IS ARTIFICIAL INTELLIGENCE THE KEY TO SOLVING YOUR MORNING COMMUTE ISSUES?

by

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The Command College Futures Study Project is a FUTURES study of a particular emerging issue of relevance to law enforcement. Its purpose is NOT to predict the future; rather, to project a variety of possible scenarios useful for strategic planning in anticipation of the emerging landscape facing policing organizations.

This journal article was created using the futures forecasting process of Command College and its outcomes. Defining the future differs from analyzing the past, because it has not yet happened. In this article, methodologies have been used to discern useful alternatives to enhance the success of planners and leaders in their response to a range of possible future environments.

Managing the future means influencing it—creating, constraining and adapting to emerging trends and events in a way that optimizes the opportunities and minimizes the threats of relevance to the profession.

The views and conclusions expressed in the Command College Futures Project and journal article are those of the author, and are not necessarily those of the CA Commission on Peace Officer Standards and Training (POST).

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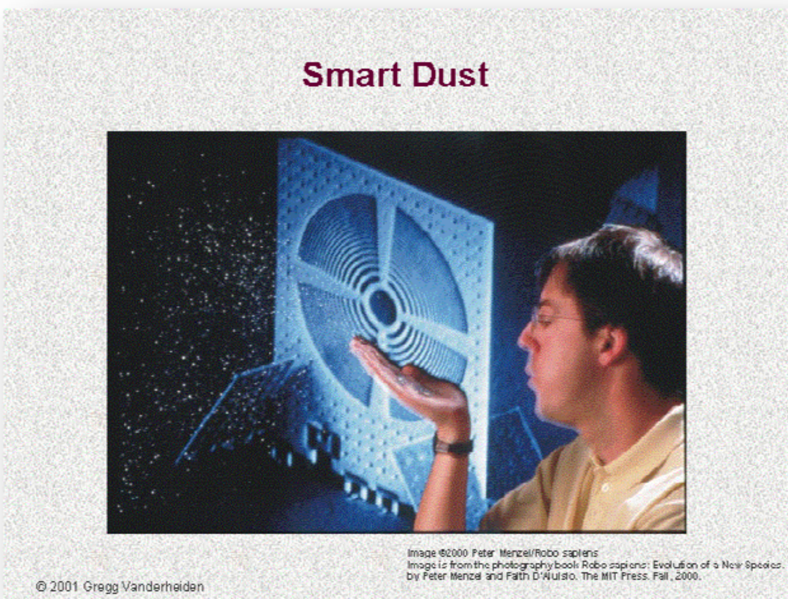
6:40 am. The morning commute is just getting into full swing in this metropolitan maze of freeways. “The approach to downtown is moving at the limit,” says the traffic reporter from her news helicopter above. But before the next commercial can run…CRASH. Two of the four northbound lanes into the city are blocked. Without even as much as screen change on the first passerby’s cell phone, however, emergency response is already en route. The exact location is known; the Highway Patrol is responding, an ambulance has been dispatched, and tow trucks have been called to clear the lanes. Social media alerts are sent, and GPS traffic locators are notified with alternate routes sent to cell phones and cars. Within minutes, all emergency responders are on scene; the injured are tended to, damaged cars removed, vehicle fluids and glass debris removed and the investigation is being documented. A short time later, lanes are all open again with only temporary disruption to the commute.

Is this possible or just fantasy? There’s no way to plan for every crash, is there? The truth is yes, it is possible; but it requires some “smart” thinking on the part of law enforcement and government officials. Today’s society is all about “smart.” We have smart phones, smart televisions, smart cars and anything else that can communicate information automatically. Enter the artificial intelligence of "Smart Dust" and its ability to transform emergency highway incident response.

Smart Dust

Smart Dust is a term coined by its inventor Kris Pister, a University of California, Berkeley, professor, and Founder and Chief Technologist of Dust Networks. Pister invented a wireless sensor in 1998 capable of receiving and transmitting data. The term "Dust" was used as his vision was to create micro-sized sensors, or motes, that might be installed as simply as dropping particles of dust. Since then, improvements have been made to extend battery life of the sensors, increase range, and reduce their size. Initial prototypes were sensors the size of a VHS tape, but now have been reduced to the size of a grain of rice. The vision of Pister is to continue to reduce the size of these sensors until his vision of 'dust' is achieved. These devices have sensing, computation and communication ability and are envisioned to become widely incorporated in the modern city (Dickson, 2007).



Glimpses of this modern city can even be seen today in current applications of wireless sensor networks. Transforming them to use in the city of the future is the goal.

Current Applications

Smart dust was original developed as part of a Defense Advanced Research Project Agency (DARPA) endeavor. Military applications were explored in an effort to determine troop movements as well as to determine the use of weapons of mass destruction (Dickson, 2007). Fast forward to today and the technology has been used commercially to monitor systems; mechanical as well as environmental. Current highway applications have the ability to monitor traffic speeds, volumes, and vehicle mass. When speeds decrease below certain thresholds or volumes increase, traffic incidents can be targeted and agencies can be deployed. Limitations are that only speed and volume is captured and specific incident details cannot be identified (Greenwood, 2012).

A relatively new smartphone application has been developed in a combined effort by Pister's Dust Networks and Streetline Networks with the company's mission: "To make smart cities a reality through the use of sensor-enabled mobile and web applications." The "Parker" application allows anyone with a smart phone to find vacant parking spaces in the city and receive texts when their meter is running out.

The system works by utilizing sensors installed in the pavement with long life and low power battery systems. Information is collected and then transmitted to receivers. For the Parker app, these receivers are typically installed atop poles or light standards. The relays transmit data through a mobile mesh network to a data center commonly referred to as “the cloud”. The mobile mesh network is significant in that it makes repairs in the data transmission to account for impediments such as radio frequency interference. The cloud then allows for integration with smartphones. The sensors are strategically located along streets, in parking spaces and public garages. In one application, pay parking spaces can be paid right on the phone’s app and prevent the need for using credit cards or coins in the meter. Parking enforcement officers can also increase efficiency by tying into the system and be alerted when a parking meter is expired. These systems are working in several large cities today, including New York, Los Angeles and San Francisco (Streetline, 2011). The company seeks to appeal to the environmentally conscious by advertising the benefits of reducing emissions by quickly finding a space rather than driving around town. They also appeal to the businesses in the urban area that seek to increase customer base with the newfound ease of parking.

Smartphone communication is not the only conduit to consumers. New vehicles are being constructed with information and entertainment systems which include familiar phone apps such as Twitter© and Facebook©. Voice commands can also read texts to drivers. Driverless or autonomous vehicles are being developed such as the one recently demonstrated by Google©. These examples are only the tip of the iceberg when speaking of the possibility for real time communication. The real value is in the way these systems could dramatically improve the way we use, and interact with, the roadway of the future.

The Future Highway

Two-way communication is the key to law enforcement and its goal of efficient traffic management. A smart system utilizing wireless micro sensors would be able to alert not only the emergency responders, but also the other commuters – in truly real time. No longer would drivers need to wait ten minutes to hear about the backup in which they are already stuck. New highway construction should require the inclusion of smart dust in the concrete, asphalt, jersey walls, or virtually anywhere along the roadway including bridges with its ability to detect stress fractures (Shultz, 2011).

One option for the smart roadway would be to integrate the Streetline - Dust Networks sensors and mobile mesh network to monitor traffic. The Streetline – Dust Networks product uses surface mounted sensors that resemble current highway reflectors or lane delineation markers. This type of product could be used in existing roadways with the smaller, micro-sized sensors used in future construction for the “ultimate traffic management” system (Dickinson, 2010).

When an incident occurs, the sensors would immediately identify the location. Sensors would determine if airbags deployed, if fluid was released (including hazardous material) and damage to vehicles and roadway. Emergency responders would be notified. In most cases that notification would go directly to the unit's onboard computers rather than through a dispatch center. Immediate alerts would go out to smartphones and smart cars identifying the incident location and alternate routes. Communication with traffic cameras would alert the cameras to the incident and alert news media for video feed. Sensors would also monitor the traffic flow and give accurate information regarding the congestion backup.

Unfortunately, current costs to implement such a system may delay its emergence into reality. Individual sensors such as those depicted can cost anywhere from $30-$100. With more than 50,000 miles of freeway in a state such as California, the cost today would be quite prohibitive. A typical eight lane freeway (four lanes each direction) with one sensor every 25 feet would require approximately 1690 sensors for just one mile. A license fee of $120 per sensor would also apply, bringing just one mile of freeway to a cost estimated at $372 thousand. There are options, however, to make such a system a reality. Acceptance of the technology and innovative financing are a must. Streetline has even partnered with municipalities in some cases to limit taxpayer liability. In California, a test project might be to include smart dust sensors in currently active highway projects. Caltrans has secured a record $12.4 billion in highway projects for 2013. New projects where grinding and repaving roadway surfaces are involved might be the first opportunity to try the mounted sensor technology in roads. In a relatively lower-cost project where reflectorized lane delineators would need to be installed

regardless, the State of California might venture into this new technology and take it for a "test drive." Once the systems are in place, the role of policing and government would also need to change.

Role of Law Enforcement

Traffic safety and emergency incident response is the primary role of law enforcement agencies responsible for patrolling our highways. Information on State highways is generally relayed through sophisticated communication and traffic management centers. Aside from those functions, however, the traditional paradigm is that State and municipal infrastructure design and construction should be left up to the engineers and bureaucrats. Smart Dust seeks to change the paradigm of communication and data transfer and can be used as a metaphor to equally change governmental systems. The idea of Smart Dust is to link systems. Government agencies can be more effective and innovative if they do the same.

Agencies such as the California Highway Patrol (CHP), with its statewide investigative jurisdiction over the state's freeway system, would be one of the end users of a wireless sensors network. The CHP should be involved as a stakeholder in the project from inception in order to provide input relative to their expertise (traffic congestion, equipment used in emergency response, enforcement, communication). Regional transportation authorities with their control over local funding sources, and their understanding of regional transportation needs might take the lead on such a project and roll it out first at the local level. The State's Department of Transportation (CalTrans) would coordinate future projects and maintenance.

This linking of regional and state resources is key to implement such a project; even with all this cooperation, funding is still an issue. Infrastructure projects are expensive and innovation in paying for such a project is critically needed. A recent movement toward Public/Private Partnerships or P3's may provide an answer for this problem.

Partnering with the Private Sector

Some law enforcement agencies have internal technology divisions, but most rely on the purchase of private sector goods. The size and scope of infrastructure projects would require significant public investment - an investment source many municipalities and states do not have. A solution may be found in public/private partnerships.

In 2010, California held a Public Infrastructure Financing Forum bringing together transportation, finance and industry experts and investors to discuss how to finance critical infrastructure projects (Dust, 2010). The overall concerns of the investment community targeted the processes government has in place to even begin the discussion of private resources.

Traditional progression of a project is to decide to build something (a road for example). Government then establishes an agency and sub-agencies to study the project. Funds are sought through use taxes or bonds. Election cycles pass. If a private contractor is needed, a Request for Proposal is posted and the bidding begins. Time and money is wasted and private companies begin to lose interest. If the private company comes up with an innovative idea first, procurement rules restrict their ability to approach the government due to “fairness” and the concept of equal access. Former Orange County Transportation Authority Chief, Will Kempton, spoke of this type of restriction when speaking about a regional effort to expand high occupancy lanes in 2010. He described how many private investors wanted to reach out to him with financing options and the roadblocks to open dialogue he faced. Frustration with that process was abundant during the forum. What was also abundant, however, was the amount of money investors were willing to spend if only an opportunity would present itself (Dust, 2010). One such example does exist, though, and it could be a blueprint for the future.

An example of innovative infrastructure projects can be found in California’s response to the 1994 Northridge earthquake. Major transportation arteries collapsed with the likelihood of long term reconstruction crippling Southern California’s goods

movement. Private industry approached the local government structure with an idea to quickly rebuild the freeway. Local governments reached out to the state, laying out a plan with private industry incentives and great public benefit. Procurement requirements were navigated through a cooperative effort of State and local government to speed the process. As a result, the freeway was repaired in 66 days (McClintock, 2000).

Following Northridge’s example, Government agencies should seek and present these types of opportunities to private industry. The smart dust wireless sensor networks are a perfect example, where the private technology sector can once again invest in public infrastructure to the mutual benefit of the company and the public. Nowhere can this be seen more clearly than where it is already in use; the city of tomorrow.

<u>The City of Tomorrow</u>

A great example of the Smart Dust concept can be found in a new master planned city called New Songda in South Korea. The City is roughly the size of Boston, MA, and is being showcased as a City for Tomorrow (Lindsay, 2010). The City's builder, Gale International, partnered with Cisco Systems with its infrastructure application of synapses wired throughout the entire city. Cisco has been an active partner with Dust Networks to develop comprehensive wireless network systems (Walter, 2008). There will be a master control room monitoring all essential city services including water, power, traffic and telephone. The roadways will include embedded sensors utilizing the Smart Dust technology that will not only monitor traffic, but will also dim the streetlights when they detect no vehicles (Liang, 2012). By monitoring traffic patterns, officials believe congestion will diminish as traffic lights will be triggered according to the patterns. New Songda is scheduled for completion in 2020 but Gale International is not stopping at one. Another City of Tomorrow is under construction in China's Meixi Lake District, Changsha.

Conclusion

The City of Tomorrow is available today. The question for law enforcement agencies and government is how they want to fit into this new City. By embracing technology and reducing barriers to public/private partnerships, the City of Tomorrow can be built and shaped into something that can truly benefit the public. The technology is here, the capital is available and the opportunity to act is in our grasp. Agencies can truly get "smarter" and better if they continue to look to the future for the best and most innovative ideas to maximize all possibilities to keep their communities safer. If they do, your morning commute will never be the same.

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