



# The Value of Travel Time

## New Approaches for a Better Mobility System

18 JUNE 2020



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 770145



Author(s)

Holger Haubold, European Cyclists' Federation

Reviewer(s)

Ghadir Pourhashem, Yannick Cornet (UNIZA), Pedro Santos, Fatima Santos, André Freitas (TIS)

Design

Omer Malak, European Cyclists' Federation

Disclaimer

The information in this report is written by the MoTiV project consortium under EC grant agreement No 770145 and do not necessarily reflect the views of the European Commission. The European Commission is not liable for any use that may be made of the information contained herein.

Cover picture

© LinkedIn / Unsplash

June 2020



**MoTiV**

[www.motivproject.eu](http://www.motivproject.eu)

MoTiV (Mobility and Time Value) addresses the emerging perspectives on changing Value of Travel Time (VTT). Accordingly, it explores the dynamics of individual preferences, behaviours and lifestyles that influence travel and mobility choices. In other words, what does value of travel time mean for the end users, in relation to their travel experience.

# Table of Contents

About MoTiV .....	01
Partners .....	01
Executive summary.....	02
<b>1 Introduction .....</b>	<b>04</b>
1.1 Purpose and scope.....	04
1.2 Structure of the document .....	04
<b>2 The Value of Travel Time (VTT) – Traditional Views, New Paradigms, and the MoTiV Approach .....</b>	<b>05</b>
2.1 Traditional views on VTT .....	05
2.2 New approaches .....	05
2.3 The value proposition of mobility (VPM) in MoTiV .....	05
<b>3 The MoTiV Methodology.....</b>	<b>07</b>
3.1 Conceptual framework.....	07
3.2 Data collection .....	07
3.3 Data processing .....	08
3.4 Sample of users and characteristics, key statistics from the dataset .....	08
<b>4 Data Analysis - Results.....</b>	<b>09</b>
4.1 Citizens' mobility patterns .....	09
4.2 Use of ICT while travelling .....	10
4.3 Experience of transport services and infrastructures .....	11
4.4 Negative experience factors for alternative modes to private motorised transport .....	11
<b>5 Recommendations .....</b>	<b>13</b>
5.1 General Recommendations .....	13
5.2 Recommendations related to the use of ICT in transport.....	14
5.3 Recommendations related to transport services and infrastructure .....	14
5.4 Recommendations related to making alternative modes more attractive than motorised transport .....	15
5.5 Recommendations related to the promotion of ride-sharing services .....	16
<b>6 Conclusions, Outlook, And Need for Further Research .....</b>	<b>17</b>
6.1 General Conclusions .....	17
6.2 Conclusions related to cost-benefit analysis for transport (CBA).....	17

# About MoTiV

The Horizon 2020 project MoTiV (Mobility and Time Value) addresses the emerging perspectives on changing Value of Travel Time (VTT). Accordingly, it explores the dynamics of individual preferences, behaviours and lifestyles that influence travel and mobility choices. In other words, what does value of travel time mean for the end users, in relation to their travel experience.

The MoTiV project addresses VTT from the perspective of a single individual with a unique combination of personality, preferences, needs and expectations, in contrast with the traditional viewpoint of the economic dimension (time and cost savings). Its approach aims at achieving a broader and more interdisciplinary conceptualisation and understanding of VTT emphasising its “behavioural” component.

The main goal of the MoTiV project is to contribute to advance research on VTT by introducing a conceptual framework for the estimation of VTT at an individual level based on the value proposition of mobility. The conceptual framework was validated through data collection and evaluation in at least 8 EU countries.

The mobility and behavioural dataset was collected using a mobile application developed by the project consortium. With this mobile app, end-users were able to more easily track, understand, and re-evaluate travel decisions to make the most of their free time in accordance with personal preferences, lifestyle, interests, and budget. The target was to engage in the data collection process a minimum of 4.000 participants actively using the MoTiV app for at least two weeks. Besides validating the conceptual framework, the dataset is made available to the scientific community as an Open Dataset to stimulate further research in this area.

The MoTiV project findings contribute to the development of new mobility services and to the extension of existing applications, such as the ones offered by the business partners of the Consortium (i.e. routeRANK journey planner and the PiggyBaggy app for crowdsourced deliveries).

[www.motivproject.eu](http://www.motivproject.eu)

## Partners



# Executive Summary

## Approach and methodology

Traditionally, travel time has been seen as non-productive time by decision-makers, economists, and transport planners. Based on the assumption that people would like to spend as little time as possible travelling to reach their work or leisure activities, transport projects have therefore been focussing on minimising travel time, especially for motorised modes.

More recently, the paradigm that travel time is “wasted time” has been challenged by alternative and more holistic approaches. These approaches recognise that travel time can be used to carry out productive tasks in a wider sense, be it in the form of paid work, fitness, or personal enjoyment.

The Value Proposition of Mobility (VPM) in the MoTiV project takes up these approaches by adding the “Time well spent” dimension to the Value of Travel Time, considering that certain factors such as increased comfort, well-being or the possibility to do certain activities while travelling can influence a traveller’s choice. In some instances, these experiences or activities are as much as or more important than time and cost saved. This is captured by the concept of “worthwhileness” of travel time in MoTiV.

The MoTiV project further expands the concept of “time well spent” or “worthwhile travel time”, based on three main building blocks: The three main types of value (enjoyment, productivity, and fitness), activities carried out by travellers – related or unrelated to the act of travelling itself – and finally experience factors referring to travel conditions or other external factors.

The data was collected in 8 European countries from 3,330 users through a smartphone app (Woorti) developed in the framework of the project, automatically detecting trips and modes as well as changes between modes. Users were then prompted to select detected trips for validation and for entering further details regarding their travel experience. There were three main phases of data entry: Onboarding when starting to use the app, trip recording and trip validation.

The data was first cleaned, similar legs merged, and outliers removed. The original field of 29 transport modes was clustered into 5 different transport mode categories. The data was then analysed using the programming language Python.

## Results of the data analysis

The results of the data analysis show that in general, modes of transport belonging to the categories walking and cycling have received a high evaluation in terms of enjoyment and fitness. Productivity is, in general, lower across the board than enjoyment and fitness, with some exceptions. The evaluation for all worthwhileness factors (fitness, enjoyment, and productivity) is lower for the actual trips than the preferences stated during the onboarding process, and the actual travel behaviour also differs substantially from these preferences. Enjoyment is the most important element for making a trip worthwhile, followed by fitness and the ability to do personal tasks, whereas paid work seems to be a less important influence for the users represented in the MoTiV dataset. It is however more important for trips to work and on long-distance public transport. Travel behaviour was different depending on weather conditions, with public transport use being especially sensitive to the weather.

When analysing the MoTiV dataset with a view to learn more about the use of Information and Communication Technologies (ICT) while travelling, it was found that listening to audio and browsing the Internet are the most frequent ICT-related activities performed. Listening to audio was especially prevalent for cycling, walking, and private motorised transport, and browsing the internet on public transport.

It is noteworthy that many unusual experience factors, compared to conventional planning, rated high in both negative and positive evaluations of perceived value of travel time such as ‘Ability to do what I wanted’, ‘Scenery’ or ‘Other people’. Regarding the correlation among worthwhileness and experience factors, a higher frequency of trip legs with positive experience factors for higher values of worthwhileness was found. The analysis indicates that reliability can play an important role in a positive travel experience.

The analysis of the MoTiV dataset also made it possible to explore the potential of users of private motorised modes to shift to other modes of transport. For cycling, traffic signals/crossings, simplicity/difficulty of the route, facilities (showers, lockers), and presence of cars/other vehicles were important factors that could influence this modal shift. For public transport, crowdedness, seating, and privacy seem to be especially important.

## Policy and business recommendations

The results of the analysis of the MoTiV dataset clearly show that mobility planning needs to be rethought in many instances. Maximising worthwhileness of travel time should be recognised as an objective at the same level as for example reduction of travel time. The analysis also indicates that users generally are not able to fulfil their aspirations in terms of worthwhile travel in the current mobility system. Enjoyment is the worthwhileness element having the highest impact on the total worthwhileness of trips; therefore, transport planners, manufacturers, businesses and operators should try to make the travel experience as relaxing and fun as possible. For active modes (walking and cycling), fitness was also very significant and should be used

more as an argument in promotion campaigns. On public transport, it is also important to enable passengers to perform personal tasks and paid work during trips, for example by providing charging facilities and internet access. Regarding the influence of the weather on travel choices, it is important to provide shelter from uncomfortable weather especially for public transport users and cyclists.

Concerning the use of ICT in transport, planners should take into account that a significant number of users listen to audio when walking or cycling, first by providing safe and segregated infrastructure and possibly also by exploring innovative technical solutions. For public transport, charging facilities and internet access should be provided, and if possible, also other means of entertainment like movies or e-books especially for longer distances.

During the analysis of the dataset, reliability of travel time was identified as an important experience factor for travellers. Improving it is therefore important, especially for cycling through infrastructure measures like “green waves” for cyclists or priority at crossings, and public transport by enhancing capacity and implementing innovative technological solutions like real-time travel planning. There are many other experience factors that up to now only play a marginal role in transport planning, like scenery, but which the analysis identified as important for users. While planners should take these into account more, the analysis also showed high-quality infrastructure in a more classical sense is important as well for a positive travel experience.

The analysis of experience factors in the framework of MoTiV can also help to promote alternative modes to private motorised transport. To promote cycling, it is necessary to invest in safe, segregated and high-quality infrastructure. For public transport, planners and operators should try to avoid overcrowding and ensure that as much privacy as possible is given to passengers.

For the promotion of ride-sharing services, it is important to ensure that users receive the expected cost savings or financial benefits, ensure that the unwanted efforts for users (arranging the ride and establishing reliability) are minimised; and to remind them of the additional sustainability and social benefits.

## Conclusions and outlook

Going beyond the framework of the MoTiV project, the complexity of the concept of worthwhile travel time requires a more detailed analysis and data modelling which can potentially identify additional correlations. Ultimately, this knowledge is expected to support inclusive transport policies balancing the ‘need for speed’ and ‘accessibility’ with investments that increase the perceived quality of travel time, increasing individuals’ well-being and ensuring integration of all different groups of the population in the society, aiming at closing the existing equity gap.

The MoTiV project has also made a significant contribution to improving the appraisal of transport projects through cost-benefit analysis (CBA). It has provided a unique novel attempt to quantify worthwhileness and to develop this into an index (Worthwhileness Index WI). The next research challenge is to quantify worthwhileness in monetary terms (i.e. unit values) so that estimates can be embedded more easily in conventional appraisal.

# 1 Introduction

## 1.1 Purpose and scope

This document takes up the results of the following reports, which present the outcomes of the MoTiV data analysis in greater detail:

- the Report on Mobility and Travel Time (Deliverable 2.2 of the MoTiV project);
- the Report on Cost-Benefit Analysis (Deliverable 5.1);
- the Report on Influence Factor Analysis (Deliverable 5.2);
- the Report on VTT in Crowdsourced Micro-Tasks (Deliverable 4.5).

It formulates recommendations to, amongst others, decision-makers, mobility planners, industrial actors, SMEs, and innovators based on the findings of this report. It focuses on four main areas:

- Citizens' mobility patterns and preferences as identified in the MoTiV dataset;
- Influence factors related to information and communication technologies;
- Influence factors related to the transportation system and supporting infrastructure;
- Potential for modal shift from private motorised modes to alternative modes like cycling and public transport.

The document will also briefly discuss the influence of the weather on travel choices and value of travel time, since this was identified as a decisive factor in the analysis and can help to put some of the other results and recommendations into context. Finally, it also looks at gender aspects that were identified in the analysis as possible influences on travel choices and value of travel time.

## 1.2 Structure of the document

After this introduction, the second chapter explains the concept of value of travel time, traditional views on the topic, new approaches and the contribution of the MoTiV project to redefining the value of travel time. The third chapter briefly explains the methodology used for data collection and processing and describes the main characteristics of the dataset. The fourth chapter summarises the main results of the data analysis as described in detail in Deliverables 5.1, 5.2, and 4.5. Based on these results, the fifth chapter develops recommendations to relevant stakeholders. The sixth chapter concludes and points out areas of further research.

## 2 The Value of Travel Time (VTT) – Traditional Views, New Paradigms, and the MoTiV Approach

Traditionally, travel time has been seen as non-productive time by decision-makers, economists, and transport planners. Based on the assumption that people would like to spend as little time as possible travelling to reach their work or leisure activities, transport projects have therefore been focussing on minimising travel time, especially for motorised modes.

More recently, the paradigm that travel time is “wasted time” has been challenged by alternative and more holistic approaches. These approaches recognise that travel time can be used to carry out productive tasks in a wider sense, be it in the form of paid work, fitness, or personal enjoyment.

The Value Proposition of Mobility (VPM) in the MoTiV project takes up these approaches by adding the “Time well spent” dimension to the Value of Travel Time, considering that certain factors such as increased comfort, well-being or the possibility to do certain activities while travelling can influence a traveller’s choice. In some instances, these experiences or activities are as much as or more important than time and cost saved. This is captured by the concept of “worthwhileness” of travel time in MoTiV.

### 2.1 Traditional views on VTT

Since the 1960s, Value of Travel Time (VTT), defined as the cost of time spent on transport, has been regarded as particularly valuable by decision-makers, transport planners, engineers, and economists in the context of projects aiming at enhancing transport infrastructure. According to this view, travel time is non-productive (i.e. it has no utility) in the sense that it cannot be allocated to economically productive uses. As everyone spends much time on the move, in order to be engaged in leisure or work activities, travel time has significant economic implications. As such, VTT is regarded as the most important concept in the domain of transport economics and cost-benefit analysis of transport implementations.

### 2.2 New approaches

In the last decade or so, alternative and more holistic VTT conceptualisations emerged. Among others, the idea that travel time is “wasted time” without any intrinsic utility is increasingly questioned, especially when the traveller’s perspective is considered. For instance, people can increasingly carry out a variety of productive tasks while on the move, particularly thanks to the increasing use of mobile devices connected to the Internet. Furthermore, emerging conceptualisations of VTT stress the importance of acknowledging that travel time value should not necessarily be associated only to the “economic” dimensions of utility and productivity. In this respect, value may be rather referred to the ideas of pleasant, meaningful or worthwhile travel time. It is worth noting that worthwhile travel time does not exclude the idea that this may be productive, and multiple types of “value” may be associated to each specific journey. For instance, the time

devoted to bike to work can be regarded as productive time producing benefits both to personal health and to the environment. Due to these benefits, which can be also described in economic terms, a person may consider it more valuable to spend 10 or 15 minutes more to go to work by bike rather than going by car or by public transport. Emerging approaches to VTT support the idea that investments and policies in transport infrastructure and services should support various types of requirements and objectives, not only of an economic nature. These requirements include, among others, accessibility, equity, empowerment, participation, environmental friendliness, individual health and well-being. With one word, these requirements may be summarised with the aim of supporting high-standards of quality of life, in which citizens and communities can increasingly take responsibility and influence the course of their lives.

### 2.3 The value proposition of mobility (VPM) in MoTiV

Taking up these more holistic VTT conceptualisations, MoTiV Deliverable 2.2 “Mobility and Travel Time Report” ([www.motivproject.eu](http://www.motivproject.eu)) introduced the definition of Value Proposition of Mobility (VPM), a core concept of the MoTiV project. VPM is defined as the subjective value embedded in individual mobility choices.

The new concept of VPM aims to go beyond the classic research scope on value of travel time (VTT) which has, for a long time, focused on time and cost savings (“Time well saved”) related to specific types of trip purposes, namely work-related and leisure trips (“Trip Purpose”). The MoTiV VPM concept considers other relevant areas.

It widens the concept of “Trip Purpose” to the idea of “Location activities” that justify and influence mobility choices. Most importantly, it adds a new dimension of “Time well spent” which focuses on the travel experience.

The “Time well spent” dimension considers that certain factors such as increased comfort, well-being or the possibility to do certain activities while travelling can influence a traveller’s choice. In some instances, these experiences or activities are as much as or more important than time and cost saved, therefore considered more valuable. Within this new dimension, MoTiV defines the concept of worthwhileness (or worthwhile travel time). Worthwhileness is not necessarily related to an evaluation in terms of cost; worthwhile time does not always need to be “productive” in the sense that it would have to be monetised.

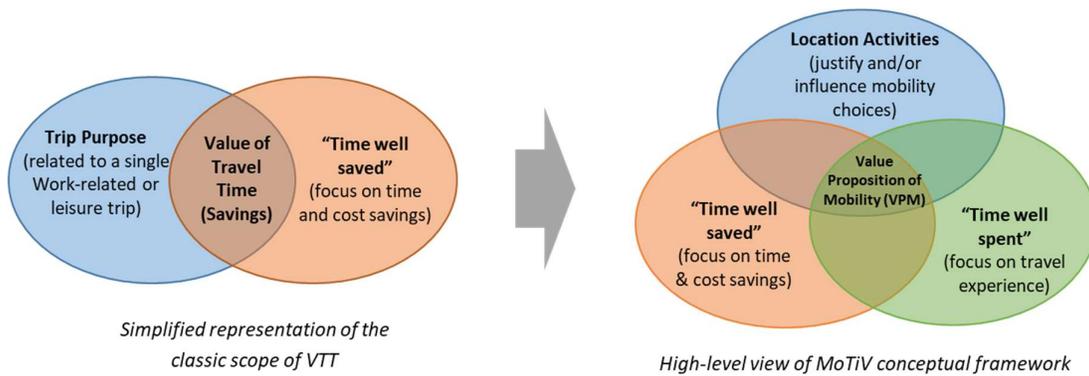


Figure 1: Representation of MoTiV Value Proposition of Mobility (VPM) as an evolution of the concept of Value of Travel Time Savings (VTT). Source: MoTiV D2.2

# 3 The MoTiV Methodology

The MoTiV project further expands the concept of “time well spent” or “worthwhile travel time”, based on three main building blocks: The three main types of value (enjoyment, productivity, and fitness), activities carried out by travellers – related or unrelated to the act of travelling itself – and finally experience factors referring to travel conditions or other external factors.

The data was collected in 8 European countries from 3,330 users through a smartphone app (Woorti) developed in the framework of the project, automatically detecting trips and modes as well as changes between modes. Users were then prompted to select detected trips for validation and for entering further details regarding their travel experience. There were three main phases of data entry: Onboarding when starting to use the app, trip recording and trip validation.

The data was first cleaned, similar legs merged, and outliers removed. The original field of 29 transport modes was clustered into 5 different transport mode categories. The data was then analysed using the programming language Python.

## 3.1 Conceptual framework

The MoTiV project further expands the concept of “time well spent” or “worthwhile travel time” (WTT). This is based on three main building blocks:

**Block 1** expresses the perceived worthwhileness level experienced by a traveller according to three main types of value: enjoyment, productivity and/or fitness.

- **Enjoyment:** is related to how travel can be used for fun or relaxing activities. In the Woorti app used for MoTiV data collection, this concept is explained as «Relaxing or having fun: taking time to listen to music, rest; engaging in social media; observing the surroundings»;
- **Fitness:** measures how much the user values the fact that when traveling she/he can exercise. In the app, this concept is explained as «When you walk, cycle, or even run on your travels, you are getting exercise and keeping in shape»;
- **Productivity:** it captures how much the user values the possibility of using travel time to complete some tasks, either personal (unpaid work) or work-related (paid work). In the Woorti app this is explained as: «Using travel time to get things done, not only for work or study, but also personal things like managing home or family stuff».

In Woorti, users are asked to rate their perception of worthwhileness twice, firstly as an overall valuation “Was your travel time wasted or worthwhile?” (the answer must be provided choosing between 1 and 5 stars, values 1 to 5) and then according to worthwhileness elements described above “What value did you take from your time on this part of the trip?” (the answer must be provided choosing between none, some or high, values 0, 1 and 2).

**Block 2** focuses on travel activities. It expresses that perceived value is largely dependent on the travel activities that the traveller is able to engage with while

travelling. These activities can be ‘on-the-move’ activities unrelated to the trip itself, or the trip as an activity in its own right.

**Block 3** are experience factors. These can refer to the travel conditions related to the transport supply itself (for example infrastructure, air quality), or other external factors such as the weather or other passengers/road users. Experience factors also depend on the equipment the traveller decides to bring along, which influences the ability to engage in some activities.

In addition to these three building blocks, there are explanatory variables, which typically consist of the traveller’s personal characteristics and attitude, the door-to-door trip characteristics, as well as spatial and temporal circumstances.

## 3.2 Data collection

The data was collected between May 1<sup>st</sup> and December 16<sup>th</sup>, 2019 using the Woorti mobile app, designed and developed within the scope of the project. The app automatically detected trips and modes as well as changes between modes, which appeared in a travel log. Users were then prompted to select detected trips for validation and for entering further details regarding their travel experience. Data collection was facilitated by dedicated national data collection campaigns, coordinated by project campaign managers; these campaigns took place in 8 European countries: Belgium, Finland, France, Italy, Norway, Portugal, Slovakia, Spain. In addition, data was also collected in Croatia and other countries.

The use of the app consists of three main phases:

1. Onboarding: upon installing the application and registering a new account, the user is introduced to the functionalities of the app. During this process, the user enters her/his travel preferences in terms of typical modes and travel time use, as well as, optionally, basic

demographic information.

2. Trip recording: the app automatically detects the start of a trip by monitoring the phone sensors, and attempts to distinguish trip legs and transport modes (for example walking, cycling, car, bus, tram or train).
3. Trip validation: when a trip finishes, the user can validate it, provide more precision on the transport mode (e.g. car passenger or car driver), and answer a number of trip-level questions (trip purpose, mood, etc). The user is then prompted to select a specific leg (and therefore a specific mode) to answer further questions about the key worthwhileness variables (worthwhileness assessment, value, travel activities, and assessment of positive and negative experience factors).

### 3.3 Data processing

To obtain the data used for the analysis, it was first pre-processed performing four main tasks:

1. data cleaning: duplicate or incomplete data was removed;
2. automatic merging of similar legs: trip legs were automatically merged when all of the following conditions were met: a) they belonged to the same user; b) they had the same mode of transport; and c) the time difference between the ending time of the first leg and the starting time of the second was less than 5 minutes;
3. outlier removal: to reduce noise in the data, extremely long and short legs were eliminated by removing legs belonging to the first and last percentile of the distribution of legs – for each different transport mode – in terms of distance (leg distance) and time (leg duration). Trips containing one or more outlier legs were eliminated altogether;
4. user removal: users that did not have any trip left at the end of the previous steps were eliminated.
5. The original set of 29 different transport modes users could select in the Woorti app was clustered in 5 categories:

- private-motorised,
- public transport – long distance,
- public transport – short distance,
- walking
- cycling – emerging micro mobility

Python an interpreted, high-level, general-purpose programming language with a variety of powerful features, widely used in the context of data science, was used for interpreting data and analysing the results of MoTiV EU-wide dataset.

### 3.4 Sample of users and characteristics, key statistics from the dataset

With the app, data was collected from 3,330 users, close to the original goal, consisting of 71,509 validated trips and 179,679 legs. After pre-processing, the final dataset was comprised of 3,269 unique users, with a total of 64,098 validated trips and 158,897 trip legs. More than half of the users (56%) were male, and the largest share of trips (61%) and trip legs (62%) was also validated by male users.

The table below presents the number of trips and users for each transport mode category. Since a user could choose multiple preferred modes of transport and perform multiple trips, the sum of users is greater than the number of unique users. Trips shown at the table below refer only to trips with a valid transport mode and for those users that have validated at least one trip.

For the Cycling and Micromobility category, the overwhelming majority of trips was carried out by bicycle, with only very few trips by non-active modes like electric scooters.

It is important to note that the distribution of trips and users among the different categories below is not representative of the actual modal share of the different transport modes in the regions concerned.

Category	Trips		Users	
	#	f(%)	#	f(%)
Cycling and Micromobility	11,023	21.99	1,317	43.74
Private Motorised	15,003	29.93	1,741	57.82
PT long-distance	481	0.96	189	5.28
PT short-distance	6,097	12.16	1,211	40.22
Walking	17,529	34.96	2,124	70.54
<b>TOTAL</b>	<b>50,133</b>	<b>100</b>	<b>6,582</b>	<b>-</b>

## 4 Data Analysis - Results

In general, modes of transport belonging to the categories walking and cycling have received a high evaluation in terms of enjoyment and fitness. Productivity is, in general, lower across the board than enjoyment and fitness, with some exceptions. The evaluation for all worthwhileness factors (fitness, enjoyment, and productivity) is lower for the actual trips than the preferences stated during the onboarding process, and the actual travel behaviour also differs substantially from these preferences. Enjoyment is the most important element for making a trip worthwhile, followed by fitness and the ability to do personal tasks, whereas paid work seems to be a less important influence for the users represented in the MoTiV dataset. It is however more important for trips to work and on long-distance public transport. Travel behaviour was different depending on weather conditions, with public transport use being especially sensitive to the weather.

When analysing the MoTiV dataset with a view to learn more about the use of Information and Communication Technologies (ICT) while travelling, it was found that listening to audio and browsing the Internet are the most frequent ICT-related activities performed. Listening to audio was especially prevalent for cycling, walking, and private motorised transport, and browsing the internet on public transport.

It is noteworthy that many unusual experience factors, compared to conventional planning, rated high in both negative and positive evaluations of perceived value of travel time such as 'Ability to do what I wanted', 'Scenery' or 'Other people'. Regarding the correlation among worthwhileness and experience factors, a higher frequency of trip legs with positive experience factors for higher values of worthwhileness was found. The analysis indicates that reliability can play an important role in a positive travel experience.

The analysis of the MoTiV dataset also made it possible to explore the potential of users of private motorised modes to shift to other modes of transport. For cycling, traffic signals/crossings, simplicity/difficulty of the route, facilities (showers, lockers), and presence of cars/other vehicles were important factors that could influence this modal shift. For public transport, crowdedness, seating, and privacy seem to be especially important.

### 4.1 Citizens' mobility patterns

As stated above, the MoTiV dataset does not give a representative overview of citizens' mobility, e.g. time spent in transport or modes used, in the way a classic household travel survey would. It does, however, reveal a lot of information on the motivation behind citizens' mobility choices, and on the user experience for different modes of transport.

One aspect of this analysis is the link between the importance given by users to the individual worthwhileness factors (fitness, enjoyment, productivity), and the stated preference for specific transport modes.

There are some overall patterns emerging from the data analysis: In general, modes of transport belonging to the categories walking and running and cycling and emerging micromobility receive a high evaluation in terms of enjoyment and fitness. Productivity is, in general, lower across the board than enjoyment and fitness, except for the categories of Private motorised (private cars, car-sharing) and Public transport - both for short and long distances - for fitness.

It is also possible to define five different profiles of users from the dataset based on the relation between importance of worthwhileness factors and preferred transport modes:

1. Users with high values for fitness and enjoyment while having low values for productivity. They are active people, whose preferred modes of transport are comprised of walking and running, cycling, and public

transport modes;

2. Users with medium values for fitness and productivity but high values for enjoyment. They are active people, who choose to walk and cycle, but also use their private car;
3. Users with medium to low values for fitness, high enjoyment, and medium productivity. These users walk, use their private car and local public transport, but they are not interested in using bicycle or micromobility modes;
4. Users with medium to low values for fitness and productivity, and medium values for enjoyment. These users have the overall lowest values in all worthwhileness categories. They mostly use private cars and public transport;
5. Users with high values for fitness, medium-to-high values for enjoyment, and low values for productivity. These users prefer to use bicycle and new forms of micromobility, together with private cars and public transport.

Another aspect of the analysis made possible by the MoTiV dataset is the comparison between the stated preferences described above and the actual travel behaviour.

Interestingly enough, the evaluation for all worthwhileness factors (fitness, enjoyment, and productivity) is lower for the actual trips than the preferences stated during the onboarding process. The matching between preferences

and behaviour reveal that the same user ends up being characterised in very different ways when comparing their intentions with their actual usage of transport. More concretely, only 31% of users have a corresponding profile between stated preferences and actual travel behaviour. The results show that users overestimate their preferences for specific mobility modes, which in general yield a lower return in terms of the worthwhileness of their trip.

The results of the analysis also reveal general differences in the assessment of worthwhileness for different transport modes, showing that bicycle, walking and train users on average experience the highest levels of travel worthwhileness, whereas car drivers and users of other forms of public transport experience the lowest (see graph below).

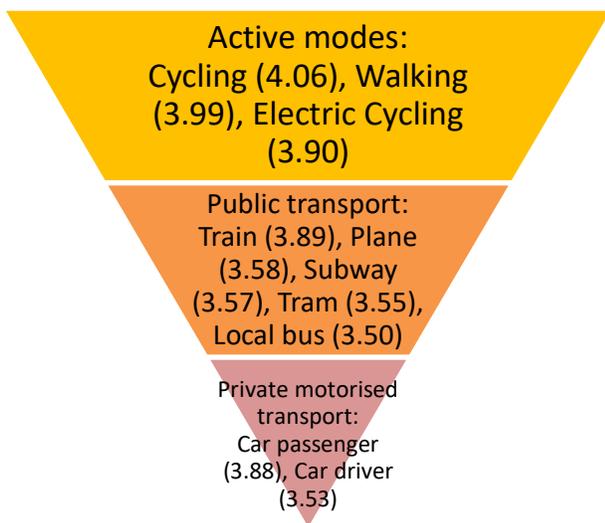


Figure 2: Average worthwhileness assessments on a 1-to-5 scale, per transport mode, 5 being most worthwhile; other modes: 3.61, transfers: 3.81

It also emerges from the analysis that enjoyment is the most important element for making a trip worthwhile, followed by fitness and the ability to do personal tasks, whereas paid work seems to be a less important influence for the users represented in the MoTiV dataset. This even holds true for trips to work, which may indicate that on commuting trips users prefer to enjoy the trip and perform fitness activities to be healthy than actually have time to work. Still, the ability to do paid work has a higher influence on the worthwhileness of trips to work than for any other type of trip. As expected, higher average values of enjoyment and fitness are reported for walking and cycling categories relating to higher worthwhileness assessment as these elements increase.

When data was analysed based on 7 different weather scenarios, it was shown that travel behaviour was different depending on weather conditions, and the perceived value of travel time was influenced by the different modes of transport chosen. Today's Weather was reported among the top 10 most frequent experience factors in all

transport mode categories apart from Public Transport (PT) used for Short Distance trips. Regarding different transport mode categories, Public Transport modes seem to be more sensitive to weather conditions with an exception of a Neutral/Good weather scenario. Worthwhileness ratings in Cycling & Emerging Micromobility are affected most by uncomfortably warm or cold temperatures. Private Motorised modes seem to be more sensitive to any weather scenario related to temperature and perhaps counterintuitively, walking modes present the most unaffected distribution of worthwhileness ratings compared to the rest of transport mode categories.

Finally, elements such as the day of the week (working weekdays or weekends) or the area of the trip (rural, suburban or urban) do not seem to have a great impact on the worthwhileness evaluation.

## 4.2 Use of ICT while travelling

When analysing the MoTiV dataset with a view to learn more about the use of Information and Communication Technologies (ICT) while travelling, it was found that listening to audio and browsing the Internet are the most frequent ICT-related activities performed. However, results show that people who browse the Internet while travelling find their travel time the least worthwhile, and conversely, people who read electronic devices find their travel time the most worthwhile.

The results indicate also differences in the use of ICT and the perception of the value of travel time by gender. The worthwhileness of travel time is evaluated more positively by men than women when reading electronic devices or browsing the Internet. Regarding ICT-related experience factors men who consider Internet connectivity to be an important factor while travelling evaluate their travel time more positively than women. On the other hand, regarding the numbers of ICT activities performed during travel, no significant difference was identified between the activities performed by men and women and their assessment of worthwhileness factors.

Different ICT-related activities and ICT-related experience factors were found also across different transport mode categories. High frequency of listening to audio activity was found among active modes of transport at zero levels of productivity. In the case of walking, the average rating of worthwhileness of travel time is higher when listening to music than when browsing the internet, which is likely due to the very nature of walking. On the other hand, users of Cycling & Emerging Micromobility modes considered their travel time more worthwhile when browsing to the internet compared to listening to audio, an activity probably performed in stops.

Listening to audio is also a frequent activity for the private motorised category which is related to the fact that this category mainly includes drivers who must drive the car and thus cannot browse or watch movies, videos. An

interesting finding for the private motorised travel modes category is the high average rating of worthwhileness for reading on electronic devices which is probably linked to passengers of this mode category.

In the case of public transport, passengers are mainly browsing the internet or listening to audio while travelling. Average values of travel time worthwhileness for ICT activities are similar for long-distance public transport and short-distance public transport).

### 4.3 Experience of transport services and infrastructure

The analysis performed related to mood ratings showed that the average score of mood reported from all users was around 4 out of 5 and most values were within the range of 3-5. In addition, there was no correlation found between the number of trip legs and the mood either between trip duration, waiting events and the mood score users assigned to the trip. Regarding the type of transfers and the mood ratings assigned for the whole trip, it was found that the most frequent types of transfer for the highest mood ratings of 5 always incorporated “walking” as one of the two trip legs. It is worth mentioning that walking was either part of the transfer or a trip itself.

Data analysis showed that for all trip legs where experience factors were selected by users, the majority was referred to experience factors having a positive influence on the quality of travel time representing around 79% of the total responses. Overall, it was observed that 14 out of 20 most frequently reported experience factors were present at both positive and negative evaluations. It is noteworthy that many unusual experience factors, compared to conventional planning, rated high in both negative and positive evaluations of perceived value of travel time such as ‘Ability to do what I wanted’, ‘Scenery’ or ‘Other people’. Regarding the correlation among worthwhileness and experience factors, it was found a higher frequency of trip legs with positive experience factors for higher values of worthwhileness. The analysis of worthwhileness ratings in relation to the combination of experience factors and activities demonstrated that different activities were carried out when value of travel time was rated high or low with different experience factors selected as well.

The analysis demonstrated that approximately 40% of the trip legs where reliability had a positive impact were given the best evaluation in terms of worthwhileness. This indicates that reliability can play an important role in a positive travel experience. When comparing reliability across trip purposes, this is more frequently reported as a positive factor for the maximum worthwhileness value of 5 in ‘Leisure’ or ‘Everyday Shopping’ trips compared to trips to ‘Work’ or ‘Home’.

The data analysis performed among the two genders has revealed interesting findings. Female users were reporting

fewer negative factors when the trip was more worthwhile (for ratings 3 to 5) while this relation was opposite for male users. Furthermore, it was shown that male users present higher worthwhileness values in all experience factors related to smoothness apart from the “Vehicle ride smoothness”. Crowdedness and seating availability experience factor is more important for high speed and intercity train trip legs among male users of the app rather than long bus journeys which remains the first mode for female users. Regarding the analysis of activities, the “thinking” activity together with Cycling were the ones with the most notable difference between male and female users.

Looking at different modes of transport, cycling and walking trip legs were rated higher in terms of their worthwhileness compared to other mode categories, both when positive or negative experience factors were selected by users. Furthermore, when smoothness factors were selected for active modes, the trip legs received higher worthwhileness ratings. In particular, when factors related to smoothness of travel were negatively rated, Cycling and Personal Care activities were selected more frequently while Accompanying someone and Relaxing or sleeping were less reported, indicating that these factors correlate with activities in a different way.

Public transport modes as well as private motorised modes were found to be more sensitive to reliability of travel time. Crowdedness and seating availability experience factor was mostly reported to have a positive impact on the value of travel time and it was among the top 5 experience factors most frequently selected in trip legs performed by public transport modes. Travellers tend to give more importance to “Crowdedness\_Seating” when journeys with public transport are longer, with long distance bus, high speed and intercity train trip legs presenting higher relative counts.

### 4.4 Negative experience factors for alternative modes to private motorised transport

Besides the general information on the influence of experience factors stated above, the analysis of the MoTiV dataset also made it possible to explore the potential of users of private motorised modes to shift to other modes of transport.

This in-depth analysis was carried out in two ways. First, the cycling or public transport trips of users that used both private motorised modes and cycling or public transport (short distance) were analysed, focusing on negative experience factors. In a second step, using geodata, trips made by cycling or public transport (short distance) that were similar in origin and destination to trips made by private motorised modes were analysed.

Interestingly enough, while the order of importance of the various negative experience factors is slightly different, the

results are largely similar for both methodologies.

For trips made by the same users, the following findings were made:

- For trip legs in Cycling & Emerging Micromobility, Noise Level and Today's Weather were selected in lower frequency in comparison to what all users have reported, indicating that these experience factors have less importance in shaping the perceived value of travel time negatively. At the same time, three additional experience factors are now within the top 10 factors which are Traffic Signals/Crossings, Simplicity/Difficulty of the Route and Facilities (showers, lockers). Presence of cars/other vehicles is by far the most frequent experience factor reported by users of private motorised modes who also cycle, reflecting safety concerns.
- Interestingly, in Public Transport Short Distance trip legs more than half of the top 10 negative experience factors were not present in the respective top 10 factors reported by all users. In addition, Seating Quality/Personal Space and Internet Connectivity were not reported even among the top 20 experience factors negatively affecting the perceived value of travel time. Privacy has now the first place whereas Crowdedness/Seating, Other People and Charging Opportunity moved more than 6 places higher in the list compared to the list with the negative experience factors reported by all users. At the same time, Noise Level (like in Cycling & Emerging Micromobility), Air Quality and Scenery received less importance by users of Private Motorised modes evaluating their perceived value of travel time when performing trip legs by Public Transport Short Distance modes.

Also when comparing similar trips using geodata, it is striking that the most important negative experience factors for cycling are road path availability and safety, road path quality and cars/other vehicles, while for public transport they are privacy, other people, and almost at the same level air quality, noise level, and crowdedness/seating.

## 5 Recommendations

The results of the analysis of the MoTiV dataset clearly show that mobility planning needs to be rethought in many instances. Maximising worthwhileness of travel time should be recognised as an objective at the same level as for example reduction of travel time. The analysis also indicates that users generally are not able to fulfil their aspirations in terms of worthwhile travel in the current mobility system. Enjoyment is the worthwhileness element having the highest impact on the total worthwhileness of trips; therefore, transport planners, manufacturers, businesses and operators should try to make the travel experience as relaxing and fun as possible. For active modes (walking and cycling), fitness was also very significant and should be used more as an argument in promotion campaigns. On public transport, it is also important to enable passengers to perform personal tasks and paid work during trips, for example by providing charging facilities and internet access. Regarding the influence of the weather on travel choices, it is important to provide shelter from uncomfortable weather especially for public transport users and cyclists.

Concerning the use of ICT in transport, planners should take into account that a significant number of users listen to audio when walking or cycling, first by providing safe and segregated infrastructure and possibly also by exploring innovative technical solutions. For public transport, charging facilities and internet access should be provided, and if possible, also other means of entertainment like movies or e-books especially for longer distances.

During the analysis of the dataset, reliability of travel time was identified as an important experience factor for travellers. Improving it is therefore important, especially for cycling through infrastructure measures like “green waves” for cyclists or priority at crossings, and public transport by enhancing capacity and implementing innovative technological solutions like real-time travel planning. There are many other experience factors that up to now only play a marginal role in transport planning, like scenery, but which the analysis identified as important for users. While planners should take these into account more, the analysis also showed high-quality infrastructure in a more classical sense is important as well for a positive travel experience.

The analysis of experience factors in the framework of MoTiV can also help to promote alternative modes to private motorised transport. To promote cycling, it is necessary to invest in safe, segregated and high-quality infrastructure. For public transport, planners and operators should try to avoid overcrowding and ensure that as much privacy as possible is given to passengers.

For the promotion of ride-sharing services, it is important to ensure that users receive the expected cost savings or financial benefits, ensure that the unwanted efforts for users (arranging the ride and establishing reliability) are minimised; and to remind them of the additional sustainability and social benefits.

### 5.1 General Recommendations

The results of the analysis of the MoTiV dataset clearly show that mobility planning needs to be rethought in many instances. Instead of seeing travel time as wasted time, users recognise it as worthwhile. This means that in transport projects, maximising worthwhileness of travel time should be recognised as an objective at the same level as for example reduction of travel time. This is also underlined by the fact that in the MoTiV dataset, users' actual travel behaviour differs substantially from their stated preferences at the beginning of the data collection process, and worthwhileness ratings for actual trips are lower than these stated preferences. This could mean that users generally are not able to fulfil their aspirations in terms of worthwhile travel in the current mobility system.

The analysis also came to the conclusion that “enjoyment” is the worthwhileness element having the highest impact on the total worthwhileness rating across modes of transport, an element that is probably not always fully taken into account at the moment. This means that in order to make a particular type of travel more attractive, attention should be paid to making the travel experience as relaxing and fun as possible. This could potentially be

achieved through a wide range of measures for different transport modes, from maximising comfort and access to charging and internet for personal devices on public transport over safe, pleasant, and clean infrastructure for cycling and walking to installing artworks in road tunnels for example.

Besides enjoyment, the ability to carry out personal tasks during all types of trips, and paid work when commuting to the workplace, also had a high impact on the total worthwhileness of a trip. This means that it is important to facilitate both, particularly in public transport, for example by creating silent areas for working, or by providing charging opportunities and internet access. While the significance of the effect is not entirely clear due to low trip numbers reported for this transport category, facilitating paid work seems to be especially important for long distance public transport. Transforming train carriages into “rolling offices” with charging opportunities, fast and reliable internet access, and as much silence and privacy as possible therefore seems to be a promising way to convince travellers to choose trains over cars and airplanes for longer distances. An existing example would be the “Office on Wheels” bus service that is offered to companies and their commuting employees in Belgium ([www.officeonwheels.be](http://www.officeonwheels.be)).

Active modes of mobility, i.e. walking and cycling, ranked highly in terms of enjoyment, but fitness was also found to be a very significant element contributing to the worthwhileness of trips. This complements earlier research and policy recommendations focusing on the public health benefits of these modes, for example the World Health Organisation's Health Economic Assessment Tool for Walking and Cycling (<https://www.heatwalkingcycling.org/>). While these focus on the health benefits for society as a whole, the results of the MoTiV analysis clearly show that personal fitness, and ensuing health benefits, are also an intrinsic motivational factor for users to choose active modes of transport. This could for example inform promotion campaigns for increasing the use of these modes to focus even more on the fitness aspect, for example by using smartphone apps counting steps walked by foot or kilometres ridden by bicycle, as well as indicating calories burnt and fitness targets reached through gamification designs.

Regarding the influence of the weather on travel choices, the data analysis shows that there is a clear influence on mobility behaviour, with short-distance public transport being the most sensitive transport mode category. This means that in order to nudge users towards using public transport, providing them shelter from uncomfortable weather conditions, such as enough shadow at bus or tram stops in sunny and hot weather, shelter from rain, or heated waiting rooms in cold winter weather, should receive more attention from public transport planners. For cycling, to mitigate the negative influence of uncomfortably hot temperatures, a solution could be to install drinking water fountains along popular cycling routes in urban areas, to plant more trees along roads to make shade and natural cooling, or to provide shower facilities at work places and universities. This could potentially become even more important with rising average temperatures and hotter summers due to the effects of climate change.

## 5.2 Recommendations related to the use of ICT in transport

Regarding ICT activities, people listen to audio and browse the Internet the most while travelling.

A significant number of users listen to audio during active travel, i.e. when walking or cycling. This is interesting for transport planners and policy-makers alike, since this poses a potential problem in terms of road safety in mixed traffic – people wearing headphones while walking or cycling might not hear approaching vehicles and could be at higher risk for crashes in cities lacking segregated cycling or walking infrastructure. Besides putting in place segregated and safe infrastructure, this risk could be further mitigated by the accelerated introduction and generalisation of technologies like automatic braking systems, but also vehicle-to-device communication, where the device used for listening could send warning signals to approaching vehicles.

In the case of public transport, passengers are mainly browsing or listening while travelling, meaning that this mode of transport could gain in attractiveness from facilitating these activities, for example by providing internet access and charging opportunities. Two other activities that were associated with high worthwhileness ratings were reading electronic devices for men and watching films or videos for women. In order to increase attractiveness of public transport modes, operators could therefore consider providing a small selection of free and/or pay-on-demand e-books and movies/series via the vehicle's WiFi network.

## 5.3 Recommendations related to transport services and infrastructure

According to the analysis of the MoTiV dataset, the number of trip legs, trip duration and waiting times do not seem to have a decisive influence on the mood of users. However, the reliability of travel time was identified as an important experience factor for the worthwhileness of travel time. The results indicate that reliability can play an important role in a positive travel experience. Apart from this general trend, the impact of reliability is different for different transport mode categories:

- In the cycling and walking categories, reliability as a positive as well as a negative factor is increasingly selected when worthwhileness values increase. One explanation could be that when users perceived a trip as worthwhile, they were comparing reliability with alternative modes of transport where travel time is not so predictable as with walking and cycling. This means that when promoting these modes, reliability of travel time should be put forward even more as an argument for users besides fitness, environmental arguments etc. Concrete infrastructure measures for further improving the speed and reliability of cycling traffic could include continuous cycle paths (where motorised vehicles must wait to cross) or a synchronisation of traffic lights to the speed of bicyclists ("Green Wave" for cyclists).
- In public transport and private motorised modes, the distribution of reliability as a positive and negative factor is more even across different values of worthwhileness, indicating that this factor influences the perceived value of travel time in these mode categories since the distribution differs significantly compared to the overall distribution of worthwhileness ratings. This means that for increasing the use of public transport, it is of paramount importance to ensure maximum punctuality.
  - For trams and buses, this could be achieved for example by providing them with dedicated infrastructure that is separated from the rest of road traffic, or by optimising their passing through traffic lights at intersections.

- For rail transport, providing enough rail infrastructure capacity especially at big nodes and on highly frequented lines will become even more important with rising passenger numbers.
- Looking further into the future, the generalised automation of public transport could also make a decisive contribution to more punctuality and reliability.
- Besides these measures focusing on infrastructure and vehicle technology and requiring substantial investments, services based on ICT applications could also help to improve the reliability experience of public transport users, for example through easy-to-use smartphone applications that warn about delays and immediately suggest reliable alternative connections based on real-time information. This could also include intermodal alternatives, such as bicycle sharing services for shorter distances, or ride-sharing services for longer distances. With the development of Mobility as a Service (MaaS) platforms, the payment for the intermodal alternatives could also be integrated into the public transport ticketing system.
- Another way to mitigate the negative impact of delays could be to compensate travellers for the lack in reliability of travel time and consequent reduction of worthwhileness, for example by introducing “mobility guarantees” with monetary compensations for delays (also above the legal minimum standards) and payments for e.g. necessary taxi rides.

Regarding the experience factors having an influence on the overall travel experience, the analysis found many unusual experience factors, compared to conventional planning, rating high in both negative and positive evaluations of perceived value of travel time. These were for example ‘Ability to do what I wanted’, ‘Scenery’ or ‘Other people’. These could imply for example, that when planning walking and cycling infrastructure, scenery aspects should be taken into account more, e.g. by providing cyclists the choice between direct infrastructures along existing road or rail corridors (e.g. “cycle highways”) or separate, more scenic routes.

Besides travel time reliability and the more unusual experience factors, the analysis found that quite a few of the most cited factors relate to transport services and infrastructure such as the road path availability, quality and directness, parking, information and signs or route planning and navigation tools. It is worth mentioning that ‘Simplicity/Difficulty of the Route’ was the top experience factor which affected positively the perceived value of travel time in 12.7% of trip legs. This means that planning and building high-quality infrastructure for all modes of transport remains important, even with the advent of new technologies with the potential to change the mobility

system.

This is also confirmed by the part of the analysis looking in detail at “smoothness factors”. The results of this analysis show that factors like road path quality and road path directness in active transport, vehicle ride smoothness in public transport, and road quality/vehicle ride smoothness in private motorised modes play an important role in shaping the journey experience. It also indicates that activities like relaxing or sleeping are less frequent when these factors are negatively rated, meaning that the journey might be more stressful for users. By improving the state of the infrastructure, transport planners could therefore directly contribute to reducing the stress of the users.

Route planning and navigation tools, as well as signage, while being generally available at an advanced level for private motorised transport and in many cities also for public transport, could in many cases be greatly improved for walking and cycling.

For public transport, another important experience factor among the top 5 selected by users was crowdedness and seating. Travellers tend to give more importance to crowdedness and seating when journeys with public transport are longer, with long distance bus, high speed and intercity train trip legs presenting higher relative counts. This means that public transport operators, especially those responsible for long distance transport, should strive for providing enough space for passengers and for an optimal spread across vehicles. This is especially important in the aftermath of the Covid-19 crisis, which has shown that appropriate distancing is also important for public health reasons. ICT applications which inform operators and travellers about vehicle occupation rates in real time – for the first to enhance seating capacity and for the latter to choose alternative connections if possible, in case of overcrowding – could be of great help.

## 5.4 Recommendations related to making alternative modes more attractive than motorised transport

By directly comparing trips between private motorised modes and alternative modes like cycling and public transport, the analysis of the MoTiV dataset also made it possible to explore the potential of users to shift to more sustainable transport options by improving the experience factors that were rated negatively in direct comparison.

For cycling, experience factors directly or indirectly linked to perceived road safety seem to be particularly important: availability, safety, and quality of the road, cars/other vehicles, traffic signals/crossings, and simplicity/difficulty of the route. This shows that in order to increase cycling and make car users consider the shift to active mobility, safe and high-quality infrastructure is essential. The high

values for the “cars/other vehicles” experience factor could imply that cycling infrastructure should be separated from other road infrastructure wherever possible to increase perceived safety and improve the user experience. Also, the mentioning of traffic signals/crossings shows that these nodes in the road network need special attention, as they are often mostly designed for motorised vehicles and perceived to be especially dangerous by active modes users – it is not enough to build a cycle path that suddenly ends at a crossing or in more narrow road sections (e.g. under bridges) and pushes cyclists into motorised road traffic.

Regarding public transport, it is striking that most negative experience factors in direct comparison to private motorised trips relate to privacy and personal space. As stated in 5.3, there are various options to address this issue: increasing passenger capacity and service frequency wherever possible; informing users about vehicle occupation rate in real time; and providing silent spaces for activities requiring concentration like reading or working, especially on long-distance public transport.

## 5.5 Recommendations related to the promotion of ride-sharing services

The results of the case study on crowdsourced micro-tasks within the MoTiV project (Deliverable 4.5) in 4 EU countries: Finland, Portugal, Slovakia and Spain indicate that the value of travel time is affected by other (cost, sustainability and social) considerations in addition to speed and effort. This indicates that at least when thinking of ride sharing hypothetically (instead of deciding on whether to do it for a specific concrete trip), people do not focus on the time constraints as much as the frequency of trips for which they could consider adopting ride sharing as the travel choice (i.e. its impact and importance on their lives). This shows that for ride sharing to be adopted in larger scale, it is equally important to address the concerns about unwanted efforts as it is to ensure that it addresses the motivational drivers of the participants.

The conclusions from the study point out that the average perceived acceptable extra travel time for ride-sharing services ranges from 12.8 to 14.4 minutes. 57% of people without cars and 41% of people with cars think that ride sharing would make travelling easier. However, in order to improve the efficiency and sustainability of the transport system by having more people actually share rides, it is also necessary to:

- Ensure that they receive the expected cost savings or financial benefits (motive for 60%, or 75% if no car);
- Ensure that the unwanted efforts (arranging the ride and establishing reliability) are minimized; and
- Remind them of the additional sustainability and social benefits (motive for 39% and 31%).

To estimate the potential impact on an individual's VTT, we can observe that if a car user would be potentially interested in giving a ride to someone else, then they could accept, a detour of on average up to 5-10 minutes or 15-25% of the total trip duration.

To estimate the potential overall impact on transport system - every offered car ride could potentially cause a reduction of 28.5% of overall car trips.

We can see that the potential reduction of an average car trip (across all 4 countries) is 17% if we assume that every car user who offers the trip also finds someone to share the ride. If we take into account the variations in the interest of car users to offer rides on certain types of trips, and the interest of other car users to share the ride on that kind of trip, the reduction varies from 3% to 18% depending on the trip type and country. However, it will take time before this potential can be achieved because it requires widespread adoption of the means to share rides and the culture of doing so in everyday mobility among the car users who are potentially interested in it.

# 6 Conclusions, Outlook, and Need for further research

Going beyond the framework of the MoTiV project, the complexity of the concept of worthwhile travel time requires a more detailed analysis and data modelling which can potentially identify additional correlations. Ultimately, this knowledge is expected to support inclusive transport policies balancing the 'need for speed' and 'accessibility' with investments that increase the perceived quality of travel time, increasing individuals' well-being and ensuring integration of all different groups of the population in the society, aiming at closing the existing equity gap.

The MoTiV project has also made a significant contribution to improving the appraisal of transport projects through cost-benefit analysis (CBA). It has provided a unique novel attempt to quantify worthwhileness and to develop this into an index (Worthwhileness Index WI). The next research challenge is to quantify worthwhileness in monetary terms (i.e. unit values) so that estimates can be embedded more easily in conventional appraisal.

## 6.1 General conclusions

The analysis of the MoTiV dataset has revealed a variety of different attributes that travellers perceive as important when evaluating their travel time. The 'Ability to do what I wanted', the 'Scenery' or 'Other people' were selected among the most frequent experience factors reported by users of the app, demonstrating that travellers perspective differs significantly compared to the approach of conventional planning where time and cost are the main players of time savings. Investigating such qualitative aspects of the value of travel time can improve travel experience and guide policies towards shaping more sustainable travel patterns.

The complexity of the concept of worthwhile travel time requires a more detailed analysis and data modelling which can potentially identify additional correlations. A few examples of additional analysis can focus on:

- exploring the importance of experience factors across different countries and modes, the difference of modal choice in various countries, the weight that different experience factors or activities have on worthwhileness ratings and the differences in gender, age groups or socioeconomic status;
- towards shaping more sustainable travel patterns, factors hindering the wider adoption of cycling can be further explored, for example factors related to lack of safe infrastructure that were partially touched upon in the recommendations above, but could be explored in much more detail;
- transfers in door-to-door trips, factors that influence positively or negatively intermodal transfers, and how they influence perceived worthwhile time (worthwhileness);
- the variances of daily travel time budgets, and whether patterns of combined daily travel time and worthwhileness ratings by mode emerge;
- the enablers and barriers for shifting to low carbon modes for specific travel distance brackets (e.g. cycling for 5km or less, electric cycling for 15km or less, public transport for 25km or less, trains for

150km or less, high speed rail for 750km or less etc;

- the importance and influence of traveller attitudes towards specific transport modes and travel time use;
- correlation between service/infrastructure quality and travel time quality (worthwhileness) on specific trunks;
- the importance of general smoothness of the ride (e.g. turns, stop and go, vibrations) in different types of vehicles compared with the ability to conduct tasks while travelling.

The findings of the MoTiV data analysis can provide the basis for further research revealing at the same time the areas of improvement in terms of the methodology and tools used. Overall, and perhaps more importantly, the MoTiV results make the case that from a traveller perspective, the experience of travel time matters, which places the user experience in a central role in transport planning. They bring important insights for conventional transport planning and assessment tools that are currently based on a more simplified set of variables such as travel costs and absolute time savings on mode-specific portions of door-to-door trips. Furthermore, the results provide important implications for urban and transport planners, policy makers and authorities to update the current assessment methodology for transport projects, contributing to a gender-sensitive and inclusive design of future mobility services and transport infrastructure (e.g. Mobility as a Service, Active and Electric Micromobility, Connected and Automated Driving). Ultimately, this knowledge is expected to support inclusive transport policies balancing the 'need for speed' and 'accessibility' with investments that increase the perceived quality of travel time, increasing individuals' well-being and ensuring integration of all different groups of the population in the society, aiming at closing the existing equity gap.

## 6.2 Conclusions related to cost-benefit analysis for transport (CBA)

The MoTiV project has also made a significant contribution to improving the appraisal of transport projects through cost-benefit analysis (CBA). It has provided a unique novel attempt to quantify worthwhileness (on a scale of 1 to 5) and to develop this into an index (Worthwhileness Index WI). Such an index would enable the estimation of worthwhileness (on that scale) for a trip if there is information on the level of productivity, fitness and enjoyment. This model is helpful to develop our understanding of the factors behind worthwhileness. The next research challenge is to quantify worthwhileness in monetary terms (i.e. unit values) so that estimates can be embedded more easily in conventional appraisal.

Future research could also re-think the way modal shift is dealt with in appraisal, by unpacking the ways in which changes in worthwhileness impact upon existing calculations of user benefits. In this way, research could help to ensure that all relevant benefits associated with increased worthwhileness are captured within the CBA.

Meanwhile, whilst research on monetisation gets under way, the WI outcomes of the MoTiV project could help in another (more qualitative) way – as complementary information to that provided by the Benefit-Cost Ratios (BCR) of projects. This would require the development of a new complementary approach (via WI) to understand the opportunities for worthwhile travel and take these into consideration in appraisal. Perhaps this could initially be something qualitative, similar to the complementary approaches used for accessibility via Distributional Assessment in UK appraisal guidelines (see TAG Unit A4.1). Decision-makers may welcome seeing evidence on how much worthwhileness is being achieved by project A compared to project B (even if a monetary value is not practically available).

[www.motivproject.eu](http://www.motivproject.eu) |  MoTiV\_Project

**Ghadir Pourhashem, Project manager**

University of Žilina

Univerzitná 8215/1, 010 26 Žilina, Slovakia

MoTiV (Mobility and Time Value) addresses the emerging perspectives on changing Value of Travel Time (VTT). Accordingly, it explores the dynamics of individual preferences, behaviours and lifestyles that influence travel and mobility choices. In other words, what does value of travel time mean for the end users, in relation to their travel experience.

