlated with lack of happiness. A German study comparing commute time with life satisfaction shows that a one way commute of 25 minutes or more puts the commuter in the lowest quartile for happiness. There is commonly an assumption that a particular salary or house size will be fulfilling, but people find that the time taken away from family, friends, hobbies, and other enjoyable activities provides a significant decrease of overall life satisfaction. In fact, even after five years, commuters still experienced nearly the same level of dissatisfaction regarding the increased commute time. Meanwhile, the fulfillment experienced by the increase of income faded nearly altogether after about 3 years (Stutzer). At 100 hours per year, the average American is now spending more time traveling to and from work than the average 2 weeks or 80 hours of standard vacation time (Longley).

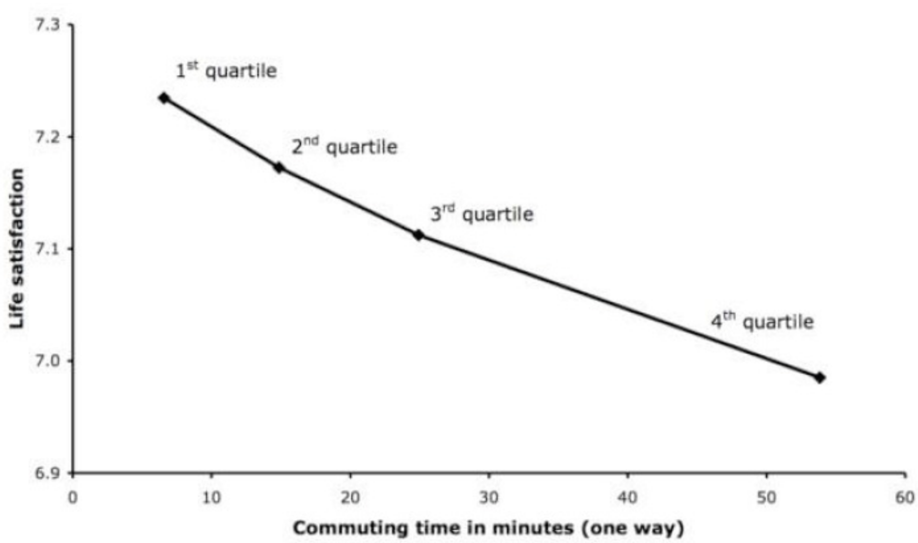

Figure 1: Life satisfaction compared to commuting time

Source: http://www.cces.ethz.ch/agsam2009/panels/AGSAM2009_panel_mobility_Stutzer.pdf

Health also suffers in our current transportation systems. Commuting as little as 15 minutes has been shown to significantly increase cholesterol and other factors of cardiovascular disease. Longer commutes have been positively correlated with increased blood pressure along with decreased immune systems (Frank).

In addition to losing time, many people are also losing their lives. In the US in 2008 alone, 5.8 million highway accidents occurred resulting in 2.3 million injuries and 37,300 deaths. For every 100,000 licensed drivers that year, 18 of them died in a crash (US Census).

Before taking a look at how to solve these issues, I will first closely examine current commonly used transportation systems - particularly the automobile.

Transportation Systems Currently or Commonly Used

PRESENT

In order to commute to and from work in 2009, Americans used automobiles 86% of the time. Public transportation was used 5% of the time and walking was used only 3%. Bicycles were used less than 1% of the time (*Bureau of Transportation Statistics).*

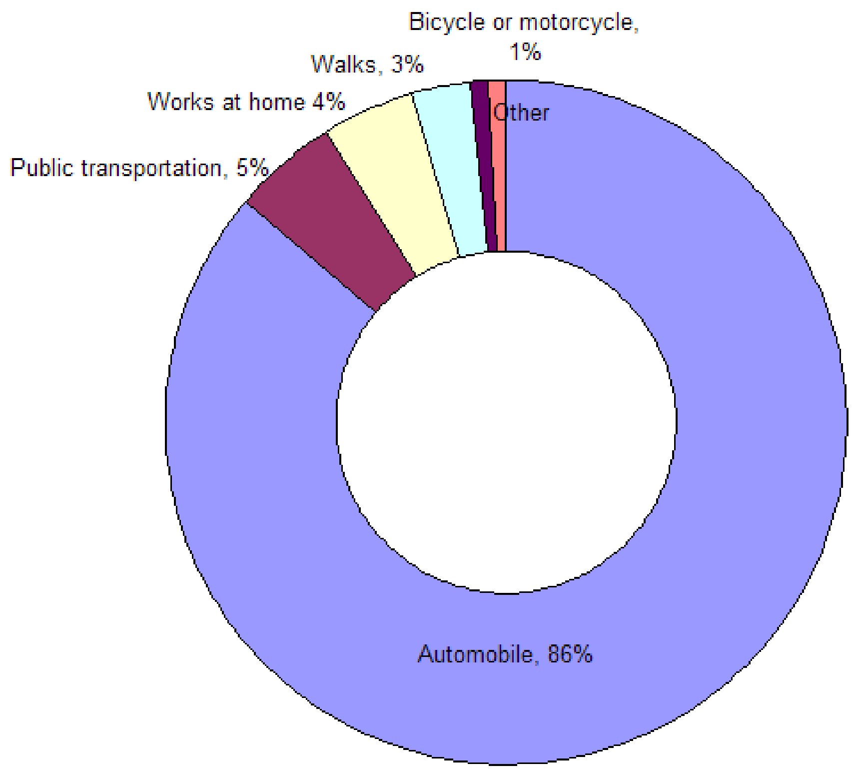

Figure 2: How Americans are getting to work

Source: http://www.bts.gov/publications/national_transportation_statistics/html/table_01_41.html

These numbers contrast sharply with other countries where biking, walking, and public transportation are used much more frequently. For example, more than 50% of trips in China are made by bicycle while in Germany and Denmark the trips made by bicycle are around 20%. In The Netherlands, 30% of commuters are using only the bicycle for transportation (Block).

Even though Americans travel mostly by automobile, there are many negative side effects.

Cars use quite a bit of space. The roads we drive on rarely can be shared for other uses, and we have to have a place to put vehicles when we are not using them. A study of East Lansing, Michigan found that more than 50% of the retail district was dedicated to "automobile space" – parking, roads, and the like (Vanderbilt). A study in White Flint, Maryland showed similar results in that 59% of space there was devoted for vehicles. This is an extraordinarily disproportionate use of land particularly considering that cars are parked and unused most of the time (Johnson).

Also, those traveling by car tend to have lower levels of life satisfaction. With the exception of bus riders, automobile users are the unhappiest of people. Bicyclists and pedestrians are the happiest (Frank).

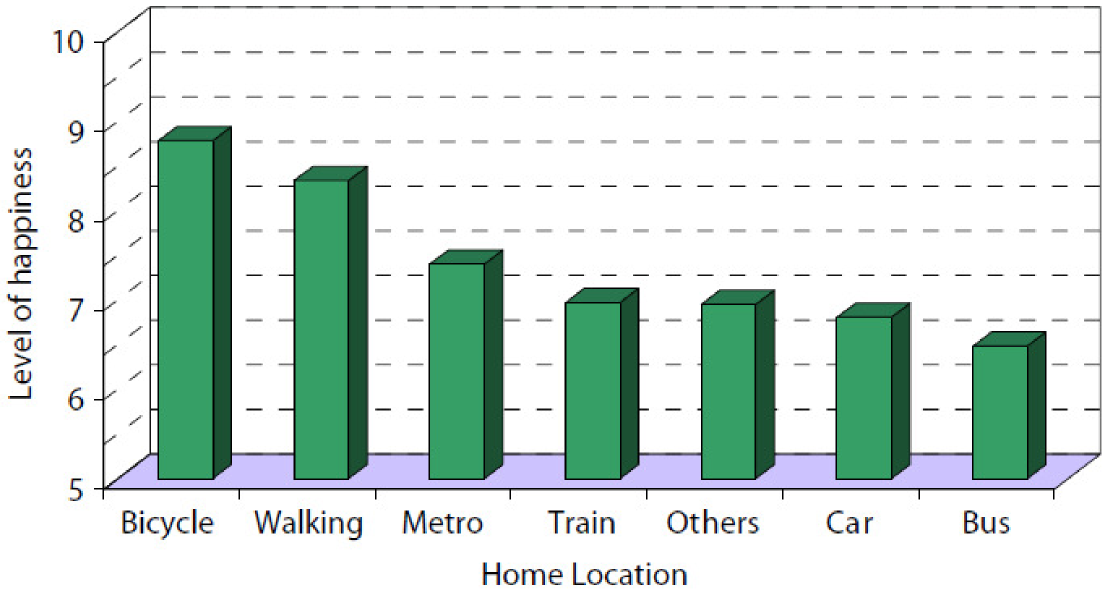

Figure 3: Level of happiness compared to mode of transportation

Source: Duarte, André, Camila André, Grigoris Giannarakis, Susana Limão, Amalia Polydoropoulou, and Nikolaos Litinas. "New Approaches in Transportation Planning: Happiness and Transport Economics." Netnomics 1.1 (2009): 5-32. Web. 10 July 2011.

Those traveling by car are also at a notably increased risk for cancer – particularly cancer of the lung. This risk is significantly lower for those who commute by bus or rail and smaller still for non-commuters (Frank).

PAST

So if car usage has so many negative side effects and other countries aren't traveling by automobile nearly as frequently, how did America become so car centric?

Roads have existed since ancient times, and paved roads have existed since about 4000 BC (Lay 12). The first long distance trip by car happened in 1888 (Bertha Benz Memorial Route). Putting these pieces of information together demonstrates that roads were not always seen as a place for cars. In fact, when automobiles were new, they were seen as a misuse for the streets. The automobile industry spent a significant amount of time and money in the 1920s changing the American public opinion to believe street uses that impeded *automobiles* were misuses of the street (Norton). Clearly, they were very successful.

One industrial engineer writes, "Many years ago, people were taxed to build roads for automobiles. They did not vote for the development. The automobile and bus industries, real estate lobbies, and the military greatly influenced the development of freeways and roads because of the potential for automobile and land sales represented by the expansion of the highway system. Many cities had transportation systems that were far cleaner, more efficient, and more economical than automobiles, but these were sold and dismantled by vested interests representing the automobile industry. We now have a transportation system that has caused urban sprawl, the loss of millions of acres of natural areas and croplands, air and water pollution, thousands of people killed or injured each year on highways, and transportation that is so expensive that many cannot afford to participate" (Fresco 34).

Figure 4: Pacific Electric Railway cars piled atop one another at junkyard on Terminal Island, Calif., 1956 Published caption: AWAITING DESTRUCTION--Old Pacific Electric cars are piled up like toys at junkyard on Terminal Island, awaiting dismantling to become scrap metal.

Source: Los Angeles Times Publication date: March 19, 1956

AUTOMOBILES ARE STILL FAVORED IN THE US

Despite this, the car today is viewed as convenient, a symbol of freedom, a method of self-expression, and sometimes a symbol of status. Americans paradoxically agree with the reduction of automobile usage to deal with transportation problems yet are not favor of restricting their own car use. There is reasoning that benefits take time and there is uncertainty in whether enough people will cooperate in the common interest to achieve the desired goals (Steg 61-62).

Put simply, despite the monumentally negative impacts, the car is likely not going to go away – at least not altogether. With this in mind, I shall begin by discussing methods of improvement for roads.

Roads and Technology That Respond to Conditions

One method by which our roads can become more intelligent is for them to adapt to their users via technology.

VARIABLE MESSAGE SIGNS

Variable message signs are signs which have the ability to change.

Dynamic route information panels and graphic route information panels, also known as DRIPS and GRIPS, respectively, are two types of VMS. DRIPs are typically three lines of text and give information on route, route choice, obstructions, and incidents. For example, a DRIP would inform a driver if a path is congestion free or indicate if a route choice will lead to a traffic jam. Obstruction information, as the name implies, is about road blocks of various kinds. Incident information is about localized incidents such as crashes, road works, and open bridges. GRIPs, or Graphic Information Panels, are similar, but have the ability to show images which visually demonstrate the area or length of the road experiencing congestion. Various studies have shown that route information panels have modest to moderate positive effects on traffic flow (Netherlands Ministry of Transport SWOV Institute).

Figure 5: Example of a Dynamic Route Information Panel (DRIP) and a Graphic Route Information Panel (GRIP)

Source: http://www.swov.nl/rapport/Factsheets/UK/FS_ITS_UK.pdf

However, it should be noted the credibility of variable message signs will be associated with how they are used. Nygardhs and Helmers, in their literature review titled "VMS - Variable Message Signs" communicate the following:

Today the fixed road sign "warning for children" has little credibility because you seldom see children on the street and "warning for wild animals" has no credibility at all because most drivers have never seen any wild animal after these warnings. Also, "Workers on the road" is a message with often low credibility because the road sign is now and then not taken away when there are no workers on the road. Compared to that of fixed road signs, the new VMS technique has essentially a better potential to give the road-users immediately updated messages here and now about incidents on the road and other relevant traffic conditions that change over time. The most important condition for a success of the VMS technique is that the messages are trusted by the road-users by *experience in traffic. So, the VMS technique has to earn credibility of its messages. It is very counter productive each time there is a message that warns for something that does not exist* (44).

Similarly, I would caution against distracting drivers with messages such as “Don’t text and drive” that don’t apply to immediate road conditions. Such desensitization will lead drivers to ignore messages which could be significant to safety.

Another changing road sign used is the dynamic speed limit sign. The maximum speed allowed is adjusted for situations such as traffic buildup, accidents, or poor weather conditions (Netherlands Ministry of Transport Policy Framework 24). Congested roadways can create what analysts call a shock wave, which is the tendency for traffic to build up in a wave-like fashion. Mathematical analysis shows this wave to move backward through traffic at a rate of 15 kilometers per hour. In their report entitled, “Optimal Coordination of Variable Speed Limits to Suppress Shock Waves,” the authors show that coordinated control of traffic with dynamic speed limits is effective at preventing the backup of traffic. The authors explain that the lowered speed limits preceding the congested area “… reduce the inflow to the jammed area. When the inflow of the jammed area is reduced sufficiently, i.e., to a lower value than the outflow, the jam will eventually dissolve… the speed limits … create a low density wave … [that] meets and compensates the high density shock wave. As a result, the shock wave is reduced or eliminated” (Hegyi, Schutter, and Hellendoorn).

Figure 6: Dutch highway using a dynamic speed limit during a traffic jam

Photo by Danielle Locke

OTHER ADAPTIVE ROADS

A ramp meter, ramp signal, or metering light is a light placed near the on ramp of a highway that signals to cars when they may gain entrance to the freeway. This is a light or a two-section signal light together with a signal controller that regulates the flow of traffic entering freeways according to current traffic conditions. By reducing demand and by breaking up platoons of cars, a higher traffic volume can also have increased speed.

The Netherlands has been using this method since 1989 and has more than 65 metering lights in place today (Netherlands Transportation Research Board).

Figure 7: An example of ramp metering in The Netherlands

Source: http://www.dcsc.tudelft.nl/~crweb/research/node20.html

There are also many options for encouraging or discouraging behavior by using per use fees methods such as toll roads. Express toll lanes or high occupancy toll (HOT) lanes offer use of the carpool lane for a fee which changes based on congestion (Bovy). I am not in favor of financial penalties since they have a disparate impact on the poor (Barrow).

Small Improvements with Big Positive Impacts

In addition to running more efficiently, roads also have an enormous opportunity for safety improvement. Very effective changes can be made at a minimal cost which will save time, money, and lives. At nearly 30%, rear-end collisions are the most common type of auto accident. One study found that the reaction time of the following driver went up significantly when the preceding car's break lights underwent minor modifications (Wierwille). Many accidents at intersections take place because one vehicle does not give way to another. The simple solution of using a roundabout instead of a four-way intersection reduces severe injury accidents by 17% and light injury accidents by 38% (Cygas). Adding a particular type of material around the lower part of a car windshield would reduce severe head injuries by 90% in automobile to pedestrian collisions (Fredriksson). Another study showed serious injuries occurring on bridges went down by 29% when lighting was improved. A cost benefit analysis showed that there would actually be a significant positive financial return on the investment if proper lighting were installed (Griffith). Even a measure as simple as installing guardrails will reduce the chance of fatalities by 45%, given that at an accident has occurred (Elvik). Overall, research shows that roads and environmental factors are the cause for 28% percent of accidents and that vehicle features are at fault 8.5% percent of the time. Figure 8 shows a breakdown of environmental factors responsible for a sample of 2,042 accidents while figure 9 shows which changes would provide the highest financial return. Clearly, making these small changes would be a benefit to everyone (Schwing).

ADVERSE ROAD DESIGN — Unsuitable Layout, Junction Design — Poor Visibility Due to Layout	316
ADVERSE ENVIRONMENT — Slippery Road, Flooded Surface — Lack of Maintenance — Weather Conditions, Dazzle	281
INADEQUATE FURNITURE OR MARKINGS — Road Signs, Markings — Street Lighting	157
OBSTRUCTIONS — Road Works — Parked Vehicle, Other Objects	129
TOTAL FACTORS	883

Total accidents in which a road environment factor was a main contributor – *569*

Total accidents assessed –*2042*

Figure 8: Road design shown as top cause among a sample of 2,042 accidents

Schwing, Richard C., and Walter A. Albers. "Societal Risk Assessment: How Safe Is Safe Enough?" Proc. of General Motors Symposium on Societal Risk Assessment, Warren, Michigan. New York: Plenum, 1980. Print.

Potential for Accident and Injury Reduction in Road Accidents

Options	Potential — Percent Savings
ROAD ENVIRONMENT (Low Cost Remedies)	
— Geometrical Design, Especially Junction Design and Control	10½ (11½)
— Road Surfaces in Relation to Inclement Weather and Poor Visibility	5½
— Road Lighting	3 (1½)
— Changes in Land Use, Road Design, and Traffic Management in Urban Areas	5-10 (7½-16½)
OVERALL	ONE-FIFTH of Accidents

Figure 9: Financial return on investment for changes in road design

Schwing, Richard C., and Walter A. Albers. "Societal Risk Assessment: How Safe Is Safe Enough?" Proc. of General Motors Symposium on Societal Risk Assessment, Warren, Michigan. New York: Plenum, 1980. Print.

The Concept of Shared Space

We've discussed a number of tools, but what about using simple common sense? Let's take a step back to question if we need the most basic controls – even stoplights and street signs – in order for traffic to stay safe and keep moving. Hans Monderman, a Dutchman who worked as a civil engineer, road builder, and an accident investigator firmly believed that "…if you want people to behave in a village, maybe make it feel like a village." Monderman believed that without all of the distractions of road instruction and control that people would simply pay attention to one another. He views traffic signs as an invitation to stop thinking (Vanderbilt). He said that when signs are removed people "… look each other in the eye, to judge body language, and learn to take responsibility … to function as normal human beings" (Brunton). He uses the example of a bridge saying, "Do you really think [that without a sign] no one would perceive there is a bridge there?" People report feeling less safe at places where his shared space concepts are used, but Monderman says this is positive because it means people are paying more attention (Vanderbilt). The results are astounding; in all cases, both safety and throughput significantly improved. Fatalities and travel times dropped when signs were taken down at an intersection in a Dutch city called Drachten which 20,000 cars per day travel though (Reed). At another intersection, crossing time went from 50 to 30 seconds and accidents from 9 per year to 1. Monderman even used a favorite demonstration where he'd walk backward with his eyes closed through his intersections to prove their safety. Monderman says a single lane using his concepts can handle up to 25,000 cars per day (Brunton).

Figure 10: A traffic circle designed by Monderman

Source: Google map search for “DRACHTEN Monderman”, street view

.

Figure 11: Cars, bicycles, and pedestrians sharing space in Drachten, Netherlands

Google map search for “DRACHTEN Monderman”, street view

Futuristic, New, and Less Commonly Known Transportation Systems

INTELLIGENT CAR SYSTEMS

In order to add more tools to our toolbox – and promote thinking outside the box - I will discuss powerful transportation ideas that exist, but may not be widely known.

Still not widely implemented, is the availability of commercially produced in car guidance systems. Systems may be differentiated by the level of communication they have with the road. These include no communication, systems that interact with roadside systems, systems that allow vehicles to communicate with each other, and systems that provide cooperation between the vehicle and roadside systems. An example of a positive effect had by an in-car system is that e-Call, a Dutch technology which automatically calls the 112 emergency number, created a 5% - 15% increase in survival rates from accidents (Netherlands Ministry of Transport Policy Framework). Additional services available by in car systems include lane departure warning systems, collision avoidance systems, vehicle detection at intersections, and warnings that the driver is becoming fatigued. These systems may go beyond warning the driver and actually intervene in control of the vehicle (Netherlands Ministry of Transport SWOV Institute).

Such is the case for the Google car. After seeing his best friend die in a car accident at the age of 18, Sebastian Thrun decided to spend his life reducing the death toll caused by auto accidents. This was his inspiration to create the driverless car now associated with Google and the DARPA challenge (TED.com). This may seem paradoxical since studies show people are likely to see loss of control as higher risk. However, these driverless cars went through over 140,000 miles of testing including "such difficult driving conditions as crowded cities and dark mountain roads, and drove around pedestrians, bicyclists, joggers, and deer without [causing a single accident or] harming anyone" (Biddle). Effective June 16th, 2011, Nevada passed a law allowing for "endorsement for the operation of an autonomous vehicle on the highways … [and] recognize the fact that a person is not required to actively drive an autonomous vehicle" (Assembly Bill No. 511–Committee on Transportation).

Figure 12: Google's driverless test car

Source: http://johnbiddle.us/proposal.pdf

Though manually driven using traditional gasoline, the "Car2Go" program in Austin, Texas is demonstrative of the innovative concept of car sharing. There is a fleet of about 200 cars that one simply gets in when it is needed, and leaves the vehicle in any legal parking spot when done. The rental price includes fuel, insurance, maintenance, and mileage. Various methods such as an iPhone app will tell a driver where to find the nearest available vehicle (Car2go Austin). Car2GO will be expanding to San Diego with an electrical automobile fleet (Blanco).

MAGNETIC LEVITATION TRAINS

We've all heard that we shouldn't reinvent the wheel, but what if there is a better way? There are now trains called maglev – short for magnetic levitation – which use magnetic repulsion and attraction to guide the train along the track. While it wasn't high speed, the first maglev train to carry passengers has been open in Emsland, Germany since 1984. Other places which maglev trains are operational include China, South Korea, and Japan (Maglev Monorails of the World). Tokyo's maglev test train was able to go from zero to 500 kph in just a minute and a half along with reaching a top speed of 581 km per hour (Fastest Train in the World).

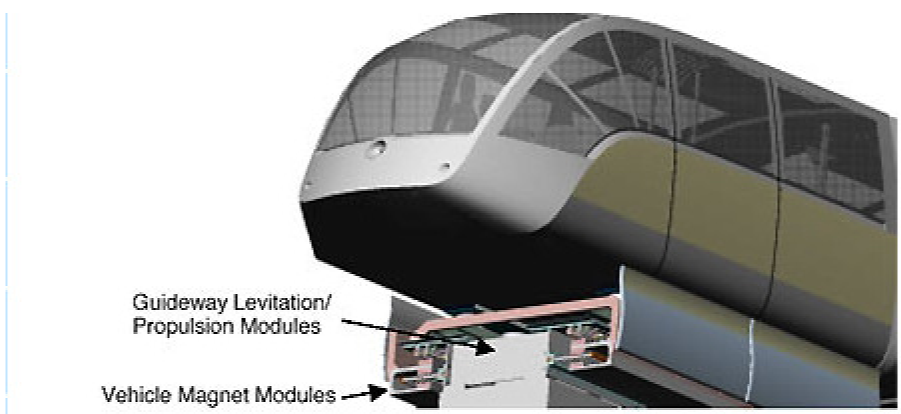

Figure 13: Inside the track of a maglev train

Photo http://www.monorails.org/tMspages/MagGenAtomics.html

The speed of the maglev train is limited only by air resistance and turns. However, if magnetic levitation were to operate inside of a tube with the air sucked out that didn't turn, these challenges would not exist. Such is the case with evacuated tube transport technology, also known as ET3, which was patented in 1999. This type of transportation is not currently in operation, but has the ability to go thousands of miles per hour. Some have expressed concerns about how such high speeds would affect human riders, but experts say we only feel changes in velocity – not actual speed. One might think of being on a plane or the rotation of the earth as examples. Others have expressed concerns about trusting the technology with human safety. Experts respond that machines are currently handling eggs at processing facilities and break significantly fewer eggs than when humans handle them. When taking into account the very high throughput achieved due to very high speeds, ET3 is said to be able to replace an 80 lane superhighway with a single tube. In fact, due to how quick and cost effective trips will be, it is projected to be able to connect people and objects across the globe the same way the internet moves information today. An ET3 backbone route is suggested to connect the world as shown in figure 16. In other words, evacuated tube transport could also replace plane travel including international destinations. This system can run on wind and solar energy (YouTube - Evacuated Tube Transportation Technology).

Figure 14: Artist rendering of evacuated tube transport

Source: http://www.youtube.com/watch?v=03kVU2FYl6U

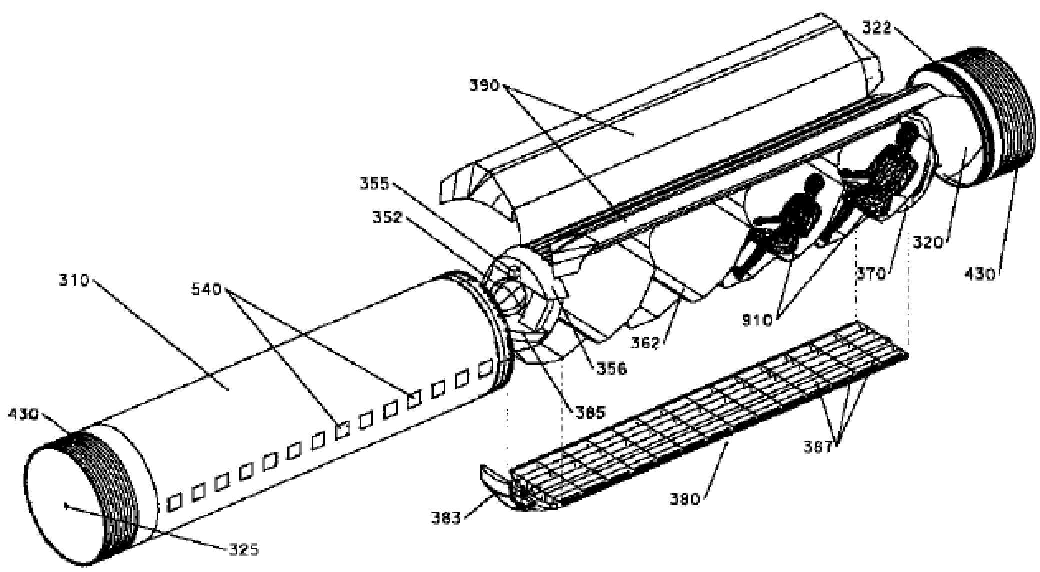

Figure 15: Diagram of evacuated tube transport as shown in US patent 5,950,543

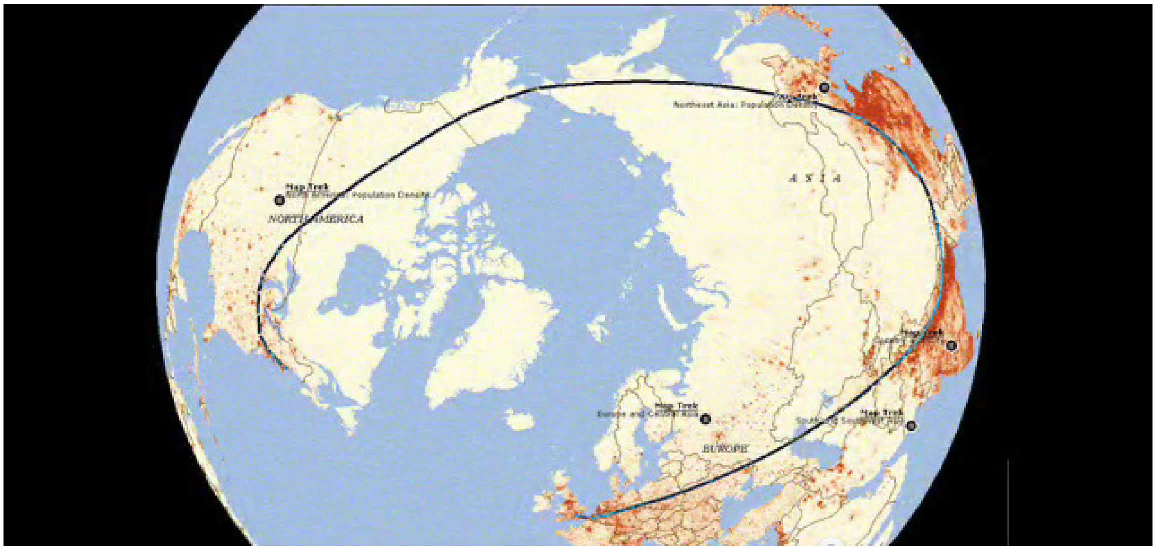

Figure 16: An evacuated tube transport backbone can physically connect the world

Source: http://www.youtube.com/watch?v=03kVU2FYl6U

PERSONAL RAPID TRANSIT

Urban Light Transport, also known as ULTra, is sort of like mixing rail with an automobile. As described on their website, "ULTra Personal Rapid Transit is an innovative transportation technology, combining the convenience of the private car with the social and environmental benefits of mass transit. ULTra's pod cars provide on-demand, non-stop, point-to-point service -- yet are 70% more energy-efficient than private automobiles." Stations may be located above ground, at ground level, below ground, or even directly inside buildings. A user simply selects a destination then is taken directly there in a private vehicle. The ULTra pods are wheelchair accessible and can hold up to six adults. This personal rapid transport system is now operational in London's Heathrow airport. An additional dozen proposed test systems are in the works including

Cupertino (Apple's city) and midtown Raleigh, North Carolina (ULTra – Urban Light Traffic).

Figure 17: Personal rapid transport, ULTra, as used at London's Heathrow airport

Source: http://www.ultraprt.com/

A Few Commonly Used Solutions

Now that we've looked at where we are and a number of available options, I'd like to weigh the pros and cons of a few potential solutions.

EXPAND ROADWAYS?

Let's start with what America does most commonly – build more roads. Roadway expansion is often proposed for traffic congestion reduction, but the added capacity is often soon filled with generated traffic (additional vehicle travel that would not occur). Most of this is additional personal travel, which provides minimal net economic productivity gain, and increases external costs such as downstream congestion, parking costs, energy imports, accidents, and pollution (Litman).

Productivity Impacts – Roadway Expansion

Increases Productivity	Reduces Productivity
• Reduces traffic congestion. • Provides short-term employment.	• Costs per additional peak-period vehicle trip are often high. • Wider roads and increased vehicle traffic often degrade walking and cycling conditions. • Often increases automobile dependency and sprawl, which reduces travel options and increases parking, accident, consumer, fuel import, and pollution costs.

Figure 18: Summary of productivity impacts of expanding highways

Source: http://www.vtpi.org/econ_dev.pdf

Increase Public Transportation?

Is the solution to increase public transit? Of the 5% of trips made via public transportation in the US, 53% are made by bus, 35% by metro/subway, and 9% by other types of rail (United States Census Bureau *Transit Ridership in Selected Urbanized Areas*). Public transportation does have some down sides such as investment in setting it up, noise, and possibly having a barrier effect when it blocks other forms of transport. However, the benefits are many. Public transportation is more affordable to users (Litman). This is especially important considering in 2005, households below the poverty level were spending more than ¼ of their income on transportation (Barrow). Other benefits of public transit include less land use, reduced traffic congestion, less pollution, fewer accidents, less energy consumption, and reduced vehicle ownership (Litman). In fact, one city in Spain is finding the advantages of public transit so beneficial that they are giving citizens a lifetime public transportation pass for trading in a working vehicle (Pérez Prieto).

Productivity Impacts – Public Transit Improvements (Litman 2004)

Increases Productivity	Reduces Productivity
• Provides short-term employment. • Attracts travelers who would otherwise drive on major urban corridors, and so reduces traffic congestion, road and parking costs, accidents, energy consumption and pollution emissions. • Stimulants more compact, multi-modal land use development, which provides savings and benefits. • Allows households to reduce vehicle ownership and so leverages additional reductions in automobile travel and associated costs. • It improves mobility for non-drivers, providing basic mobility and affordability benefits. • Improved efficiency due to scale economies.	• It requires substantial subsidies. • Costs and subsidies per passenger-mile are often high. • Public transit can impose external costs, such as barrier effect if it blocks pedestrian access, and noise pollution.

Figure 19: Summary of productivity impacts of improving public transit

Source: http://www.vtpi.org/econ_dev.pdf

WALK?

What about just walking? The “walk score” is an algorithm which assigns a score ranging from 0 to 100 based upon how close a home is to certain activities. The distance range is usually between a quarter of a mile and a full mile. Categories of activities include restaurants, bars, theaters, shopping, schools, and parks. A study of more than 90,000 homes in 15 different markets showed a $700 to $3,000 increase in home values for the walkability score going up just a single point. Overall, above average walkability scores raised values by about $4,000 to $34,000. The authors of the study note, “It should be stressed that our measure of walkability captures not just the benefits associated with walking but with greater accessibility generally. Even households that don’t walk to every destination have shorter trips (and more nearby choices) than households with lower Walk Scores. And because places with higher walk scores tend to have more mixed uses and better transit services, some of the value measured here may be attributable to those assets.” In short, if someone can afford to live in such an area, walking or living in a neighborhood with a high walkability score provides many benefits (Cortright).

What Makes An Intelligent Transportation System Intelligent?

The concept of intelligent transportation is not new. The first automated route guidance was available in 1910 and automated highway systems were shown in the 1939 World's Fair (IEEE ITS Council Newsletter). However, exactly what makes transportation intelligent depends on who you ask.

NORTH AMERICA

In the US, "Intelligent Transportation Systems (ITS) are the application of interrelated systems of computers, electronics, and communication technologies and management strategies to improve the safety and efficiency of the surface transportation system" (Mid-America Regional Council). In Canada, ITS is "The application of advanced and emerging technologies (computers, sensors, control, communications, and electronic devices) in transportation to save lives, time, money, energy and the environment" (ITS Canada). Note that both of these definitions are about applying computer technology to transportation in a nonspecific fashion.

EUROPE

Europe takes a more specific approach by describing ITS in three categories: traffic, passenger, and public transport. Instead of focusing on that technologies be "emerging," goals include measuring and improving performance.

European Definition Of ITS

1. **Intelligent Traffic Management Systems** measure and analyse traffic flow information and take ITS measures to reduce problems. They are consisting of computerised traffic signal control, highway and traffic flow management systems, electronic licensing, incident management systems, electronic toll and pricing, traffic enforcement systems and intelligent speed adaptation.

2. **Intelligent Passenger Information Systems** improve the knowledge base of Customer and consist of passenger information systems, in-vehicle route guidance systems, parking availability guidance systems, digital map database and variable messaging systems.

3. **Intelligent Public Transport Systems** include ITS measures that aim to improve public transport performance. They are consisting of intelligent vehicles, Intelligent Speed Adaptation, transit fleet management systems, transit passenger information systems, electronic payment systems, electronic licensing, transportation demand management systems and public transport priority.

Figure 20: Definitions of ITS in Europe

Source: Vanderschuren, Marianne. *Intelligent Transportation Systems For South Africa*. Thesis. TRAIL Research School, 2006. Print.

INTELLIGENT TRANSPORTATION IS THAT WHICH BALANCES THE NEEDS OF USERS IN AN INTEGRATED AND SUSTAINABLE FASHION

This prompts the question, what is intelligent? Is intelligent finding the right technology to meet a specific need? Does intelligent have to involve the latest technology? I would like to suggest that intelligent transportation is that which balances the needs of users in an integrated and sustainable fashion. So how can this be achieved? Two Dutch authors write in the Journal of Transport Geography, “Although there is no common definition of sustainable transport, it is generally accepted that sustainable transport implies balancing current and future economic, social and environmental qualities… Sustainability indicators are needed to examine possibilities and conditions for sustainable transportation. The extent to which various sustainable policies would affect important sustainable transport indicators should be assessed by systematically examining the economic, social and environmental effects of these transport systems. Economic indicators should measure possible effects on economic welfare, such as macroeconomic changes, GDP, economic efficiency, income distribution and unemployment rates. Social indicators should reflect effects on societal and individual quality of life, such as health and safety. Environmental indicators should measure effects on environmental qualities, such as resource use, emissions and waste, and the quality of soil, water and air that may affect human (and non-human) life" (Steg 61). While technology may be used to achieve these goals, the use of technology is not itself indicated as a goal.

Putting It All Together

A Focus on Results: The Dutch Handbook For Regional and Sustainable Management Process

In a document put forth by a Dutch government agency, the AVV Transport Research Centre states very directly monetary investment in complicated technology is not what The Netherlands sees as the most effective solution to achieving traffic mobility. The sentiment is to balance the needs of users along with financial and environmental restrictions by bringing together the expertise of policy makers, business managers, and system engineers. The Sustainable Traffic Management Process can be initiated for situations such as road construction/changes, incident management, or soccer matches. The first step in the process is to bring together the stakeholders of the project to define the issues that need to be managed by creating a common vision with clear, measurable goals, and contingency priorities. Action items can then be created by examining the delta of the vision with the actual or projected challenge. This three layered approach – policy makers, business managers, and system engineers, believes that right people with the right information will make the right decision. The focus is not the ITS technique, but to achieve a solid, integrated network vision that creates quality of life for all road users (Netherlands Regional and Sustainable Traffic Management).

RESOURCE-BASED ECONOMY

The Venus Project is an organization that proposes ideas for a sustainable world that includes and goes far beyond transportation. The founder, Jacque Fresco, envisions a world where all of the Earth's resources are the "Common heritage of … all the world's people along with a global resource-based economy." (The Venus Project FAQ page) The Zeitgeist Movement – born out of ideas from The Venus Project – describes its goal is to create "A new economic model based not on the movement of money and the dynamics associated with such a system; but rather on truly objective, scientific resource management and allocation, strategically seeking to enable an equitable distribution of all goods and services to meet the needs of the entire, global human population, while ensuring maximum environmental sustainability, over generational time" (LA Townhall). Together, they advocate for a better world. I will discuss the thoughts and ideas from this world vision that relate to transportation.

Included in this vision are the aforementioned magnetic levitations trains including those which operate in airless tubes like ET3 along with car sharing like with Car2Go. Additional ideas I will discuss include improvements to cars and the idea of a circular city.

Additional Car Improvements

Jacque Fresco's models for automobiles include vehicles that are highly aerodynamic; have tires that do not cause loss of control when they go flat; allow passengers to request destination by voice command; monitor themselves for maintenance; have significantly more effective air bag systems; and prevent accidents with collision avoidance systems that use radar or sonar (Future By Design) (The Venus Project FAQ page) (Fresco). He also recommends cars be made with shape memory alloy metals which go back to their original shape after being dented. He demonstrates this capability by distorting a spring made of nitinol – which is of one of the shape memory metals - then bringing it back to its original shape quickly by applying heat (Future By Design).

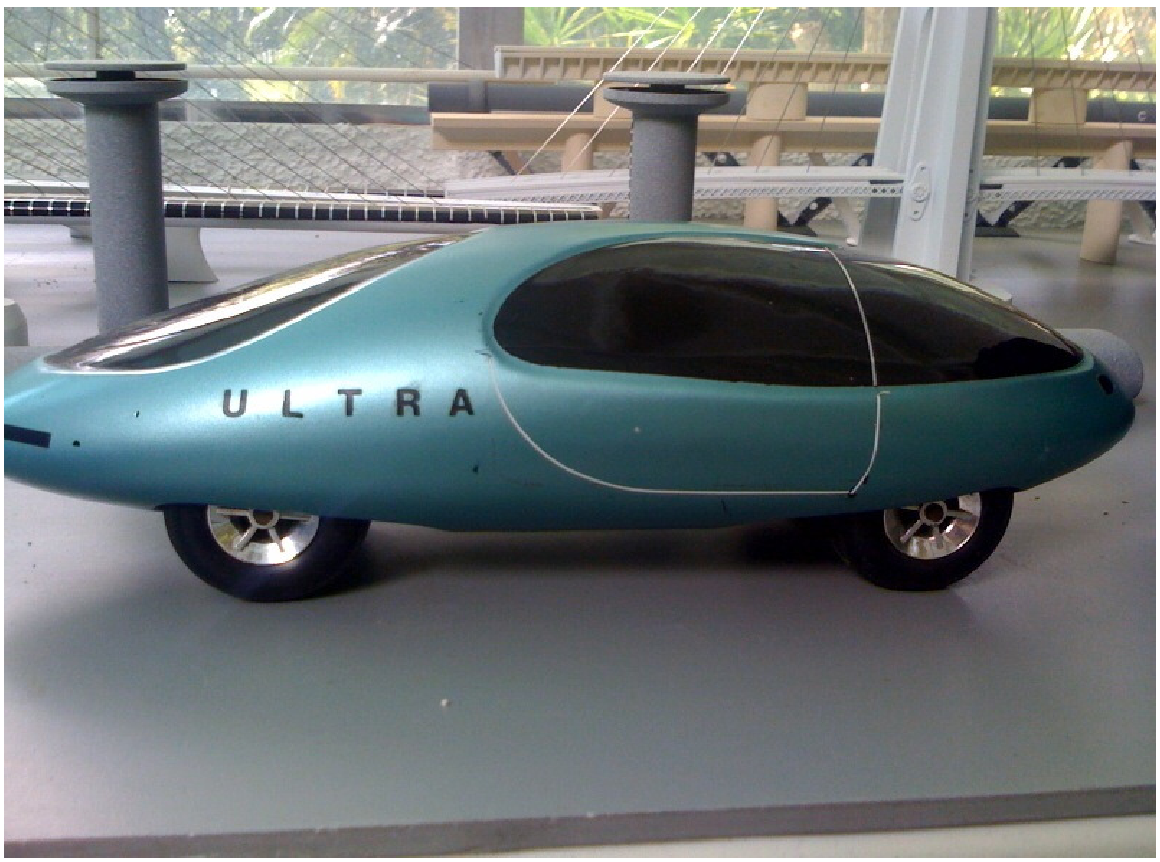

Figure 21: Car designed by Jacque Fresco circa 1946

Photo by Danielle Locke. Model by Jacque Fresco.

The Efficiency of a Circular City

However, Fresco says that the most efficient way to set up transportation systems is to plan for it when a city is designed. Fresco explains, "In the interim you can put sensors on cars to diminish accidents. They can be driven by electrical motors that put the brakes on before hitting something. The sensor can help maintain a safe distance between cars, but the cost would be enormous and detract from conservation of resources and the real solutions that could be worked on. This intermediary approach would be inefficient and more costly compared to redesigning the transportation system in an environment that includes this in the overall design… trying to patch up this technical infrastructure that we have is wasteful, detrimental and in the long run requires more energy." (The Venus Project FAQ page) Accordingly, he proposes the idea of a circular city. He bases this idea off of nature including having key functions in the center of the city just like a cell and its nucleolus. The center of the city would contain key buildings such as education, medical providers, food marts, and general shopping. Fresco explains, "The circular arrangement makes it easier to operate using far less energy than any other system. And if you start at one end of the city and go through the city, you always return to the same place. Whereas in a linear city, you go to one end, you have to backtrack to get to the same point. So the circular scheme is by far the most sufficient." (Future By Design) Cities based on the circle instead of the square are and have been in place in the Netherlands for some time.

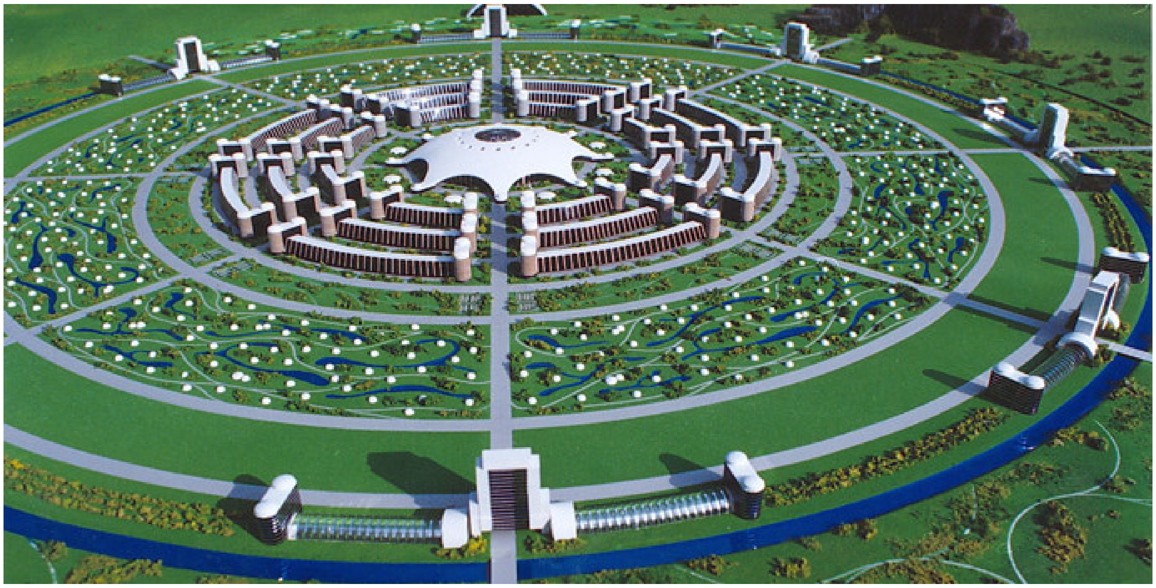

Figure 22: Drawing of Jacque Fresco’s circular city

http://www.thevenusproject.com/technology/city-systems#

Conclusion

I have described in this paper a list of potential technological solutions, but this list is not intended to be exhaustive. In fact, my proposal is that we need have a system that itself responds over time to needs and new technology. As Fresco indicates, “Don’t forget all the models I do are only transitional. They don’t represent the best that man can turn out because nobody knows what the future will bring. There are just so many variables that man can alter...they’re not necessarily what the future might look like. They’re only…extrapolations - taking the present and extrapolating forward - but we can’t go too far forward because we don’t know what new things will come into being.” (Future by Design) Accordingly, it is not possible to propose one plan that will work in every place throughout time. Instead, the key is to think outside the box – or perhaps the automobile and the square – by looking at the best technologies available at the time and integrating them in a prioritized way. Put more simply, there needs to be a balance between technology and the common sense type approach used by Hans Monderman with his shared space concepts. As an overall comprehensive vision, I propose the following solution which borrows greatly from the definition of the Zeitgeist Movement to describe my vision of how the world can achieve intelligent transportation. We should use a model based not on the movement of cars and the profits associated with such a system; but rather on truly objective, scientific resource management and allocation strategically seeking to enable an equitable resolution of all needs for services of the entire, global human population, while ensuring maximum environmental sustainability, over generational time. In other words, the high level summary of my conclusion is the suggestion of a blend of scientific method, technological advancement, and common sense which is environmentally aware and integrated for all users by using the Dutch Regional and Sustainable Traffic Management Process.

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