Portal introduces this special feature on the recent 'Intelligent Transport Systems: a Tool or a Toy?' event in Žilina, Slovakia

ITS: a Tool or a Toy?

The University of Žilina (UNIZA), a hotspot in intelligent transport systems (ITS) research, was awarded a prestigious ERA Chair grant by the European Commission, under the Seventh Framework Programme, for the implementation of the ERAdiate project launched in 2014. ERAdiate ('Enhancing Innovation and Research dimensions of the University of Žilina in Intelligent Transport Systems'), the first EC-funded project to establish an ERA Chair for ITS, is led by Dr Karl Ernst Ambrosch, who, among his team of researchers, is building up a unique research and innovation hub located in the Žilina region and oriented on global societal and environmental challenges connected to the solving of mobility issues with the use of ITS.

ERAdiate has the overarching objective to unlock and strengthen the research potential and promote the excellence of UNIZA as well as the Žilina convergence region in the field of ITS and, as the project website explains, 'the main aim is to enhance UNIZA and the Žilina region performance in research, innovation and education, as well as to strengthen UNIZA's competitiveness within the European Research Area (ERA).

'ERAdiate is developing significant ITS topics with international recognition and creates a recognised footprint. The project focuses on societal challenges, political goals, long-term strategies, sustainable solutions, technological and societal development to determine future 'market demand'.'

The relevant fields in research and innovation tackled by the project are co-operative ITS, the decarbonisation of mobility, urban mobility/smart cities, and intermodal ITS.

A tool or a toy?

In November 2016, the 'Intelligent Transport Systems: a Tool or a Toy?' event was held in Žilina, which *Portal* attended as media partner. This conference was co-organised between the COST Association and the University of Žilina, the latter as ERA Chair on ITS, and ERTICO as supporting partner, and was held under the auspices of the Slovak Presidency of the Council of the European Union.

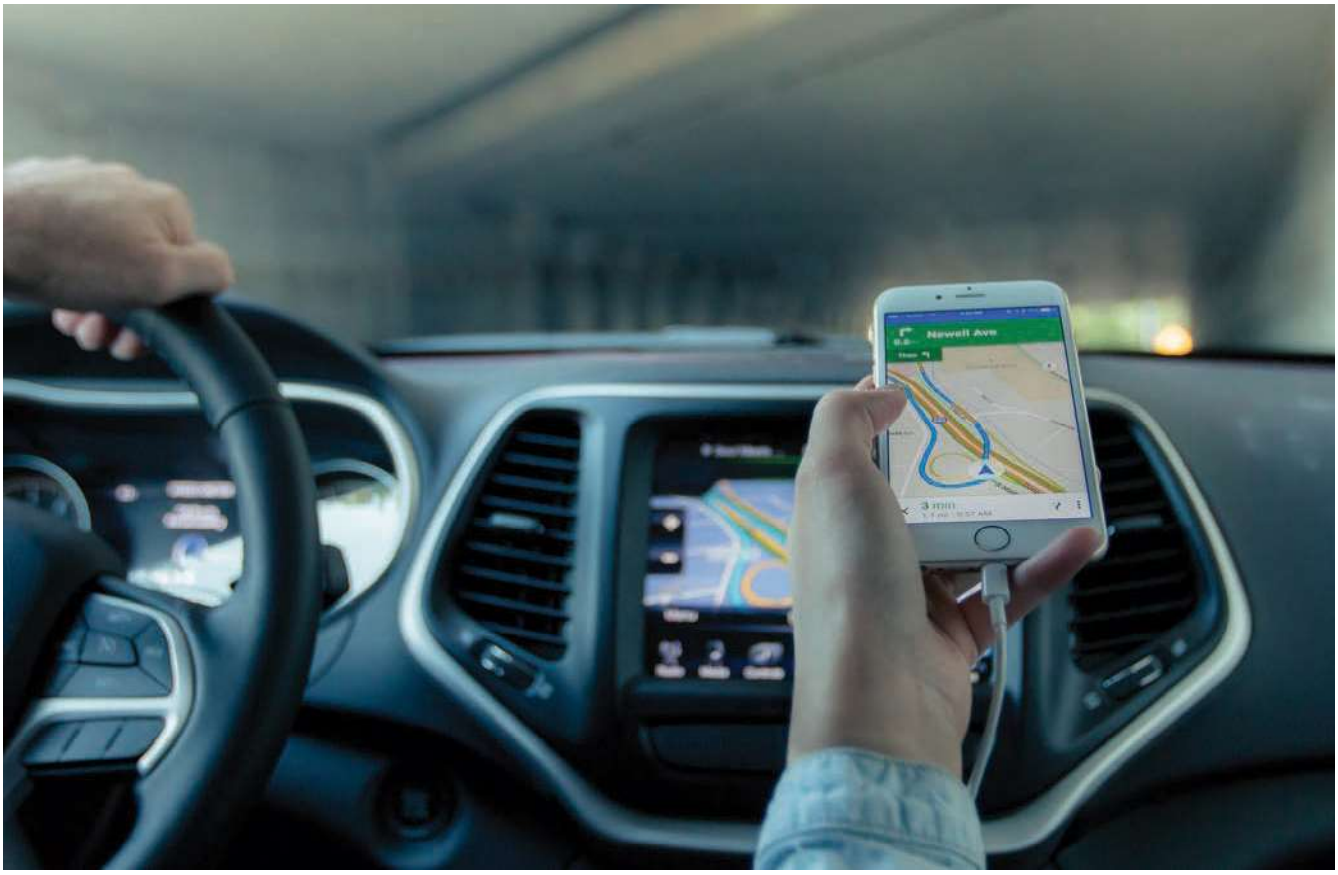
The relevant fields in research and innovation tackled by the ERAdiate project are co-operative ITS, the decarbonisation of mobility, urban mobility/smart cities, and intermodal ITS

The European Cooperation in Science and Technology (COST) is a funding agency for research and innovation networks. COST Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.

The aim of the event was to bring special attention to the role of research organisations in providing evidence to the policy makers for shaping the right ecosystem in ITS, and to the role of the industry, and in particular small and medium-sized enterprises (SMEs), in delivering innovative, sustainable and interoperable solutions. Particular attention was given to two important pillars of future mobility: autonomous driving and mobility as a service (MaaS).

This two-day conference took place in the context of the implementation of the legal framework (Directive 2010/40/EU) that was adopted by the European Union on 7 July 2010 to accelerate the deployment of the ITS across Europe.

According to the European Commission's White Paper on Transport, new forms of mobility have to be proposed for overcoming reliability, environmental safety and affordability issues towards sustainable solutions for the transport of people and goods. Until this event, advancements in research and technology had significantly contributed to this recommendation



by integrating multidisciplinary approaches, and by having addressed the fragmentation of knowledge in ITS.

However, the deployment of widely used interoperable and seamless ITS solutions was still lagging behind expectations, in terms of both their sustainability and competitiveness, and integrating their socioeconomic impact at regional, national and pan-European level.

Dr Mikael Pero, science officer at COST, said: "Over the past 30 years, COST has been helping researchers co-ordinate national initiatives leading up to today's intelligent transport systems concept. COST networks – also known as Actions – have been proposing solutions for transport issues affecting European citizens' lives, especially in urban areas: air quality, congestion, safety, accessibility, equity, inter-modality and journey time. For instance, transport operators and experts are now able to analyse harmonised EU data thanks to the COST Action 'SHANTI' methodology, meant to measure urban mobility.

"Travellers are also receiving more reliable information and experiencing safer journeys thanks to the work of TU1004 and TU1305, the latter using big data to improve transit

Over the past 30 years, COST has been helping researchers co-ordinate national initiatives, leading up to today's intelligent transport systems concept

predictive models. Similarly, app users may soon take advantage of European tracking and tracing technology, as Action SaPPART is advancing work on a standard use of global navigation satellite systems for personal mobility applications (EGNOS and Galileo)."

He added: "Understanding, analysing, and developing ITS is a complex matter, requiring a wide range of expertise. We noticed that COST Actions in ITS tend to grow more interdisciplinary, as they engage experts from different backgrounds: urban planners, architects, transportation engineers, sociologists and economists. This way, COST networks sum up the interdisciplinary nature of ITS.

"By co-organising the conference, COST and the invited Actions aim to share their experience and expertise with the wider ITS community, and certainly stimulate future collaborations."

Speakers at the event included Dr Angeles Rodríguez-Peña (president of the COST Association), Tatiana Čorejová (rector of the University of Žilina), Viktor Stromček (State Secretary at the Ministry of Transport, Construction and Regional Development of the Slovak Republic), and many others.

In the following pages, you will find interviews with both Rodríguez-Peña and Stromček, as well as Dr Floridea di Ciommo (chair of the Transport Equity Analysis: assessment and integration of equity criteria in transportation planning (TEA) COST Action) and Dr Francois Peyret (chair of the Satellite Positioning Performance Assessment for Road Transport (SaPPART) COST Action) – in addition to other relevant content.

President of the COST Association Dr Ángeles Rodríguez Peña met with *Portal* in Žilina, Slovakia, where she outlined some of the ways in which COST is evolving

COST: benefit analysis

DR Ángeles Rodríguez Peña, president of the COST Association, has a strong vision for the organisation's future, and one that centres on the evolution of COST as the premier networking tool in Europe. Of course, while many would argue that the association is close to that already, when *Portal* met with Rodríguez Peña in Žilina, Slovakia, on the sidelines of the 'Intelligent Transport Systems: a Tool or a Toy?' event, she outlined some of the ways in which she hopes to be able to build on the COST's core strengths in order to meet the recently defined strategic goals.

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According to Rodríguez Peña, COST's core strength lies in its ability to empower its researchers. It does this, she said, by not being "overly prescriptive", by allowing the researchers to identify what they see as the problems that require addressing, and by the means and methods through which they can be tackled. This, of course, is best achieved by the creation of a network which fosters collaboration and co-operation across disciplines and borders.

She said: "You empower the researchers to think by themselves, and then you provide them with a tool through which they can connect. This is crucial, because in most instances they are aware that the problem goes beyond what they can achieve alone; they are aware that they need to incorporate expertise from other disciplines as well as from stakeholders, policy makers, civil society, or regulators, and a COST Action allows them to do that.

"People are at the very core of COST; they are the drivers behind what we do. We simply provide a platform for them to come together, and we give them the freedom for them to think for themselves."

COST's core strength lies in its ability to empower its researchers, and this, fundamentally, is best achieved by the creation of a network which fosters collaboration and co-operation across disciplines and borders

Popularity *versus* budget

Given the unique way in which COST operates – there is, quite simply, no other networking tool in Europe which offers the same degree of independence and freedom – COST Actions are extremely popular with the research community, so much so that the success rate for the last call was just 5%, and not because of a lack of excellent proposals, but a lack of budget.

Indeed, Rodríguez Peña revealed that COST receives just €300m from Horizon 2020, which means that, frustratingly, so few new COST Actions receive funding. She added: "This is frustrating for both COST and the research community, who come to us with a wealth of great ideas, but who we have to turn away; what is more, we have lost an important part of our budget because of the European Fund for Strategic Investments (EFSI).

"Because of this, we perhaps run the risk of disappointing too many members of the community to the point where they may not return with a new application when subsequent calls are announced, which is something we really want to avoid."

The relatively low level of funding made available to COST through the framework programme

does indeed seem somewhat short sighted in that the COST Actions require little – in terms of funding or other support – in comparison to the projects funded under H2020 proper and yet have a tremendous effect.

Given the fact that H2020 and much of EU-funded science are geared towards the commercialisation of results, there is, perhaps, a sense that COST may be at a disadvantage here, as turning research into commercially viable products is not as high on its list of priorities.

Fostering communication

Moreover, for Rodríguez Peña, the way in which the framework programme is designed, essentially following a linear model of innovation, is now outdated. She explained: "Innovation does not happen in a 'linear fashion' –it happens in a more serendipitous way, and one of the most important issues inherent in attempting to get products to the markets is the establishment of a clear communication pathway, from the knowhow to the implementation to the users. An idea can be great, but if the market is not there, then the commercialisation of any results is all-but pointless."

This communication pathway is now beginning to emerge, with, for instance, universities increasingly developing technology parks where industry and SMEs can plug in. However, as Rodríguez Peña highlighted, this is only having an impact at the local level. "While that is, of course, a positive beginning, when these activities are successful they naturally want to grow, and then they must look at the common market, and so they are looking at the EU level, but there we have complete failure because the necessary instruments quite simply don't exist," she said.

"While COST may be unable to completely fill that void, its unique research-driven, bottom-up approach can play a major role. Indeed, 50% of our Actions have industrial participation, which clearly demonstrates our ability to attract industry.

"This level of industry involvement is also something that has evolved naturally, and is something that is also happening, although to a lesser degree, with other relevant stakeholders within the European community. However, we are not as successful at attracting larger businesses, and this is perhaps for the best, in that they can often be quite myopic in their approaches and, indeed, many sectors – such as pharmaceuticals, for instance – are heavily subsidised. As such they can often have less concern over project failures as they know they are able to absorb the cost later on," the COST president continued.

Due to the relatively small amount of finances COST receives from H2020, relatively few new Actions receive funding

For Rodríguez Peña, jobs and growth are kick-started by SMEs at the local level. COST is there to enable networks to begin here but also to be able to grow, to reach the European level, and to prosper. It is here, she told *Portal,* that communication really is key, with the networks enabled by COST creating communication platforms of all kinds. But, she added, "you need to have enough networks. Not 300, but 3,000 or even 30,000. When we reach that level, we will be able to have a truly significant impact."

The advantage of synergies

COST's ability to generate synergy is also one of its defining features, and, again, this is perhaps also something that is lacking at the EU level. Rodríguez Peña explained: "In Europe, there are numerous initiatives and funding mechanisms for science-related activities, but there is nothing to provide the glue to hold them together, and so they run on without connecting. At COST, we bring people together at the grass roots level and let it evolve naturally into something more powerful."

The ITS event in Žilina was a great example of how, for instance, COST is able to create such synergies amongst various stakeholders. Yet, while the association is indeed very good at this, it is not one of its core focuses; rather, this again is something that has grown organically from the way in which COST operates.

The organisation's president added: "In this sense, I see COST as a contributor, and we are happy to be able to contribute in our own humble way to create the necessary synergies at the EU level."

A further area in which COST has a role to play is in creating and sustaining a feedback loop to the European Commission. That is, in order to ensure future calls are relevant, those designing them require feedback

from those involved in answering them, and as COST is independent and, indeed, not led by any single country, therefore avoiding any kind of bias, the commission is always keen to hear what COST has to say about where future priorities should lie.

Trial and error

Given the ability of COST to provide a communication platform from which to build networks and form synergies, the fields of intelligent transport systems and smart cities are amongst those which stand to benefit significantly from the work of relevant COST Actions.

Indeed, smart cities and their constituent parts – from smart lighting, to transport, buildings, health, leisure and everything in between – will require a multistakeholder approach at a level never seen before, as sectors (some of which are not traditionally 'smart') need to come together for the success of the greater whole.

For Rodríguez Peña, however, the challenges posed by the transition to a smarter future are too great to be tackled in any one single way, and so numerous approaches to the various elements must all be tried. She told *Portal:* "This is something that, quite simply, has to be achieved, and the only way of doing that will be to break the overall challenge down into manageable elements.

"For a scientist, this is quite natural, and they will go on to formulate a hypothesis and conduct experiments on the areas they feel require attention. Here, as in many others, a 'trial-and-error' approach will be necessary, but, of course, if we don't try then we won't succeed. Pilot cities, and indeed projects, also have a clear role to play as they will enable the researchers to see what works where and to share best practice."

This, she added, is important, because Europe's strength is often said to lie in its diversity, and this very diversity will mean that a 'one size fits all' approach will find little success; flexibility and diversity in the work being done to tackle smart city-related problems, however, will be vital to their realisation.

Once the over-arching challenge has been broken down it will also be important to ensure synergy between the various initiatives and, finally, to bring the diverse elements back together once more. Again, COST can play a role here. Rodríguez Peña explained: "We are able to create networks of networks, and these are extremely successful in reaching out and connecting with not only other COST Actions, but also other networks within other programmes, such as the Marie Skłodowska-Curie Actions, and others. This is something that, moving forwards, COST needs to become much more active in; we aim to help our Actions with more support, more funding, logistic support and contacts."

Future objectives

COST's future has been under scrutiny by the organisation in recent months, with an assessment being made of what it does, why it does it, and what it would like to do in the future. This has been compiled into a document entitled 'Vision and Strategic Goals' and while, according to Rodríguez Peña, they currently remain just that – 'visions' and 'goals' – the exercise has been useful in that now objectives have been identified, work towards them can begin.

She said: "We have identified four strategic goals. Firstly, we want COST to be *the* networking tool in Europe – the most relevant in the sense of being the front runner by covering things that others cannot because of cost or any other reason.

"There are other networking tools in Europe, but none can offer the same as COST: the Marie Skłodowska-Curie Actions have a very specific purpose, the Networks of Excellence are no longer functioning, and the ERA-NETs have no clear networks. We want to be able to provide a lens through which it is possible to view a snapshot of a specific field or area so as to be able to quickly map that area, rather than relying on lengthy and often expensive exercises which are never truly complete."

The second strategic goal concerns the empowerment of researchers, which is to be widened so as to also include capacity building. "COST has always been very good at capacity building, but we need this to be applied to everyone, and that includes a substantial amount of support for young researchers," the organisation's president said, adding: "We have to provide the necessary skills and opportunities for developing leadership and strengths, which should be available for everyone so that we can ensure that the next generation can surpass their predecessors in terms of both their creativity and their output and results.

"That will be achieved through networks, as this enables the sharing of skills as well as providing the chance to learn new things and to then put these things into practice. You cannot be a leader if you don't lead anything, and the networks in which we help the research community to develop will ensure that the next generation of leaders has the skillset necessary for success."

Third, Rodríguez Peña explained, COST will work to become better at providing policy advice. COST has some 50,000 researchers all around Europe, who can be used "to feed the political debate," she said, by highlighting the needs of the research community. "This," she added, "is something that will also be able to benefit the policy makers at the member state level, which is often missed when research-based policy is discussed."

The formation of synergies forms the basis of the fourth and final strategic goal, and the COST

president explained that this now needs to go beyond the synergies between COST Actions to include a much broader focus and so include other initiatives. Rodríguez Peña said: "We can do this by looking at how we can provide added value and help other, previously existing synergies. We are planning a strategic approach to this, and hope that, in the future, this will be something we will not have to actually actively pursue; it will happen by default."

COST hopes to have made significant progress towards achieving these goals by the time that the successor to Horizon 2020, Framework Programme 9, is rolled out. Discussing her hopes for the future, Rodríguez Peña said: "For FP9 we want to be the leading network in Europe, which will mean that any researcher who feels they need a network will know where to go.

"By that time, COST will also be able to provide a range of networks, whether large or small, for instance, and applied to any number of topics. By doing this, we will create added value by creating synergies and complementarities with other EU initiatives, and will also have an impact at the member state level."

These goals are, of course, quite ambitious – especially given the timeframe in which the association hopes to achieve them – but, as Rodríguez Peña pointed out, "ambition is important". Nevertheless, in the same way as she believed the challenges posed by the smart cities of the future must be tackled, the COST president revealed that the organisation will work towards its strategic goals by breaking them down into more achievable ones that comprise the whole, whilst also ensuring that these tasks are properly prioritised.

Visibility, reach and impact

The future of COST was also discussed at a recent ministerial conference in Slovakia's capital, Bratislava, where, despite receiving praise and positive feedback for the work done thus far, it was also decided that the association needed to enhance its visibility and impact. Outlining some of these comments, Rodríguez Peña said: "It became evident that while we are doing well, this impact is diminished somewhat by the fact that we are simply not visible enough; not enough people know what we do and how we do it.

"Similarly, we have concluded that we must do more to support the next generations of researchers and, alongside this, must do more to ensure the inclusion of SMEs. As such, we are now changing our documents and perspectives and are enhancing the dialogue we have with stakeholders and participants with regard to what research is taking place. By doing so, we hope to ensure that those reading our material will see that, no matter their area of professional expertise, they can become involved in one of our COST Actions."

Administration

As COST is not a part of the European Commission's framework programme, there is also potential, Rodríguez Peña said, for the organisation to become a very effective administration. She said: "We can work to protect the interests of researchers, ensure that they are not overwhelmed with regulatory hurdles and bureaucracy, and we can actually run processes and make pilots.

"For instance, one thing that COST is doing now is exploring how to evaluate interdisciplinarity, which is a challenge. Having a bottom-up approach can be difficult in some senses because it means that we can potentially receive proposals of any kind. Indeed, most of our networks are highly interdisciplinary, and so we need to be able to evaluate that, which has been quite challenging. We are now trying to put in processes which are incredibly important because, essentially, the nature of the end product will depend on the process it has been subject to."

There is also, Rodríguez Peña added, a need for a paradigm shift on the part of service providers. According to the COST president, it is often easier to provide funding for a single, large project, as opposed to several smaller ones of lesser cost. Yet, with the latter option, if one project fails all is not lost. This, she said, needs to be better recognised, which will depend on a change of mentality. She concluded: "Being a service provider, you have to understand that you are there to serve a purpose and, moreover, that you are there to ensure that the end user is receiving the proper support.

"Many administrations manage to somehow implement layer after layer of processes, making it increasingly difficult for the end user to navigate. For COST, the opposite approach will be taken, with the superfluous layers pared away so as to streamline the entire process."

FP9 is just around the corner, and while COST's goals are ambitious, the association has a strong, focused and proactive approach through Rodríguez Peña and the rest of her team; as such, the association is more than capable of achieving them.

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Dr Ángeles Rodríguez Peña
President
COST Association

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Viktor Stromček, the State Secretary of the Slovak Ministry of Transport, shared with *Portal* his thoughts on intelligent transport systems and Slovakia's role in the transition to an autonomous transport future

Slovakia in the driving seat

Intelligent Transport Systems: a Tool or a Toy?, held in November in Žilina, Slovakia, took as its theme the role of research and industrial organisations in shaping the future of intelligent transport systems (ITS) in Europe, with particular attention being paid to autonomous driving and mobility as a service. Organised by COST (European Cooperation in Science and Technology) and the University of Žilina, and supported by ERTICO (a platform for the development and deployment of ITS in Europe), the two-day event was held under the auspices of the Slovak Presidency of the Council of the European Union, a role the country assumed from the Netherlands in July 2016 and handed over to Malta at the beginning of January this year.

On the sidelines of the conference, *Portal* met with Viktor Stromček, the State Secretary of the Ministry of Transport, Construction and Regional Development of the Slovak Republic, to hear his thoughts on intelligent transport systems and how Slovakia is driving the transition to an autonomous transport future.

Which particular areas of intelligent transport systems is Slovakia focusing its efforts on?

When we talk about infrastructure, we are not just talking about highways and railways – we're talking about highways, railways and intelligent systems, which have become a necessary part of that infrastructure. Say we want to build a new tramway, we want to know how many people use trams, how many use a certain line, and how they can run more efficiently. When we are talking about cars we want to know the capacity of the highways and where the peaks in traffic are – that way we know where best a new road might be built. Let's say the regions have supplied around €20bn for new infrastructure. It's very difficult to say which plans or proposals are the best and which ones are a definite no, and you can imagine the tension between authorities and mayors in each region, all of whom think their proposal is needed the most. It's not easy to decide what to build simply by looking at a plan on the table; we've got to have the data from the intelligent system in place before we can make any decisions about new highways or railways infrastructure – that way we'll know how our decision will impact on transport in reality.

Slovakia is a nice country but a small one, so while it's very important for us to support all kinds of activities in the area of intelligent transport systems, cross-border activities are particularly crucial. For us, the number one area of importance when considering intelligent transport systems is security, and in that respect it wouldn't make sense to work alone and do something just for us. That's why it's so important to have good co-operation with other countries.

Intelligent transport systems involve a huge amount of new information in the form of data that can be read and used online. So to be a good partner to others, we'll need to have very good internet coverage – I'm not talking about just SMS and other messaging services, but about 5G and so on. Slovakia has to be ready for that. This is one of the biggest opportunities for the country but, on the other hand, also one of the biggest issues facing us.

These are our main aims in terms of intelligent transport systems.

Is Slovakia looking to incorporate the intelligent transport system into the smart city more generally?

Good state and city co-operation is important in this respect. A good example is our big infrastructure PPP project, which is one of the largest in Europe. It aims to build a ring road around Bratislava and a speedway in a very problematic area of the city. At the moment, this area sees some 30,000 cars travelling across just one simple road, and more than 100,000 cars pass over one bridge each day.

Now we have started to build a new bridge and a new speedway. But we have warned the city to prepare itself, because we will be better with our infrastructure, but whatever we build it will have to continue. We have invested in new trams and new bridges in Bratislava, but all of

it is dependent on an intelligent-style system, and the city needs to be ready for that. I think there is some work for both state and the municipalities to do together here. There is a space for better communication and more and better data.

You mentioned in your welcome address to the conference that policy is always playing catch up with technology. How are you addressing that challenge?

The government never moves as quickly as technological progress. What that means is that we need a good, solid framework, and we have to be ready to support new technology development – whether from a university or business, it doesn't matter. We want to be a good environment for innovation. We want companies, when they think about technology development, to say, 'Slovakia would be a good partner for that'.

Concerning the importance of cross-border collaboration, how is Slovakia looking to expand co-operation with Poland, the Czech Republic and Hungary when it comes to intelligent transport systems?

We want to have autonomous driving between our countries as soon as possible. Slovakia is the biggest producer of cars *per capita* worldwide (car producers now account for more than 20% of our economy), and Hungary, the Czech Republic and Poland are also a very big part of car production in the European Union. So Slovakia would like to be a leader in this kind of activity.

Autonomous cars are the end goal. Of course, we understand that this will take time – but it will take time because to do it correctly means taking all the necessary steps. And that opens up opportunities: autonomous driving is the aim, but that doesn't mean we can't develop and implement new things in the meantime and along the way. This is what the recent memorandum of understanding signed between the four of us is about. We want to work together to achieve autonomous cars step by step, and within that process we want to involve car producers and other types of companies.

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There are a lot of opportunities in autonomous cars for technology providers, for instance, or GSM operators. Indeed, the smart car operators of the future might very well be Apple and Microsoft rather than Kia or Nissan. It'll be interesting to see who'll be faster and more proactive in that regard.

How does work within Slovakia translate through dialogue and collaboration with the European Commission? What support is available at the EU level for the kinds of activities Slovakia is engaging in?

I have to say our co-operation with the EU is quite perfect – for two reasons. First, the European Commission is very proactive when it comes to these kinds of opportunities. It hasn't just sat back and waited for a signal from the member states that they are ready to start thinking about ITS. When I meet with the representatives of the European Commission, it is clear that they really enjoy what they are doing and they enjoy new technologies. They are really passionate supporters of ours. Second, our communication with the European Commission is absolutely without any problems. We really appreciate this, and we think and we hope things will continue to work this way through many more milestones.

Slovakia inherited the council presidency from the Netherlands and will pass it on to Malta. What have you learned from your predecessor's approach to intelligent transport systems, and what advice will you be passing on to your successor?

The Netherlands presidency did excellent work with regards intelligent transport systems, and I hope that we are continuing that progress successfully. Our recommendation would be the same to Malta – to just continue with this progress. What's important to remember is that the new technologies we would like to see adopted in the car industry will in the future be mandatory. In a few years, no matter whether a car is €5,000 or €100,000, it will have these new features. That's a really good thing because they will make driving safer and drivers more comfortable, and are also beneficial from a cost-benefit and ecological perspective.

HORIZON 2020

Viktor Stromček
State Secretary
Ministry of Transport, Construction and Regional Development of the Slovak Republic

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Dr François Peyret, chair of the SaPPART COST Action, highlights the importance of positioning systems in ITS

Getting into position

Within the field of intelligent transport systems (ITS) the accurate positioning of vehicles via satellite is crucial. According to the Satellite Positioning Performance Assessment for Road Transport (SaPPART) COST Action, GNSS is 'expected to deliver many benefits, including reducing congestion, increasing capacity and improving safety. The road sector is estimated to represent more than 50% of the GNSS market and 75% when we consider the mobility services on smartphones.' There are, however, challenges which remain to be solved.

Portal **met with the chair of this Action, François Peyret, at the conference 'Intelligent Transport Systems: a Tool or a Toy?' in Žilina, Slovakia, to discuss some of the ways in which satellite-based positioning systems will play a role in the transport systems of the future and some of the challenges involved.**

To begin, why is the standardisation and certification of GNSS for road transport important?

Firstly, GNSS will be the heart of all positioning systems used in the road transport sector. This is true not only for navigation purposes, because when it comes to any advanced driver assistance system, the accurate positioning of both the vehicle and indeed the other vehicles on the road will be vital.

Indeed, positioning is really at the centre of ITS, and GNSS will be in any positioning system, even if it is used alongside other sensors and technologies – which will be necessary due to some of the limitations that GNSS has, such as a degradation of signal in so-called 'urban canyons' in cities. Thus, there is a need to hybridise GNSS technology with other sensors (which are now available) and which can even work independently from GNSS – such as LIDAR. This will be crucial in order to ensure an accurate position.

GNSS is a quite complex system. To characterise the positon you obtain via a GNSS system, it is necessary to have a knowledge of that system, which will provide you with your position, speed and time; you also need to have good metrics to measure those features so as to be able to assess their performance; and you need to have complex tests for the specific conditions you are operating in. Indeed, one cannot generalise the accuracy of any given GNSS system; it is only possible to say that it is accurate to whatever degree in a specific condition and at a specific time.

Alongside GPS, there are now other positioning systems available – GLONASS (Russia), BeiDou (China) and, of course, Galileo in Europe

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However, there is currently nothing available to be able to define the metrics and tests and to check them, because this is an area that remains under-emphasised in the transport and ITS fields. There is thus an urgent need to investigate this properly, because in order to use a vehicle which will use a positioning system, the performance of that system will have to be certified; to do that, standards will need to be developed in order to know which feature to test and which metric to use to measure it. We are currently working on that within the standardisation group at CEN-CENELEC.

Given such endeavours as Galileo, what is the current state of GNSS and other satellite positioning services in Europe? Does there need to be more improvement, more work to enhance capacity, performance, or coverage?

Yes, there is a need for improvements, and work is already happening to help their realisation. When we first started looking at positioning, GPS – the American system – was

the only system available. Now, of course, there are others: GLONASS (Russia), BeiDou (China) and, of course, Galileo in Europe.

The Galileo constellation has experienced several problems and has been delayed considerably – although this has tended to come down to politics rather than technology – and there is now a very real chance that BeiDou will be finished first. This could cause significant problems for Galileo, particularly when it is considered that the electronic chips it uses are not compatible with their GPS or GLONASS. This could prove to be problematic because the manufacturers of receivers may not see it as being worth their while to adapt their technologies. Nevertheless, Galileo will be a good system, but from the point of view of the end users and the manufacturers, the main concern is the efficiency of the system, and that could mean that Galileo will not be used if it doesn't bring anything new to the table.

What could help Galileo is the inclusion of functionalities that are unavailable for the other systems. Such services, of course, would be in addition to the basic, free civil service equivalent to that provided by GPS. These could include commercial services, such as the provision of a very secure system with authentication capabilities, which allow the user to know that the signals they are using come from Galileo (this would be of use to the security and military sectors). A further commercial service could be the provision of so-called 'precise point positioning' (PPP) which uses a phase of the satellite signal to provide centimetre-level positioning accuracy. Galileo is in a prime position to do this as it will be utilising numerous frequencies.

In Europe there are those who are working on PPP, and progress is being made, which is imperative because it could prove to have important applications in the field of ITS and autonomous vehicles, where signature accuracy is of paramount importance.

What are the biggest scientific challenges when it comes to autonomous vehicles and the utilisation of GNSS services?

Perhaps the most significant challenges concern safety, and there is a need to have what is known in the civil aviation sector as positioning 'integrity'. That is, you need to know that you are where you think you are – if your system is inaccurate by, for instance, a metre, this can be quite dangerous.

Safety very much depends on the integrity of the positioning, and integrity is the confidence you have in your position, which is generally measured by the maximum error you think you have – known as 'the protection level', which is a concept borrowed from the air transport sector. As long as it can be ensured that the actual error is below this threshold, then safety can be maintained. Achieving this level of integrity can be tricky, and using the best of the available information necessarily means combining different sources of information.

As smart city concepts evolve, will the necessary hybridisation of systems for automated driving evolve alongside it?

These two areas are indeed linked, but, for the moment at least, they are evolving in parallel. Smart cities will, of course, involve a network of sensors, but such networks are not typically built to support autonomous vehicles; they have other objectives.

In the future, vehicles – whether they are autonomous or not – will be connected (that is, they will have the capacity to talk to one another) and be co-operative (what they do with this connectivity); they will be connected to the infrastructure in particular. In cities, vehicles are almost always surrounded by objects, and so to support satellite positioning systems, these objects can become 'active'. Sensors located in certain places can transmit their position and these can be used to complement the GNSS positioning.

How will the positioning issues come to be addressed moving forwards?

I think we will come to see prototypes emerge which are able to use GNSS to navigate precisely – and not only those which make use of PPP. Indeed, I am involved in some European projects which are already working in this domain.

When it comes to autonomous vehicles and ITS more generally, the future is uncertain. There is a distinct sense that automation is an area that has now become very popular. Following the Google initiative, many different car manufacturers have turned their attention to the field and are proposing partial automation systems, but they are still far from being commercially available. Indeed, when Uber showcased its autonomous vehicles they were equipped with €50,000 worth of sensors. That, clearly, is a long way from being anything close to a level which could see a wider rollout.

Before this happens, vehicles will go through various degrees of connectivity and co-operation, but, of course, these things are not as attention grabbing as vehicles which drive themselves, and so tend not to feature in the media spotlight.

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Dr Floridea di Ciommo met with *Portal* in Žilina, Slovakia, to discuss some of the equity considerations in the field of intelligent transport systems

Transport for all

There is, it seems, quite a significant lack of understanding of equity implications when it comes to the assessment and appraisal of transport projects and policies. When *Portal* travelled to the 'Intelligent Transport Systems: a Tool or a Toy?' event in Žilina, Slovakia – a conference co-hosted by the COST Association and the University of Žilina, the latter as European Research Area (ERA) Chair (ERAdiate project) on International Transport Systems (ITS) – Floridea di Ciommo, chair of COST Action TU1209 designed to address some of these issues, explained that this lack of understanding is preventing, or at least delaying, a shift from older planning frameworks.

Di Ciommo's Action – Transport Equity Analysis: assessment and integration of equity criteria in transportation planning (TEA) – holds that understanding the equity implications of transport policies and investments is becoming increasingly important, as underscored by social movements around the world. She told *Portal* that the lack of understanding mentioned above is "a key question for equity and transport because, traditionally, transport planning assessments have been based on a cost/benefit analysis concerning the amount of time that can be saved. Now, however, with the emergence and evolution of intelligent transport systems, this needs to change – to take autonomous vehicles as an example: a traveller's time can now be used for other things while they complete their journey. Similarly, many buses and trains now offer Wi-Fi, meaning that the time spent on-board is no longer time spent out of contact with the work or social environments. As such, time should no longer be used as the key variable for funding transport projects."

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Public transport system appraisals are still based on a utilitarianism paradigm in which everyone, regardless of age, gender, ability/disability and so on, pays the same to travel between the same two points

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This, Di Ciommo added, will also come to have a significant impact on how we see cities evolving and new cities emerging, as the emphasis will be taken away from roads and cars and placed on ITS with a view to helping to foster a more profound shift towards mobility as a service (MaaS).

Utilitarianism paradigm

Alongside this, Di Ciommo explained, public transport system appraisals are still based on a utilitarianism paradigm, in which everyone, regardless of age, gender, ability/disability and so on, pay the same to travel between the same two points. "This," she said, "fails to recognise that there are many sub-populations who perhaps cannot afford that cost, or who have mobility issues preventing them from using a particular service." Furthermore, she also highlighted the fact that research has shown that those people in higher income brackets make more trips than their lower paid counterparts. Their weight within the utilitarianism appraisal is therefore higher, with a consequent higher probability to choose the best transport system for them.

Her Action is thus aiming to include social and spatial factors in social welfare assessment by introducing the concept of gains of accessibility to key social activities. Specifically, the aim is to replace the traditional measure of time savings that favour

better-off societal groups with accessibility gains that cater to the needs of more vulnerable social groups. In this way, the social welfare function will be more equitable.

In addition to a shift away from the utilitarianism paradigm, or perhaps as a part of it, it is important to understand the needs of people in terms of transport. For Di Ciommo, a bottom-up approach can be taken by utilising the mobility data from local satisfaction surveys and so on to better understand the needs of this population. She added: "These needs will, at this level, differ from person to person and trip to trip, but a more generalised picture will then begin to emerge with the needs of specific groups of people."

Horizontal *versus* social

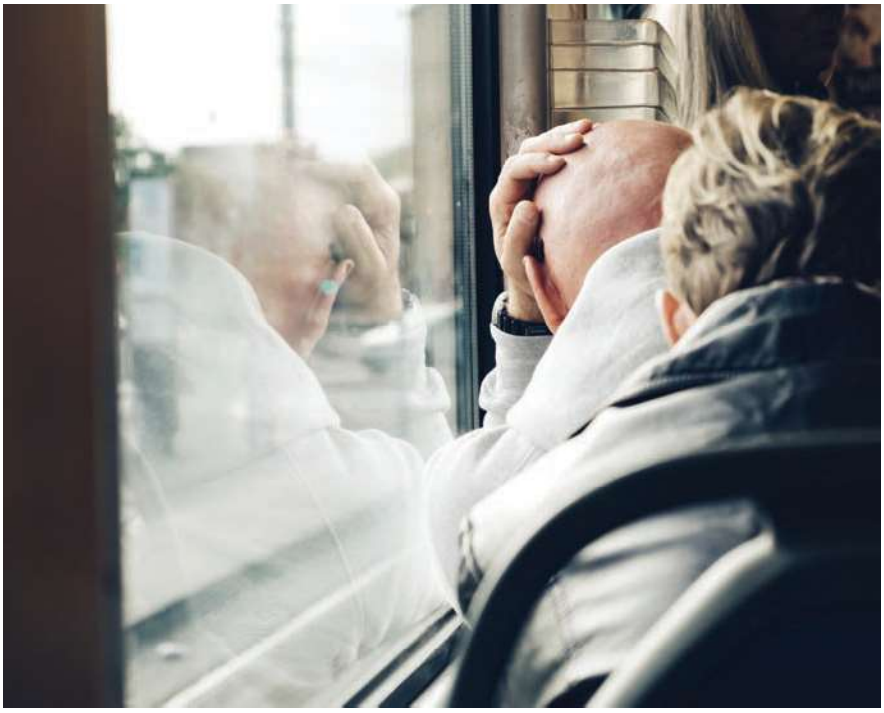
What becomes clear, according to Di Ciommo, is that the horizontal equity currently being employed is fallible. That is, charging everyone the same price for the same service – and in the transport sector this is perhaps seen as a result of the privatisation of public transport and utilities in cities – in the same way that everyone is charged the same for a product in a supermarket, is marginalising various societal groups.

In stark contrast, a vertical model of equity, also known as 'social equity', looks to provide services to those who need them but may not be able to access or afford them; one way in which this can be achieved is via subsidies – although, as Di Ciommo pointed out, when this approach is taken, there tends to also be a lack of transparency. Yet, a shift to a paradigm which puts 'needs' over 'preferences' is favourable as it will fill the transparency lack by respecting, at the same time, the social equity.

Di Ciommo also told *Portal* that "a comprehensive equity system" will be something of a Holy Grail, in that it would enable equity for everyone. She explained: "If services are designed for the impaired – whether mentally or physically – the benefits they bestow (perhaps ease of access or a much simpler explanation of information) will be of use for all. The idea is to design a system for a specific group, but to also make it a universal system that all people can use."

Gender bias

Inadequate transport sometimes contributes to social exclusion, particularly for people who live in an automobile-dependent community and are physically disabled, have a low income, or are unable to own and drive a personal automobile. This is also true for women, with a quite pronounced gender bias existing in transport systems.



Charging everyone the same price for the same service is marginalising various societal groups

Di Ciommo said: "In a typical household, it is quite normal for the man to take the car and for the woman to use public transport, and while there may well be arguments calling for women to share the privately owned transport more equally, the sociological evidence shows that women are more oriented towards ecologically friendly behaviour, such as using public transport and eco-friendly modes of transport, than their male counterparts.

"As such, it is important now for public transport providers to recognise that the majority of their customers are women, and so provide services that are more gender oriented. Of course, any such services will also be usable by men."

When arguing for one system over another, particularly for a new system, it is crucial to be able to show that it is cheaper, or at least no more expensive, than the one already in place, and the same is true for the example provided by Di Ciommo.

Moreover, it is similarly crucial to ensure that equity issues are taken into consideration at the planning stage, and the last Transportation Research Board (TRB) workshop on Equity in Transportation: Guidelines for Stakeholders and Practitioners at the TRB 96th Annual Meeting on 8 January 2017 in Washington DC looked at the issue of transportation equity with regard to gender. The idea here was to show the importance of equity consideration in planning. Di Ciommo said: "Once you integrate the equity consideration, the system as a whole becomes better for everyone."

Policy and planning

While there may be concerns that, until this can be achieved, current systems will require a retrofitting approach that may meet with resistance on the part of service providers, there is, Di Ciommo explained, a more

pressing issue: the fact that many policy makers are still not realising the value of including service users in planning activities from the outset.

She continued: "It is, of course, easier to follow the well-trodden path, but governments and policy makers are also in place in order to effect change for the better, and it is therefore vital that they understand just how important the service users and their needs are to the formulation and implementation of transport and mobility solutions of the future. There are many parts of cities which remain segregated because they are not connected, and while this raises many challenges across a wealth of sectors, transport can certainly play a role.

"When it comes to the cities of the future, they must also understand that these must not be planned and built with the private car at their heart; even when autonomous vehicles become widely available, it is doubtful that they will come to entirely replace public transport systems (for a variety of reasons), and so with less investment, these environments could be better tailored towards the idea of MaaS, and so, for instance, encourage people to walk a short distance before using public transport, with this combination of transport modes being neither more expensive nor more time-consuming than using a private car."

According to Di Ciommo, a survey of attitudes in Barcelona, Spain, has revealed that just 25% of people remain committed to owning and using their on automobile; but, she said, should the other 75% receive adequate incentives from local government to utilise public transport and MaaS more generally, then there is a very real chance to change the behaviour – particularly given that, in the long term, a reduction in investments for car-related infrastructure may also guide this smaller population towards more sustainable transport modes.

Of course, there is also the argument around the environmental impact of the ever-increasing number of cars on the world's roads, as well as the often severe health impacts that this has. Indeed, Di Ciommo told *Portal* that, recently, Spain's capital Madrid had seen unacceptable pollution levels and, as a result, people had been required to use transport solutions other than their cars. She added: "People need to look at this in the same way as, for instance, conditions caused by severe snowfall – they are unable to use their cars for a time, so have to have a 'Plan B'. Once the air quality has returned to normal, they can once again go back to their vehicles."

When it comes to the cities of the future, policy makers must understand that these must not be planned and built with the private car at their heart

There is also the argument that, once people have seen how easy it is to use MaaS – once the relevant ITS have been implemented, that is – then they may not go back to their cars, but decide instead to travel by public transport or other shared services. Of course, this will also have direct economic benefits.

Ambition

The ambition for change in Europe is there, and a lot of the credit for that can perhaps be taken by Di Ciommo's COST Action, which has made phenomenal progress in creating the necessary critical mass for this to happen. Indeed, the European Commission's DG MOVE is now taking equity into account, and there has been a call for proposals under Horizon 2020's Societal Challenges pillar for 'Improving accessibility, inclusive mobility and equity: new tools and business models for public transport in prioritised areas'.

Additionally, the COST Action has enabled the establishment of a cross-disciplinary network of researchers – bridging spheres such as ICT, economics, psychology, health, education, transport, civil engineering, sociology and so on – who all bring different background knowledge, forward-looking ideas, and theoretical approaches. As Di Ciommo said, it is often the intangibles which are more important than some of the measurable results.

Beyond the Action, Di Ciommo and her team hope to be able to establish what she termed an 'open access university', which will begin with freely available videos on transport, including ITS and MaaS, with regard to equity. This will, she hopes, begin to attract additional funding in order for it to grow and, indeed, will help to attract young researchers/planners who have an interest in these issues, thus ensuring that the field will continue to be manned in the years to come.

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