

TO DRIVE  
OR  
NOT  
TO  
DRIVE

Rush hours, feasts, festivals, beaches in summer, Paceville on Saturday night, all have one thing in common: traffic. Malta has one of the largest traffic problems in the world. Researchers at the University of Malta are trying to figure out what can be done to ease road rage and reduce drivers' lost time



Photo: Edward Duca



**Dr Kenneth Scerri**  
**Dr Maria Attard**  
**Prof. Adrian Muscat**

**T**he Maltese road network is bloated. Malta has one of the highest rates of car density in the world, rivalling some of the big cities such as London or Paris. The World Bank puts it in 9<sup>th</sup> place with 693 vehicles per 1000 inhabitants, while the US, famously considered as one of the most car dependent states, is in 3<sup>rd</sup> place with 797 vehicles. A less quoted but possibly more important statistic is the number of cars per square kilometre: the US has 25 vehicles; Malta packs a staggering 991.

A large number of vehicles means traffic. It wastes time, money, increases stress and noise levels, and pollutes the air. But can the Maltese road network be improved to alleviate these problems? Many researchers at the University of Malta are trying to solve these problems. Our approach involves using varied means like data gathering, policy analysis, transport modelling, and the assessment of innovative transport ideas.

The start of any study is based on a sound analysis of the current state of play. Dr Maria Attard (Department of Geography) has studied the local traffic situation, noting its evolution from just a few thousand cars to over 300,000.

People's dependency on cars makes Malta a world leader. Just over 1 in 10 trips are carried out by bus. Since the 80s Malta has witnessed a gradual switch from public to private transport, turning walking into a luxury.

Recent governments have tried to manage traffic growth, which has been a big part of Dr Attard's research into transport projects

and policies. The first Park and Ride scheme in Floriana was introduced to try and reduce the stress on the City's congested roads. On top of this, government even introduced a road-pricing scheme, the Controlled Vehicular Access (CVA) system in Valletta. Drivers had to pay to enter Malta's capital. In New York and Edinburgh similar ideas failed to be implemented. Certain key town centres have also been pedestrianised. All of these are efforts to reduce the congestion and pollution that come with using our cars so much.

Dr Attard's research on road pricing showed how such projects can be developed and implemented successfully. Malta introduced road pricing in 2007, three years after London's congestion charge and one year into the Stockholm trial. In Malta the scheme initially decreased the amount of traffic. Now traffic volume has levelled off as people might be getting used to paying the charge.

Dr Attard compared and analysed different cities showing that successful »



Photo: Kenneth Scerri

introduction in Malta and elsewhere needed a strong political will, thorough research, while being well thought out, designed, and executed. Malta therefore could be a good model for a mid-sized city to learn from.

## Maths to the rescue

Malta has many troublesome junctions. Fixing these problems is expensive and rarely reversible, needing extensive testing and serious evaluation before implementation. Dr Kenneth Scerri (Department of Systems and Control Engineering) and a team of engineering students build mathematical models that can test possible changes and see if these new ideas work at close to no cost at all.

The basics of transport mathematics are surprisingly simple and uncannily similar to the drain in our kitchens. The link is not as strange as it sounds.

Imagine your sink. With a slow supply of water, there is no water build up and the water flows straight out. Increase the supply

a little and the water level in the sink will probably slowly rise. Clog the drain and the water level will rise higher.

“Traffic flow behaviour can be captured mathematically by difference equations”

Traffic at a junction behaves in exactly the same way. With few cars reaching the junction, they sail right through with close to no delay. Increase the number of cars or block the junction ever so slightly, and the queue of cars slowly increases, just like your rising sink water with a stronger supply or a clogged drain.

Maltese traffic is a bit more complicated. A sink is just one junction. Malta has thousands. Imagine thousands of clogged sinks linked to each other. That is the Maltese road network. Despite its complexity, it can still be modelled with the right equations.

Traffic flow behaviour (and water, if you wanted to model your sink) can be captured mathematically by difference equations — that is, mathematical expressions of how something changes over time. Like roads themselves, the equations can all be connected to form a complex network that represents mathematically the local traffic network.

Coming up with this mathematical model is not as difficult as it might sound, though there are some complications.

First of all, have you ever heard the phrase ‘garbage in, garbage out’? This concept applies perfectly to transport models, since they can only be as good as the data available. Data gathering is a modeller’s first problem.

To make matters worse, capturing the complexities of all roads and junctions on the network requires accurate data over a long time. Thankfully, over the years, various studies have gathered some of the data needed and by collaborating with Transport Malta, University researchers have access to this data to study the Maltese network.

Most transport models require knowing from where people started driving and where they went. This information is gathered as origin-destination data and tries to capture all the regular trips performed by all drivers on the Maltese network. In 2010, Transport Malta attempted to gather this data through an extensive survey. They estimated that over 500,000 trips using a private vehicle are undertaken each day. Birkirkara is the most popular destination

with over 34,000 trips, followed by Msida (25,000), Mosta (21,000) and Attard (19,000).

Now that we have the data, how do we build the model? Traditional models assume that drivers all try to find the quickest route that gets drivers to their destination. This assumption runs into a few potholes. First of all, the quickest route will most likely change as the traffic volumes on the roads increase. Troublesome junctions might get so congested that drivers often decide to take other roads to reach their destination more quickly. Secondly, even the simplest Maltese model taking into account all arterial roads still need over 100 traffic nodes and another 100 links. Plug in 500,000 trips performed each day and most computers will burn down.

To overcome these problems, Masters student Luana Chetcuti Zammit has developed models that can work on a laptop. Her models use Bayesian Statistics to represent and estimate the traffic flow on all major roads on the Maltese Islands. This model has many advantages; most importantly they allow busy roads to be given more importance, give better results, and allow for a high level of stochasticity in the drivers choices, that is, they allow the drivers to take longer routes due to habit or because they might feel more comfortable with them.

Every model needs to be tested. To do this, Zammit flung data from another big dataset. It includes information like the daily number of vehicles on some major roads. For example, Aldo Moro Road in Marsa is the busiest road with 90,000 vehicles »



“Less cars on the road can allow people to enjoy walks around our beautiful villages and help increase the number of green spaces”



**CVA Valletta**

Cameras situated at every entrance and exit of the city capture photographs of vehicle movements. The pictures are scanned using optical recognition software to read the number plate. The driver is billed according to the time spent in the city.

per day. Thirteenth December Road in Marsa sees 50,000, while Marina Road in Msida sees around 40,000 vehicles.

The beauty behind these models is they can fill in the gaps. Transport Malta would need a hefty budget increase to monitor all roads. With this model, traffic flow in roads which are not covered can be predicted and different scenarios tested. What happens if this junction clogs up? Or what would happen if we added a bus lane, or widened the road? This model can test such ideas to make sure they work when carried out in real life.

**New ideas go under the virtual hammer**

Maltese people use cars to go everywhere. Whether we are on our way to work, the beach, the cinema, a restaurant, or to shop. Most people who can drive do so. Public transport is underused and people walk much less than their European neighbours. Maltese citizens are paying the price of underused transport resources affecting their health and emptying their pockets.

New transport ideas are needed to solve this problem. Prof. Adrian Muscat and researchers from the Department of Communications and Computer Engineering are considering novel transport modes. Their aim is to help people live better lives by reducing the amount of unnecessary cars on the road.

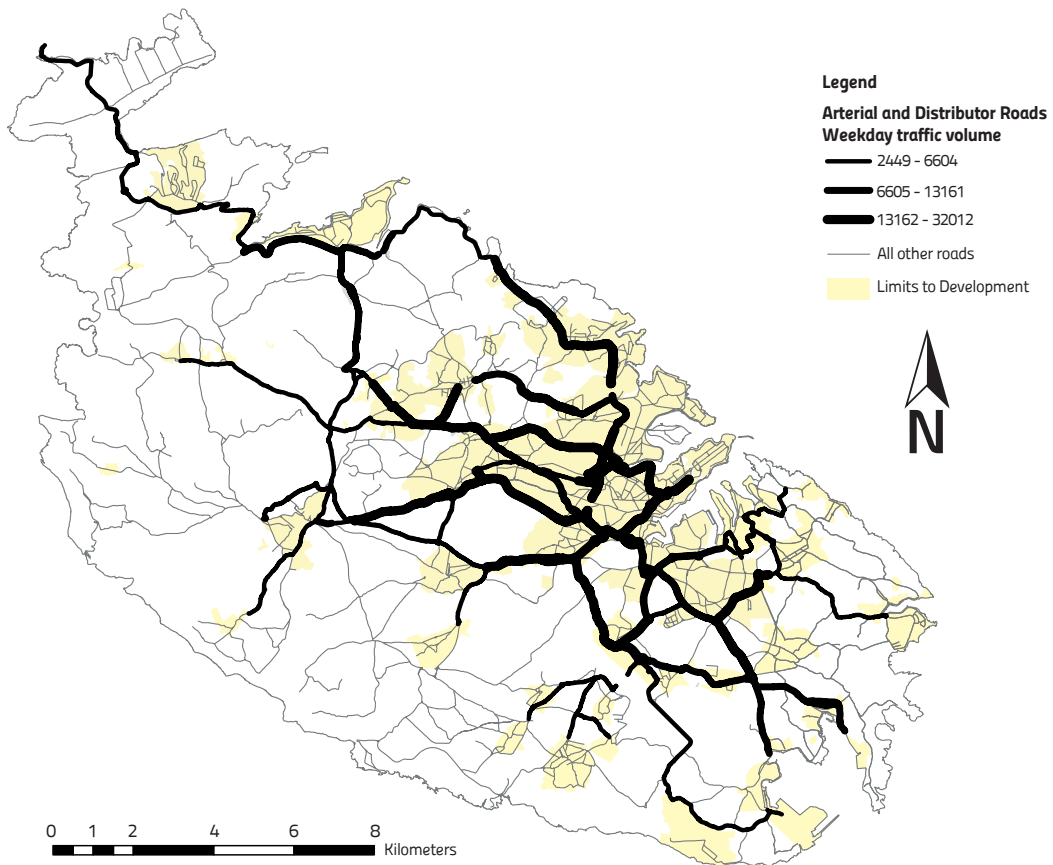
With a local lens, Prof. Muscat’s team is studying the impact of cars on people’s quality of life. Less cars on the road can allow people to enjoy walks around

our beautiful villages and help increase the number of green spaces. They are studying how ride sharing and taxi sharing, also known as dial-a-ride can help to tame our addiction to private cars. These ideas are not new, being implemented the world over, but scaling them up and offering them to the general public at low-cost is an innovative concept.

Let’s use another example to understand how taxi sharing works (no sinks this time). Sally is invited to a business meeting in Sliema. She works in Kordin. She picks up her mobile and asks (through a specific app) for a trip to Sliema. In a few seconds, she receives a message offering to pick her up in 10 minutes. She accepts, is picked up, shares her taxi with other passengers (who are travelling to different destinations), then arrives at her destination hassle free, and is finally billed three Euros.

For ride sharing, let’s consider Paul. He works in a large establishment with fixed working hours. The company organises a ride-share programme, with an added reward of a guaranteed parking space. Paul shares with four other employees. They all save on fuel, parking, and help reduce traffic at peak hours. All is again organised through an app on their phone making it quick, easy, and cheap.

Taxi sharing has a few advantages over public transport and normal taxis. It is cheaper than taxis and would only be slightly more expensive than public transport. Ultimately, it is the best of both worlds: affordable to many, flexible, and comfortable.



Model showing the 24-hour weekday traffic volume on Malta's arterial road network. Kindly provided by Dr Maria Attard

Ride-sharing is not perfect for everyone. People need to work within the same entity, which needs to ensure personal security. To effectively reduce traffic at peak hours, the scheme needs to be extended to the general public. 'How?' Is a tougher question to answer.

This group studies traffic from a holistic point of view trying to consider as many different factors as possible. By changing one point, 10 others could be affected which influences government policy. For example, it is undesirable to encourage a switch from

public transport to ride-sharing. People are better off using both.

Malta's traffic problem is solvable. Between 1998 and 2010 the number of bus trips to Valletta went up from 46.1% to 57% while private cars plummeted from 50.9% to 40.7%. Dr Attard's work shows how strong policy and effective measures can work. The current strain on roads can be reduced by encouraging more drivers to switch to public transport or sharing modes. Perhaps even reverse the trend all over Mal-

ta. But what would convince commuters to switch? Experience shows that fiscal rewards may not be enough. Delivering a high quality service is equally important. We need the right measures, tweaked to consumers' changing needs.

So let's start by all doing our part. Try to share a ride to work tomorrow, take a bus, or better still, walk with a friend. In the end, changing our travel habits might help reduce traffic but, more importantly, might make us happier and healthier. ●



Photo: Edward Duca