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*Sharing solutions for better regional policies*

# CISMOB

# Pilot Action

# Survey results

# Policy guidelines

European Union
European Regional
Development Fund

25 January 2020

# Contents

# INTRODUCTION

## The relevance of real-time information in public transport – previous findings

Providing accurate and real-time information (RTI) on services can be an effective way of encouraging passengers to shift from private to public transport (PT).

Information on current vehicle location, next stop and expected arrival times, and in more advanced applications, occupancy rate and possibility of planning routes/lines interactively in bus stops and intermodal stations, can affect trip planning/experience. Most of the available RTI is based on automatic vehicle location (AVL) and Global Positioning Systems (GPS) to predict arrival times for passengers and traffic system operators, and such information is usually provided through panels, smartphone apps and websites (Brakewood & Watkins, 2019).

RTI systems are expected to improve travel experience, affect users' perception in terms of reliability of service (Watkins et al., 2011) and allow passengers to make more informed decisions (Maclean & Dailey, 2002). However, there exist areas with inadequate distribution of PT services, showing to have adverse impacts, especially on groups of lower socioeconomic status (Lucas & Jones, 2012), and demographic and socioeconomic differences can affect transit preferences (Arabikhan, Postorino, Dupont-Kieffer, & Gegov, 2016).

Studies exist on assessing which RTI and display platform (DP) users prefer (Rahman et al., 2013). In a study on the needs in the implementation of Real-Time Transit Information Systems (Harmony & Gayah, 2017) focused on assessing the demand and supply perspectives and it revealed that demographic and socioeconomic status influence preferences for RTI. Another work on assessing the impact of RTI for public transport related to how crowded the metro was revealed that having access to this information yielded a positive impact on the boarding distribution (Zhang, 2017). Alongside with the increasing level of technology, Europe is also facing an ageing trend in population and it is expected that older people are not quite familiar with new technologies (Castilla, 2018). Moreover, the conditions of stations and stops (e.g., provisions of seats and shelters) often are not age-friendly and favourable to the elderly and may results in a very uncomfortable experience for the elderly people (Wong, Szeto, Yang, Li, & Wong, 2018). Having access to information and especially RTI for PT makes the users feel that the transit is safer, and it allows passengers to make more informed decisions (Maclean & Dailey, 2002).

Most people agree RTI is a valued way to get more reliable PT services. Passengers can take the best benefits from accessing RTI for PT from different display or shared information systems (Caulfield & O'Mahony, 2009). Users are more willing to use buses than before, because punctuality and reliability are two variables that have been improved due to the use of real-time passenger information systems (RTPI).

Research also show that passengers demonstrate higher perceived quality of service when stops and buses are equipped with information devices (Caulfield & O'Mahony, 2009). A recent study revealed that Apps usage has various benefits for increasing PT reliability and this type of DP has also provides a way of inclusion, because it can be specifically developed for persons with disabilities (Gebresselassie & Sanchez, 2018).

Therefore, for PT agencies to provide more passenger-oriented services, it is important to evaluate which RTI type and display platforms are perceived as the most useful (Harmony & Gayah, 2017) and explore potential benefits to improve mobility among different population segments, considering that there may be preference differences between socioeconomic and demographic groups, when designing an integrated system to be possibly implemented at regional level. In particular, it is clearly suggested that demographic and socioeconomic differences on perceived usefulness of different RTI and DP require a more in-depth study to explore possible patterns. This was precisely the aim of this pilot action: to provide a thorough study to support the implementation of RTI systems for PT process. Although various studies have been carried out since the beginning of the 21st century on the importance of providing RTI for PT, there are some critical issues not addressed so far and that were covered in this pilot action of the IE project CISMOB

a) Assessing which types of RTI and DP are considered the most useful by different socioeconomic and age groups;
b) Assessing relevance patterns given to RTI comparing passenger preferences from areas traditionally not served by these technologies (small rural cities) with others from cities with centralised and/or decentralised information.

This evaluation was done through stated and revealed preference-based surveys on assessing perceived usefulness, ease of use, and user acceptance regarding different types of RTI for PT and DP, which were conducted in two different readiness level areas in Centro Region, Portugal, and Stockholm, Sweden.

## Motivation of the pilot action and inspiring good practices

The present report is part of a pilot action on RTI for PT of the interregional European cooperation project CISMOB, whose main objective lies in improving policy instruments that can leverage low-carbon mobility by using ICT for a more sustainable use of infrastructure. The pilot action was conducted in Centro Region, Portugal, mostly because it is a region with minimal availability of real-time information on PT (main railway lines and public bus system of the city of Coimbra), with lack of regular PT services (frequency higher than 30-60 minutes), and that urgently needs to promote a modal shift to PT, since the region has high levels of individual transport (>70% in commuting trips).

**Fig 1 Bus stop without traveller information is a recurrent scenario in Centro Region**

In regional stakeholder meetings, participants have shown to have different perspectives regarding the best methods to provide RTI to passengers. On one hand, it was argued that centralised solutions based on dynamic message panels, such as those implemented in Ploiesti or **Timisoara**, Romania, provide information in a more intuitive, cheaper and accessible way, reaching more users, particularly, the elderly population. On the other hand, other stakeholders defended that it should be based on a decentralised approach in which the information is directly sent to user's devices. They argue that this approach may contribute to disseminate information through a larger geographic area and with less costs for operators and local authorities. Decentralised applications can be developed through an open data platform such as in **Stockholm**, Sweden, or controlled by a specific bus operator as it is the case in **Extremadura**, Spain.

Existence of this trade-off has justified the need to test the most advantageous solutions in different socioeconomic contexts of the region. The main objective of the pilot action was to assess the impact of different technological approaches by installing a prototype in a set of bus lines, serving passengers with heterogeneous socioeconomic and demographic profiles. Stated preference-based surveys assessed the potential of innovative ICT solutions to attract new clients and revealed preference surveys will assess the level of satisfaction of passengers among different presented solutions.

In the Centro Region, a vehicle location monitoring system was implemented in 7 buses of urban and interurban lines (see Fig. 2). In a second phase, an app was developed, an information system via solar panel installed at two stops in Cantanhede and Roxo (Penacova) and a web page was created.

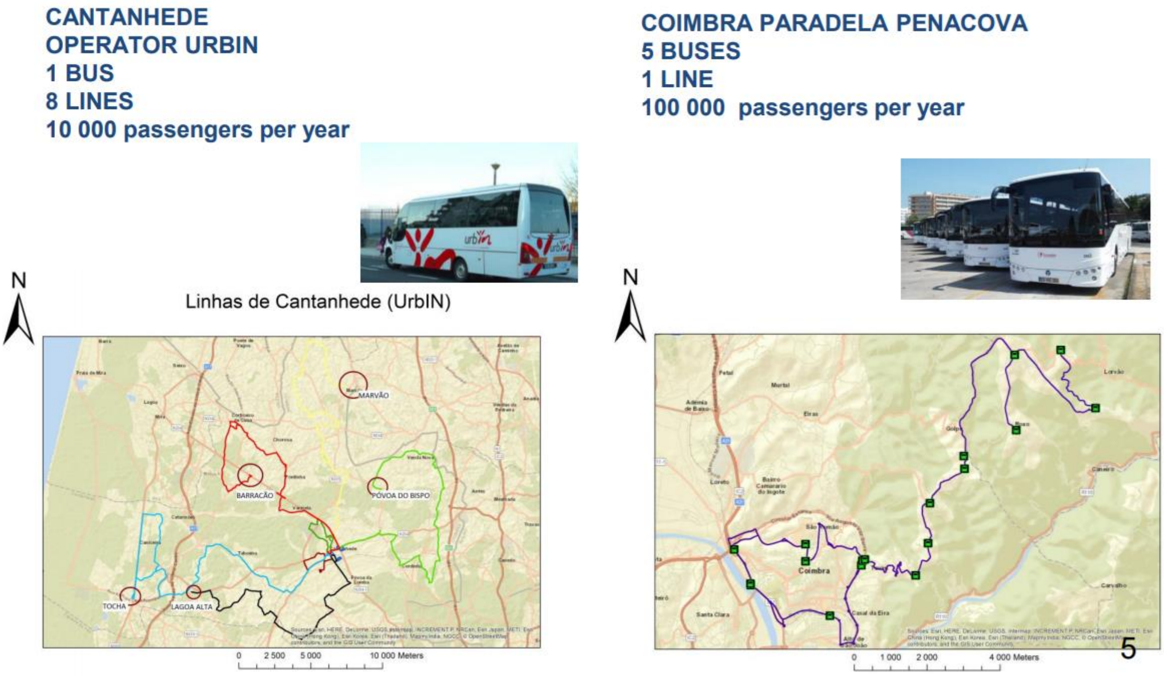


**Fig. 2 Pilot case studies description**

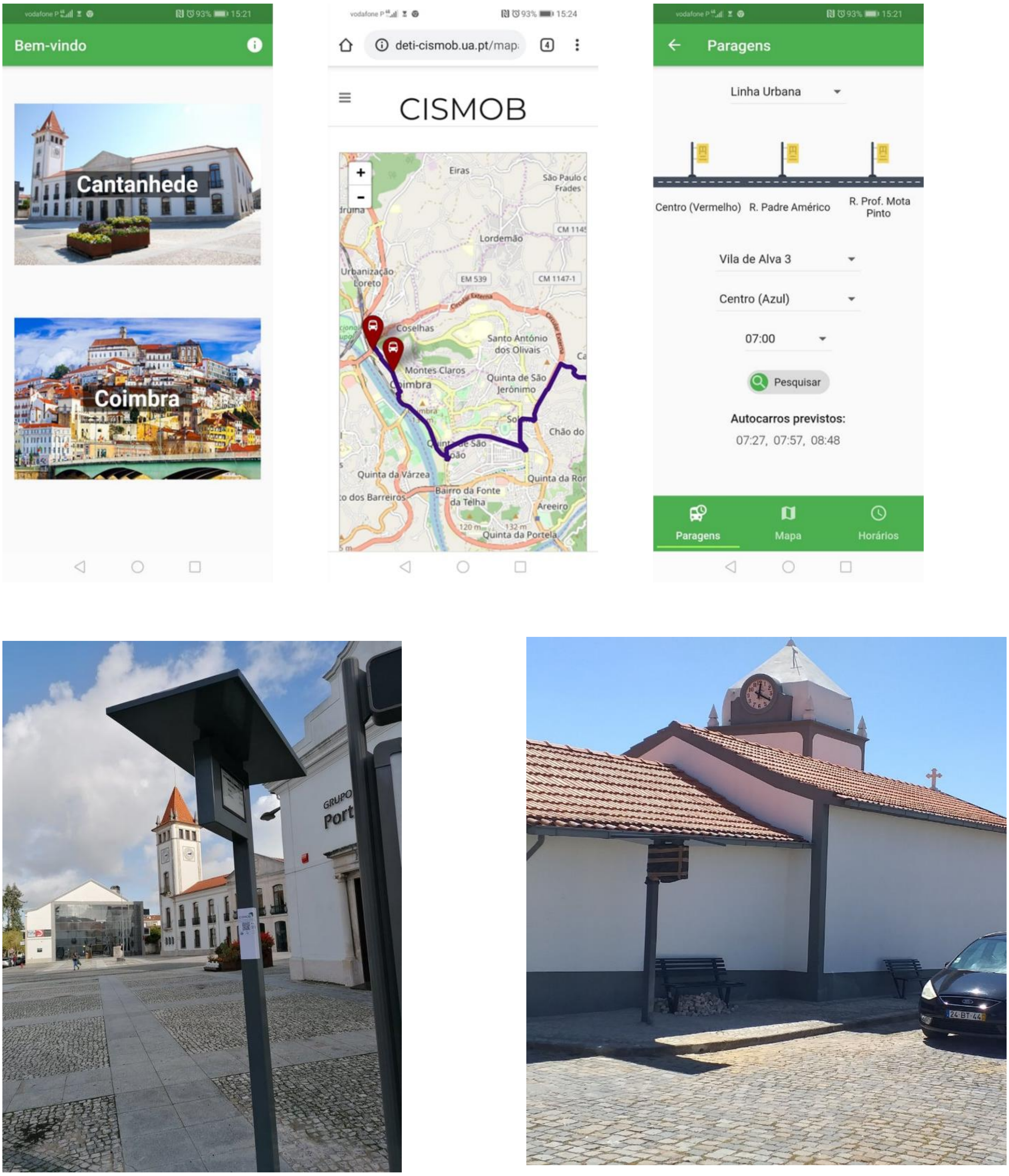


**Fig. 3 Print of smartphone app and centralised RTI systems installed in Cantanhede and Roxo**

## Survey and data analysis methods

Within the pilot action, a survey was designed and disseminated with the goal of understanding citizens preference related to RTI and DP in regions served by different technologies, namely, Aveiro and Cantanhede (Portugal) with no RTI available before the pilot action; Coimbra (Portugal) with centralised information displayed in panels at selected high demand bus stops; and Stockholm (Sweden) with both centralised (bus stop panels) and decentralised (several apps) information. Both paper and web surveys were used.

The questions were divided into five categories related to characterization of demographic and socioeconomic level of the respondents (gender, age, education and income level), basic traveling information (PT usage frequency), familiarity with common RTI and DP, perceived impact of these technologies in travel experience, and user preferences on RTI and DP. Most of the questions were short and yes/no type. In a pre-processing phase, the raw data was subject to a cleaning process on the erroneous responses and missing values. Then, data was analyzed mostly through frequency and contingency tables using SPSS, which are common tools for survey data analysis. Several statistical tests were performed to determine if any of the differences and patterns identified between groups were statistically significant within 95% confidence and association measures were also calculated.

# Results

This section presents the results of the surveys carried out during the implementation of the pilot action.

## Sample characterization

In order to evaluate which types of RTI and DP for public transport are preferable among different segments of the population of different served level areas, a total of 655 responses were obtained. The next figure allows a comparison of sample characteristics of both Portugal (196) and Sweden (459) cases.

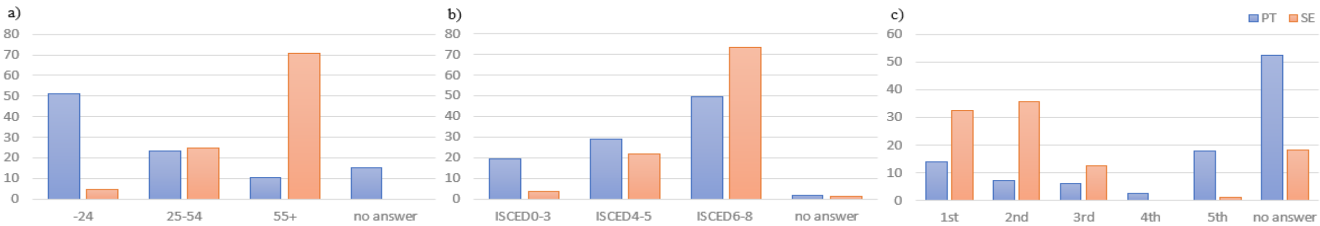


**Fig. 4. Frequencies for Portugal and Sweden cases regarding a) age; b) education level; c) income level.**

In Portugal, almost 55% of the respondents were female, while for Sweden it was more than 65%. Regarding age distribution, the samples differ, with more than half and only 5% belonging to younger group (-24 years) in Portugal and Sweden, respectively, while in Sweden, the percentage of respondents from 55+ age group surpasses 70%. The active group (25-54 years) is quite similar (25%). It should be mentioned that for Portugal, only 36% of the respondents come from an area with availability of centralised information for public transport (Coimbra – panels). With respect to education, the highest percentage belongs to the ISCED6-8 level, with approximately 50 and 70% for Portugal and Sweden, respectively, in contrast to the lower percentages for the low level of education. Considering income, more than 50% of the respondents from Portugal preferred not to answer. In the Sweden case, most of the respondents belong to the 1st (lowest) and 2nd income levels, while for Portugal, the majority are in the 1st and 5th (highest) level.

Regarding the RTI types, the survey focused on: VLM – vehicle location map, ADT – arrival/departure time, SA – seating availability, TP – trip planning, and BSA – bike sharing availability. With respect to DP, there were six options: Panel, Bus monitor, Apps, Journey planning software, SMS/Call, and operator website.

In Portugal, 65% of the respondents never use PT, while 23% use it daily. In Sweden, these percentages are around 15 and 35%, respectively. **Almost 90% of respondents recognise that such DP improve travel experience on both cases, which highlight the importance of these technologies.** Concerning how often respondents use such platforms, major differences are regarding panels, apps and journey planning software, that correspond respectively, to Portugal and Sweden, to 50 and 90%, 25% and 70%, 30% and 85%. Figure 5 presents the overview on respondents' familiarity with RTI and DP and also their preferences.

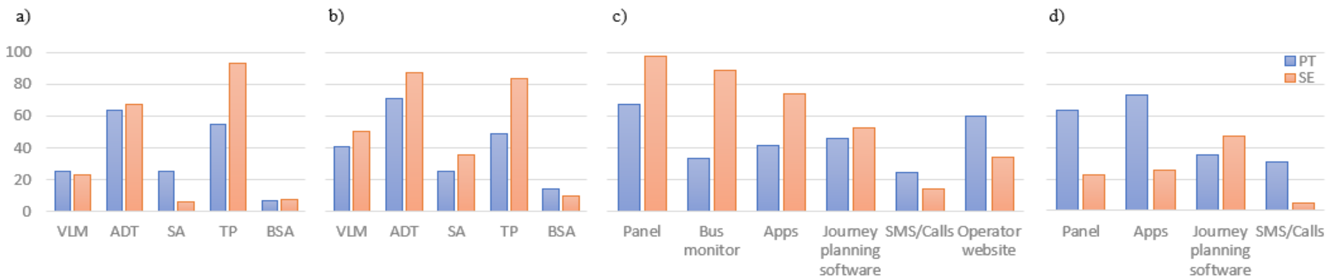


**Fig. 5. Distribution of responses of familiarity (a,c) and preferences (b,d) with RTI and DP.**

It can be observed that both familiarity and preference on the type of RTI for both Portugal and Sweden cases are arrival/departure times and trip planning (Fig.2a-b). Regarding **DP, SMS/call is by far the least known and the least preferred.** For that reason, these solutions have not been tested. However, panels, apps and journey planning software present the highest percentages of both familiar with and preferred platforms to provide RTI. Comparing both samples, the respondents from Portugal gave more importance to panel (63%) and apps (73%), while 47% of the respondents from Sweden highlighted the journey planning software as the preferred DP to provide RTI.

## What data show?

Considering the objectives of this study, in case of Portugal, from the 196 respondents, only 166 filled in the age group field, thus, in the forthcoming analysis, only this subsample was used.

For both cases, **more than 80% of the respondents belonging to any age group say that these technologies improve travel experience**. However, results show the percentage of who thinks that such DP significantly **improve the travel experience decreases as the age increases for Portugal,** while it **increases as the age increases also for Sweden**. For both cases, this percentage increases as the level of education increases and a different pattern is evident for Sweden, that the percentage of who thinks that such DP significantly improve the travel experience decreases as the level of income increases.

The following figure shows the number of respondents from Portugal and Sweden (a,b – related to age; c,d – related to education level; e,f – related to income level, respectively for Portugal and Sweden) with respect to their preference regarding the most useful (and voted) RTI and DP. **In Centro Region, Portugal, 70-75% of people of any age group do prefer ADT (arrival/departure time) as RTI for public transport** and indicate that younger people prefer the Trip planning (TP) (60%), and correspondingly, the age group of older people do not (21%). In Sweden, cross-tabulation shows that the percentage of the respondents that prefer ADT or TP increases with the increase of age, and that more than 84% of the respondents prefer TP. **Considering education level, people with higher levels of education prefer ADT.** Portugal While for Portugal 72% of the younger respondents prefer the panel; 59% of the active group respondents and **80% of the 55+ age group do prefer the panel to provide information on public transport**, in Sweden, the results show the percentage of who prefer the Panel is related to the age. It can also be observed that **~81% of those who prefer Panel belong to the older age group and that this percentage increases as the age also increases.**

Concerning the Apps**, cross-tabulation seems to indicate that for Portugal, younger people prefer Apps (65%),** and correspondingly**, the age group of older people do not (34%**), while in Sweden, the percentage of who prefer **Apps is related to the age and 76% of those who do not prefer apps belong to the older age group**. In relation with Journey planning software, this seems to be not preferred among the respondents of both cases. However, it is interesting to see that the high percentage of those who do not prefer this DP belong to the younger and older group, for Portugal and Sweden, respectively. Results also show that for both cases, **the percentage of respondents that prefer ADT or TP info increases as the level of education increases**.

For Sweden, within each level of education group, the percentage of those who prefer TP info is by far higher than the percentage of those that do not prefer. Regarding the preference on the DP, the patterns differ. While for Portugal people with higher levels of education chose Panel and Apps (52 and 66%), in Sweden, results show that in general, the respondents do not prefer the information displayed in such platforms (78 and 75%). **These results show there are different patterns for different demographic and socioeconomic segments of population**.

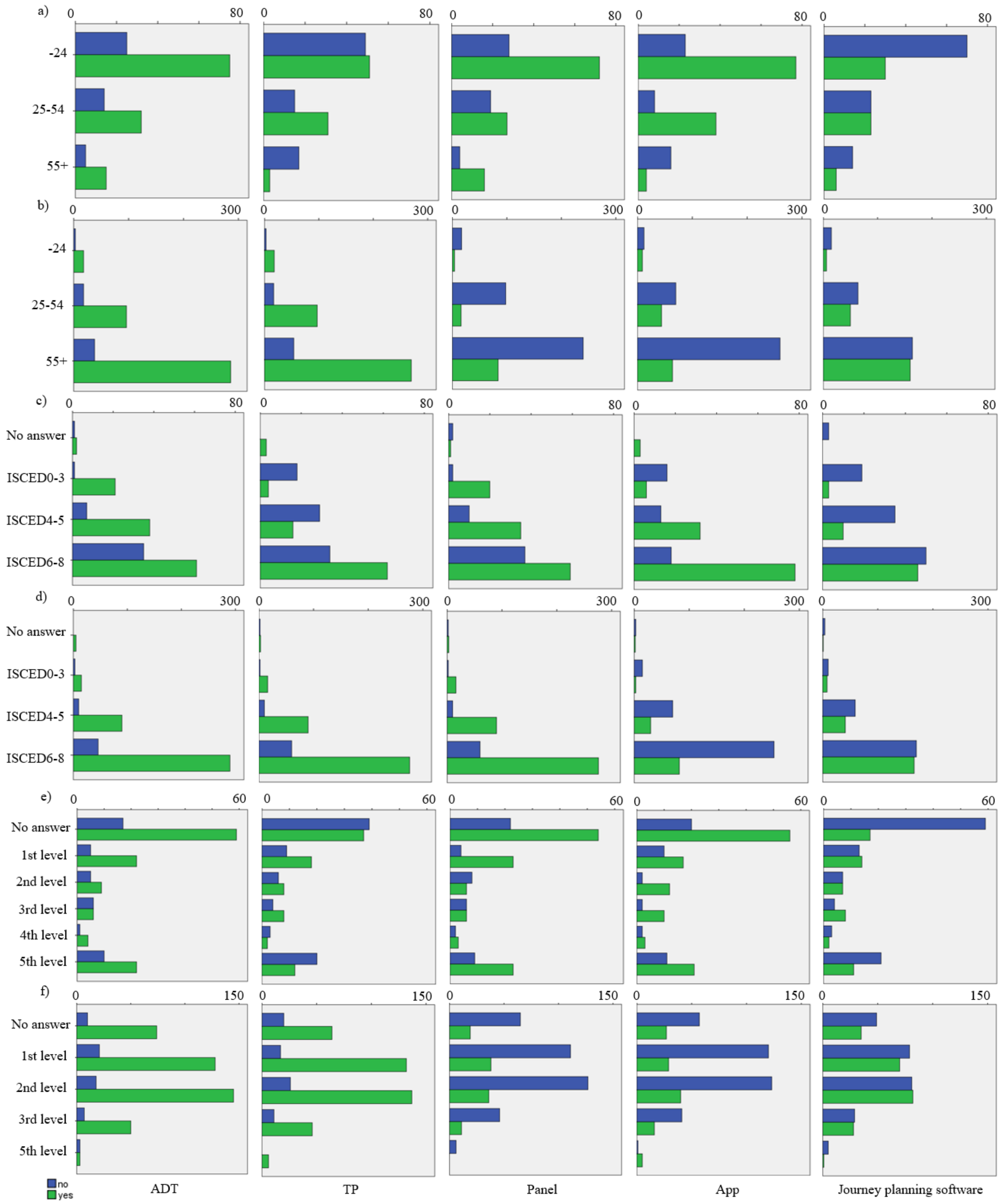


**Fig. 6. Perceived usefulness of ADT and TP RTI and Panel, App and Journey planning software for DP (a,b – related to age; c,d – related to education level; e,f – related to income level, respectively for Portugal and Sweden).**

## Different served areas: are there any differences?

Another purpose of this pilot action was to assess if there are any different patterns on the perceived usefulness and preference of the RTI and DP considering areas served by different levels of technology (none, centralised, both – centralised and decentralised). Thus, both Portugal and Sweden samples were merged into a bigger one in order to perform this analysis.

From the 655 cases, 62.3% belong to the female group. Regarding age distribution, 18.5% are in the younger group, while 24.4% correspond to the active and 52.5% belong to the 55+ age group (4.6% of the respondents decided to not share this information). The sample is divided into areas with different levels of access to RTI for PT. In particular, 19.2% of the respondents belong to areas where no access to information, 10.7% come from areas with centralised information (Coimbra – panels), and 70.1% are from areas with centralised and decentralised information for public transport (Stockholm). With respect to education level, 8.5% are in the ISCED0-3, 24.0% are in ISCED4-5, and 66.1% are in the ISCED6-8 level.

Considering now the income, 6.3% are in the 5th level, 0.8% in the 4th, 10.5% in the 3rd, 27.0% in the 2nd, and 26.9% in the 1st level, while a 28.5% preferred to not share this information. Data also show that 7.8% of the respondents never use public transport, 21.4% rarely use, 23.2% use 1-2 times in a week, 16.6% use 3-4 times in a week, and 31.0% of the respondents use it daily.

Regarding the questions related to knowledge of existence of RTI types, 23.5% know about VLM, 66.4% ADT, 11.8% SA, 81.8% TP, 7.2% BS. Regarding display platforms, 88.4% know panels, 71.9% bus monitors, 64.0% apps, 50.5% journey planning software, 16.9% SMS/call, 41.7% operator website. **From the respondents, 53.9 and 33.3% say that such types of display platforms significantly improve and improve, respectively, the travel experience**. Concerning how often do the respondents make use of such platforms, panels correspond to 13.0 and 65.5% (occasionally and often), monitors 14.7 and 49.3%, apps 9.8

and 47.6%, journey planning software 16.0 and 53.7%, SMS/call 3.7 and 14.7%, and operator website represents 12.7 and 23.2% of the responses.

Concerning the preferences regarding the type of RTI for PT, the respondents say: 47.6% VLM, 82.3% ADT, 32.7% SA, 73.4% TP, 10.8% BS. Concerning the preferred display platforms for providing the information: 34.8% Panel, 39.7% apps, 43.5% software, 12.5% SMS/call.

A closer look on the responses given the information level available in the area where people live/most travel is provided in what follows. The Figure 7 highlights the distribution of the responses regarding the perceived usefulness on providing RTI through different DP.

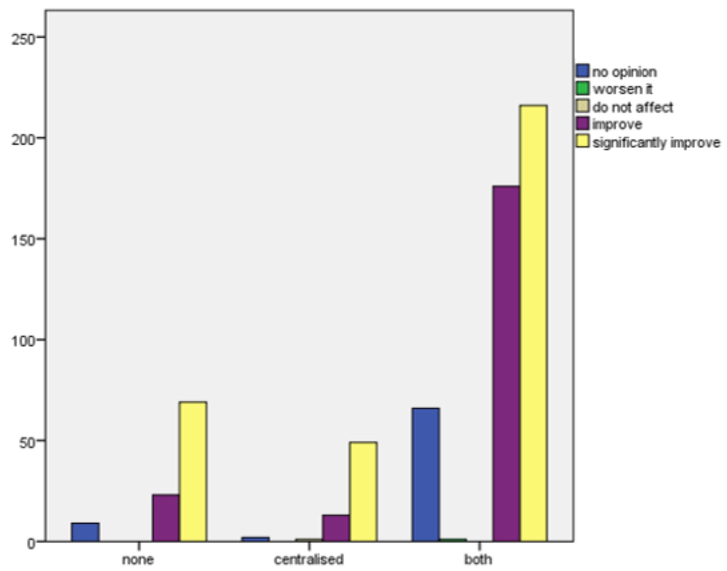


**Fig. 7 Overall perceived impact on travel experience of RTI and DP.**

There is a relationship between both variables: the significance of the Chi-square is 0.000, indicating a significant finding at 95%, and the value of Cramer's V, 0.178, indicating a weak association. Results show that more than 87% of the respondents think these DP affect in a positive way the travel experience. In particular, 68% of the respondents within the area not served with such technologies do think that such DP significantly improve the travel experience, 75% of the respondents within the area with just centralised information (panels) think that such DP significantly improve the travel experience, in contrast with 47% of the respondents that belong to the area with both centralised and decentralised information – Stockholm/Sweden. This suggests that areas served with less technologies on information for public transport give more value of having access to it.

The next figure presents the distribution of the responses regarding the most voted RTI (ADT and TP) and DP (Panel, Apps and Journey planning software).

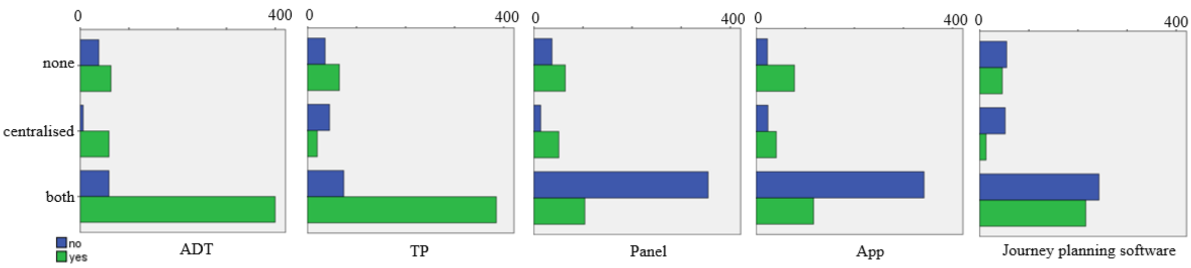


**Fig. 8. Overall perceived usefulness of ADT and TP RTI and Panel, App and Journey planning software for DP, considering the served areas.**

There were found a relationship between each group of variables, representing all significant findings. On one hand, the percentage of the respondents within areas served with some of the technologies is around 90% exhibiting a preference on ADT RTI (*p*-value 0.000, value of Cramer's V 0.252, indicating a moderate association). On the other hand, the preference on TP info of the respondents from areas not served by any information for public transport and the area with both centralised and decentralised information – Stockholm is positive, representing approximately 65% and 85%, respectively, while those respondents from areas served only with centralised information do not show preference on this type of RTI (*p*-value 0.000, value of Cramer's V 0.387, indicating a moderate association).

**Considering now the most valued platform to provide RTI for public transport, results show that areas not served by any technology and served only by centralised information (panels) present a similar positive pattern in preferring the Panel for providing information, representing more than 63% and 78%, respectively.** In contrast, most of the respondents from areas served by both centralised and decentralised technologies indicates that 73% do not have preference on this type of DP (*p*-value 0.000 value of Cramer's V 0.439, indicating a relatively strong association).

Results show that the respondents from areas with less access to information technologies for public transport present a similar positive pattern in preferring the Apps, representing approximately 63-77%. Once again, most of the respondents from areas served by both technologies (75%) indicates no preference for RTI for public transport being provided through Apps (*p*-value 0.000 value of Cramer's V 0.427, indicating a relatively strong association).

Regarding the Journey planning software as means of providing RTI, respondents from areas not served by any type of technology and the area with both centralised and decentralised information – Stockholm present a similar negative trend, representing between 52-55% in each area, while the percentage of those respondents from areas served by centralised information for public transport (panels) is clearly different, exhibiting the highest percentage of non-preference (80%) on this type of DP (*p*-value 0.000, value of Cramer's V 0.165, indicating a weak association).

Additionally, respondents from Stockholm area stressed the importance of ensuring quality in the information provided.

## Stated Qualitative evaluation of the developed RTI and DP

After the implementation of the various RTI solutions available in different DP, a stated preference survey was conducted at the Bus stops of the line served by the new technology. The number of respondents is significantly lower due to the difficulty of finding a population group with access to all supplied DPs.  Passengers were asked to rate the level of satisfaction with the developed DPs (5 very high, 0 - very low).

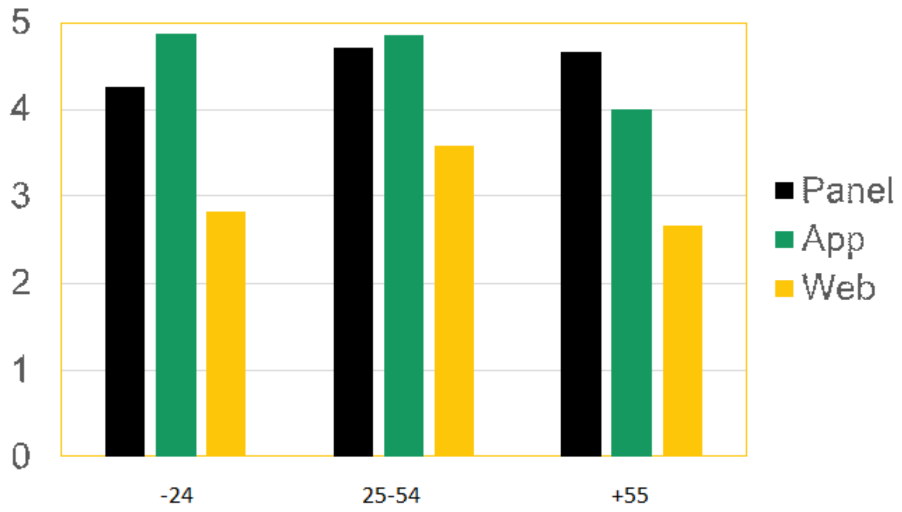


**Fig 9 Level of satisfaction with the available DPs developed in the pilot action (n=30)**

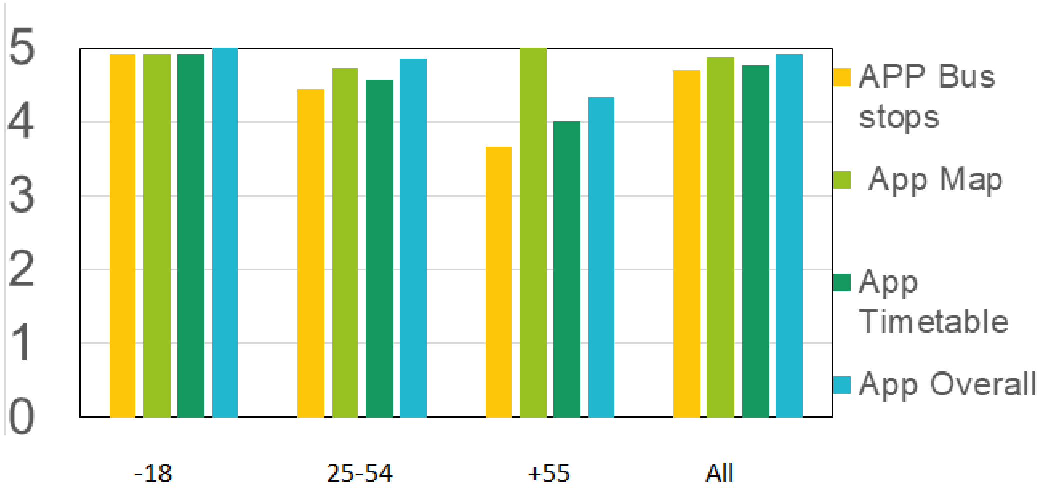


**Fig 8 level of satisfaction with the available RTI available on the App (n=30)**

The results are in line with the previous analysis - all DPs platforms have a very positive evaluation with the Panels achieving a better rating for the older population, and Apps for the young population.

In addition to the type of RTI available on the app, RTI on the map should be highlighted.

## Conclusions – policy recommendations

The underlying goal of this study is to provide a comprehensive perspective in what concerns which type of RTI and DP for PT are perceived as the most useful among different socioeconomic and demographic groups citizens.

Surveys were designed and disseminated in areas served by different levels of technology (none, centralised, both – centralised and decentralised). Results highlight different population segments prefer different RTI display platforms. In particular, the findings can be generalized to the population (95% confidence). **Specifically, areas served with some of the technologies prefer the ADT as RTI**, while **TP seems to be more useful for citizens from both not served and served with both centralised and decentralised** information areas.

Regarding the DP, areas not served by any technology and served only by centralised **information (panels) present a similar positive pattern in preferring the Panel and Apps for providing information**. **The findings also suggest that areas served with less technologies on information for PT give more value of having access to it.** This might be related to the quality of information provided, and due to the fact that in rural areas the importance of having accurate information **can be highly appreciated due to the lower frequency of PT, significant waiting times and poor waiting conditions.**

Although the present study has some limitations regarding the size and classes of the samples, the findings obtained are of especial interest. Considering the previous lack of studies in rural, peri-urban areas and small cities, the obtained results are relevant to focus future investments in RTI in a more intelligent way.

In terms of policy improvement, results also allow to draw the conclusion that public authorities and PT operators should gather efforts in order to define and implement integrated and **citizen-oriented PT services solutions based on the citizen demographic and socioeconomic profiles.**

**In summary, survey results show that:**

1) **areas not served by any technology or with less technology present a positive pattern in preferring the Panel for providing RTI, representing more than 63% and 78%, respectively;**

2) **in Centro Region, younger people prefer Apps (65%),** and correspondingly, **the age group of older people do not (34%);**

3) **Areas served with less technologies on information for PT give more value of having access to RTI.**

**In a context where there is limited financial resources for investing in RTI, public authorities must steer investment to where it is most needed**. In this context, in addition to the demand for each stop, investment in panels should be a priority in stops used predominantly by an elderly population. In areas close to schools, or with a strong concentration of young people, the information in an app can be privileged.

The waiting time (ADT) is the information preferred by passengers. However, benefiting from the flexibility as to the type of information available in the apps, the map with RTI on the bus location prove to be highly appreciated. Real-time information is highly valued in regions whose transport offer is limited and scarce.

## SPECIFIC POLICY RECOMMENDATIONS

In **terms of improving policy instruments**, both the results of the surveys and the experience gained in implementing the pilot action allow us to conclude that:

**Operational programmes should recognize that the right to information in real-time must be universal and not restricted to densified urban areas;**

**Operational programmes** should implement **new evaluation criteria that consider the demographic and socioeconomic profile of the population served and not just the total demand** (central locations);

Operational funding programmes should encourage regional transport authorities to develop a digital layer interlinking all the elements of transport**. To feed this layer, this necessity should be clearly stated in the public transport concession contracts and should cover all contracted service** to avoid losses in the supply of information when a vehicle is allocated to another line without information.

**The quality of the access signal to the internet must be guaranteed in advance - to guarantee the quality of service.**

According to UE recommendation, an efficient digital architecture must be based on open and common standards in the framework of the National Access Points, to facilitate access, easy exchange and reuse of public transport data.

## *CISMOB PILOT ACTION TEAM*

Bárbara Jael, Eloísa Macedo, Carlos Sampaio, Jorge Bandeira, João Alegria, João Paulo Barraca, José Paulo Santos, João Teixeira, Laura Silva, Margarida Coelho, Myrsini Glinos, Nélia Silva

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