

From Travel Time and Cost Savings to Value of Mobility

Tatiana Kováčiková^(✉), Giuseppe Lugano, and Ghadir Pourhashem

ERAdiate Team, University of Žilina, Žilina, Slovakia
{tatiana.kovacikova, giuseppe.lugano,
ghadir.pourhashem}@erachair.uniza.sk

Abstract. Research on Value of Travel Time (VTT) is perhaps the most developed area within the studies on value of time. This knowledge has traditionally been regarded particularly valuable by decision-makers, transport planners, engineers, and economists in the context of projects aiming at enhancing transport infrastructure. As everyone spends much time on the move, engaged in leisure or work activities, travel time represents one of the largest costs of transport.

Current VTT definitions and methodologies for its assessment and subsequent recommendations focus on time and cost savings related to the personal “Travel Time Budget” (TTB), the constant amount of time one invests in daily mobility. Less known is instead what value of travel time means for the end users, in relation to their needs, expectations, and lifestyles. Travel needs and preferences vary, for instance, people do not always consider more meaningful or pleasant the time that is spent more efficiently or productively. One’s time valuation fluctuates, also for the same activity performed in different circumstances: time remains a largely subjective entity influenced by endogenous and exogenous factors. As perceived quality of time influences individual well-being, it is important to understand and reflect on own time-use, for instance to adjust habitual behaviour and to consider alternative choices that would better define individual’s needs, goals, and expectations.

The objective of this paper is to present how the “Mobility and Time Value” (MoTiV) H2020 project addresses time value following the emerging approach of estimating VTT from the perspective of a single individual with a unique combination of personal characteristics, habits, preferences, and expectations. This approach, in contrast with the classical viewpoint of the economic theories and utility maximization hypothesis, aims at achieving a broader and more interdisciplinary conceptualisation and understanding of VTT emphasising its “behavioural” component.

Keywords: Value of Travel Time (VTT) · Value Proposition of Mobility
Daily travel patterns · Time use

1 Introduction

Time is an intangible and limited resource that everyone possesses. Although one can plan when to use it, time cannot be stopped or stored, and nobody can increase or decrease his/her total stock of time by selling or buying it. As such, it is often felt as a

scarce and therefore precious resource. Time can be used more efficiently, or just experienced differently.

It is not straightforward to tackle the issue of value of time (VOT), since there is no general definition of this concept. A classic study by Becker [1] regards the study of the allocation of time as an area of consumer economics in which time value is assessed in relation to working and non-working hours, related respectively to people's role as "producers" and "consumers" of commodities. Becker [1] argues that "*the allocation and efficiency of non-working time may now be more important to economic welfare than that of working time [...] the cost of a service like the theatre or a good like meat is generally simply said to be equal to their market prices, yet everyone would agree that the theatre and even dining take time, just as schooling does, time that often could have been used productively*". This approach has influenced subsequent research, which has for instance compared use of time to the use of money [5, 7, 8, 15]: indeed, workers' salary is calculated in relation to the number of working hours (i.e. hourly wage). Following this logic, time savings are a key objective of projects addressing value of time because implying higher efficiency and productivity.

The Value of Travel Time (VTT) is one of the most important factors of transport and mobility planning and a number of countries and international organisation have official values that transport project and policies on a consistent basis [19, 10]. On the other hand, research on VTT is perhaps the most developed area within the studies on value of time. The current VTT definitions and methodologies for its assessment and subsequent recommendations focus on time and cost savings related to the personal "Travel Time Budget" (TTB), the constant amount of time one invests in daily mobility. This knowledge has traditionally been regarded particularly valuable by decision-makers, transport planners, engineers, and economists in the context of projects aiming at enhancing transport infrastructure. As everyone spends much time on the move, engaged in leisure or work activities, travel time represents one of the largest costs of transport.

Traditional approaches to VTT estimation regards travel time as unproductive, thus separating "activity time" from "travel time". On the other hand, it has been acknowledged that travel can be an activity in itself [13]. Hence, a more complete VTT estimation should consider activities within mobility, as well as mobility within activities. This view, which goes beyond economic cost considerations, can be linked to the emerging behavioural perspective of "happiness economics" in transport planning. As underlined by Duarte et al. [6], "*existing behavioural travel choice models should be enhanced with regards to their behavioural validity incorporating the impacts of travelling happiness/satisfaction*". It follows that value of travel time as well should be investigated in relation to subjective wellbeing [4]. Although the role and importance of motivational and behavioural factors in VTT research start to be well recognised, these factors do not usually represent the cornerstone of VTT projects. Indeed, further research is needed to describe what value of travel time means for the end users, in relation to their needs, expectations, and lifestyles. Travel needs and preferences vary, for instance, people do not always consider more meaningful or pleasant time that is spent more efficiently or productively. One's time valuation fluctuates, also for the same activity performed in different circumstances: time remains a largely subjective entity influenced by

endogenous and exogenous factors. As perceived quality of time influences individual well-being [11], it is important to understand and reflect on own time-use, for instance to adjust habitual behaviour and to consider alternative choices that would better define individual's needs, goals, and expectations. In line with this research need, the project "Mobility and Time Value" (MoTiV¹) has been recently granted by the European Commission (EC) within the Horizon 2020 (H2020) programme. The aim of this paper is twofold: first, to present the holistic concept of value proposition of mobility, on which to develop a behavioural view of VTT; and secondly, to illustrate the MoTiV conceptual framework and its expected contribution to advance VTT research and applications.

2 VTT and the Value Proposition of Mobility

The "behavioural shift" of studies on VTT calls for the integration of models and frameworks of individual needs, motivations and preferences adapted to the mobility context. In this respect, which values and expectations should be generally fulfilled and therefore addressed by mobility solutions? The conception, development and deployment of mobility infrastructure, services and solutions from the perspective of individual motivations, needs and expectations defines and shapes a Value Proposition of Mobility. This represents a promise of value to be delivered, communicated, and acknowledged to the individual traveller. Group of travellers with similar needs, aspirations, motivations, and expectations are likely to have also a similar general judgment for different transport options. Being a complex ecosystem, there is no single actor in charge of shaping the Value Proposition of Mobility. It is rather a joint outcome of actors co-creating meaning and value to transport and mobility options through policy, implementation, deployment, and participation.

When referring to motivations and needs, a classic reference is Maslow's hierarchy of needs [12], which has been widely used in the transport context as well. An adapted version of this model has been recently used in the context of Mobility as a Service (MaaS) in the attempt to describe its value proposition. For instance, a recent study from UK Catapult describes how MaaS value propositions from different providers should address emerging mobility challenges (see Fig. 1).

It is worth noting that Fig. 1 includes a challenge related to VTT, namely "*enable faster journeys and increase confidence in arrival times*". This challenge is associated to the broader goal of "*enhancing end-to-end journeys by improving mobility choice*", which is not the highest goal of the hierarchy. To a closer look, the complete fulfilment of the Value Proposition of Mobility would require achieving the objective of "*enabling lifestyles by improving mobility fit*". The associated challenges combine both general sustainability aspects and individual well-being.

When considered from the perspective of the hierarchy of travel needs (adapted to MaaS), the economic view of VTT therefore addresses only the mid-level of the Value Proposition of Mobility. Indeed, the value of travel time cannot be always adequately assessed in terms of travel time savings: as shown by Mokhtarian and Salomon [13], in the case of leisure travel under some circumstances people travel just for the sake of

¹ www.motivproject.eu.

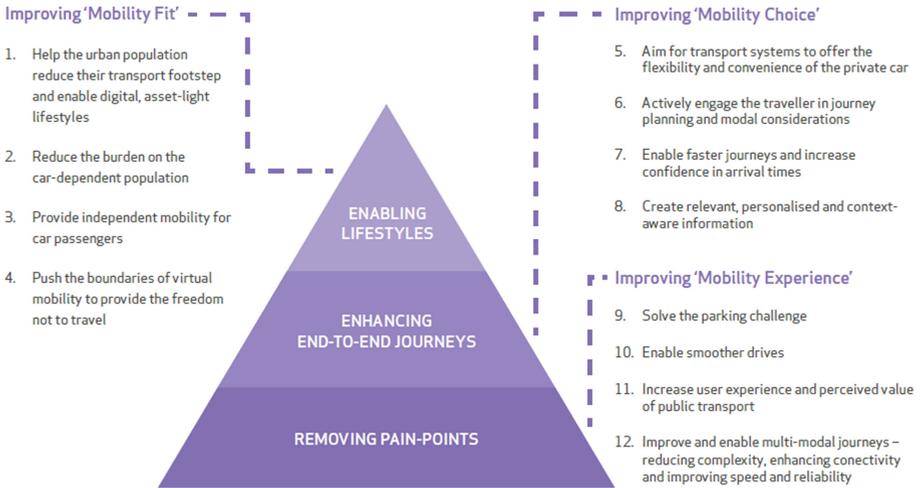


Fig. 1. The traveller needs capability challenges [21].

traveling, because it is “fun”. Indeed, it is not the activity to be carried out at destination that represents utility, and therefore value to the traveller, but the journey itself. The authors of the study include several types of activities falling under this category such as driving an off-road vehicle, recreational walking, jogging, cycling, and hiking. These activities are “undirected” in the sense that they do not necessarily have a specific objective or destination point. On the contrary, value of travel time is often associated to utilitarian travel, such as dropping off/picking up children from school, going shopping or to a medical appointment. The study goes further, describing also utilitarian travel situations in which travellers may decide to travel further (therefore, not minimising travel time) because of intrinsic reasons, such as a “variety-seeking” orientation or just curiosity. These are not exceptional situations: a common decision as dining out instead of eating at home (although food is available and quick to cook) could be included under this category.

New concepts of VTT are therefore necessary to acknowledge and fulfil the highest level of the hierarchy of travel needs, dealing with individual lifestyles and well-being. To further understand individual preferences and motivations in travel choices, a classic model by Sheth [17] distinguishes five utility needs corresponding to motivational dimensions:

1. **Functional motives:** related to the technical functions the product performs. The combination of product attributes forms the total functional utility of a product.
2. **Aesthetic-emotional motives:** style, design, luxury, and comfort of a product (class). These motives are not only important for the specific (brand) choice but also for the generic (product) choice. The product class is evaluated in terms of the fundamental values of the consumer in the emotive areas of fear, social concern, respect for quality of life, appreciation of fine arts, religion, and other emotional feelings. Thus, it may be contended that individuals tend to select those product

classes that match with their life styles and enable them to express their fundamental values.

3. **Social motives:** related to the impact that consumption makes on relevant others. Status, prestige, and esteem may be derived from the possession and usage of products and their conspicuous features. Some products are selected for their conspicuousness only (“conversation pieces”), sometimes in combination with aesthetic motives.
4. **Situational motives:** these are not motives in the sense of long-term desires to reach a certain goal. The selection of a product may be triggered by situational determinants such as availability, price discount, and/or accessibility. These situational factors apply usually for a specific brand or type. The brand choice is usually made in these cases without a careful evaluation of the product class.
5. **Curiosity motives:** motives that are supposed to prompt trials of new and/or innovative products. The consumer may try a new product; however, his repeat-purchase may be independent of such trials.

Although Sheth’s model was conceived more than forty years ago, it is still current as it acknowledged both intrinsic and extrinsic motivations. A recent study by Mokhtarian et al. [14] underlines that by “*focusing exclusively on the extrinsic motivations to travel runs the risk of substantially underestimating the demand for travel*”. In conclusion, the traditional view of VTT allows only addressing a part of the travel needs and motivations. Conventional models such as the ones from Maslow [12] and Sheth [17] are still current and can be applied to establish a framework of assessing and measuring VTT in a way that it covers the whole Value Proposition of Mobility.

3 MoTiV Conceptual Framework

MoTiV is a 30-month research project that started in November 2017. Its primary goal is to contribute to advance research on Value of Travel Time (VTT) by introducing and validating a conceptual framework for the estimation of VTT at an individual level based on the value proposition of mobility. Its approach aims at achieving a broader and more interdisciplinary conceptualisation and understanding of VTT emphasising its behavioral component. The choice of the project acronym has been chosen in line with this perspective, as motive refers to “*something that causes a person to act in a certain way*”.

This project will introduce an enlarged conceptual framework for the estimation of VTT based on the idea that each transport mode, or combination of transport modes, provides a different value proposition to the traveller in a specific mobility situation. Time and cost savings represent only one of these factors, not necessarily the ones contributing the most to VTT. Depending on the situation, other factors such as increased comfort or well-being may influence traveller’s choice more than time and cost, therefore considered more valuable.

Building on the observations made by Lyons [9] on the “orthodoxy of travel time valuation”, the project focus will be on the value of travel time itself (as perceived, experienced and reported almost in real-time via a smartphone app) rather than on the value of travel time saved (as estimated based on assumptions and rather limited survey

data). In other words, quoting two key recommendations by Lyons [9], “*investing in schemes to save travel time should be weighed against investing in schemes to make sure travel time is well spent*” and “*trend data are needed to better understand and monitor travel time use phenomena*”.

Specifically, MoTiV will go beyond the assessment of time and cost savings and will deliver a multi-dimensional framework for VTT estimation. In addition to cost and time, many other indicators play significant role in decisions on travel and mobility choices, thus representing value for the traveller. Accordingly, a new definition for “Value of Travel Time” will be introduced to acknowledge the dimension of individual “well-being” that incorporates these other indicators relevant to the individual traveller such as calories burnt, carbon footprint and overall satisfaction for the use of travel time.

The perceived value proposition of a certain travel option may not match the actual value delivered to the traveller. When the actual experience has a lower value than the perceived one, this could affect future mobility choices toward the use of other transport modes in similar situations or trip chaining. Knowledge on barriers and factors playing a role in the traveller’s choice is therefore key to align expectations and actual experience.

The project will build on latest methodological approaches for collecting travel behaviour patterns via smartphone applications. The use of smartphones for collecting individuals travel behaviour and activity participation over a rather extended period and from a large number of subjects, allows in-depth behavioural analysis that was not possible with traditional survey methods such as paper based travel diaries or telephone surveys [2, 3, 18, 20]. One may argue that despite their limitations, these latter methods were more “inclusive”. Although users without smartphone could be left out from a smartphone-based data collection, the penetration of this technology is constantly increasing, especially in Europe (e.g. 70% of the population already owns a smartphone in Spain, and 60% in Italy) that can be considered widely accessible [16]. Nevertheless, particular care will be devoted during local data collection campaigns to reach a homogenous sample that involve all relevant categories of users (including, for instance, senior citizens).

4 Expected Impact

Based on the aforementioned objectives, the expected impact of the MoTiV project can be outlined as follows:

1. *To broaden the definition and assessment of VTT beyond time savings consideration, based on a multidimensional time “value proposition” for the user.*

This will be achieved by introducing a conceptual framework based on a multi-dimensional “value proposition” that can be associated to a travel option in a specific mobility context. Travel option goes beyond the idea of “travel mode”, since it may involve a combination of travel modes and because the same mode may feature different value propositions depending on the details how it is provided (e.g. a train with/without wifi) and characteristics of the mobility context. The value proposition of a travel option plays a crucial role in the traveller’s choice, which is not only based on the purpose of

the travel (e.g. commuting, accompanying children to school, get merchandise, or leisure travelling) and the time needed. Knowledge on the role that these latent factors have (e.g. curiosity, comfort, safety & security, cost) will be valuable to assess travellers' perceived value of time in that context.

A robust conceptual framework for the definition and estimation of VTT will build upon the emerging shift from a purely "economic" view of VTT to a broader and more interdisciplinary conceptualisation of VTT emphasising its "behavioural" component. In this view, time savings are not necessarily the main objective of VTT projects, especially when these are focused on individual perception/use of travel time aiming at maximising individual happiness/well-being. Accordingly, the conceptual framework includes a broadened definition of VTT, a comprehensive description of the Value Proposition of Mobility, and how these concepts are expected to influence use of personal Travel Time Budget (TTB) in mobility contexts.

Beside, a methodology for the estimation of VTT for people work and non-work activity engagements (e.g. maintenance and leisure) in line with the conceptual framework will be developed. The methodology will link micro and macro levels of analysis, describing the process of identifying similar behavioural patterns and quantifying value propositions of mobility in such patterns.

2. *To gain an understanding of traveller's reasons for his/her travel choices in line with the perceived value proposition of mobility.*

This will be achieved by gathering data, via a smartphone application, on the reason for preferring a travel option rather than another in a specific mobility context. This qualitative information will be analysed in relation to other relevant variables such as location, time of day, working and nonworking days and weather condition to identify behavioural mobility patterns. Additionally, choices will be analysed in relation to previous travel information seek or given to the user. For example, in the scenario of daily commuting to a work place at walking distance, a walk could be more attractive than using public transport on a sunny day. In this case, the value proposition is "well-being", while at rainy weather, public transport is the option due to the value proposition "comfort". The same value proposition "comfort" could explain the choice of using one's own car. An attractive public transport system could compete with private cars because of comfort. Additionally, how do preferences and choices change when additional information is provided first-hand to the user?

3. *To assess to what extent ICT connectivity and transport services/infrastructure affect VTT across leisure and work activities and within cultures and generations.*

Knowledge on these factors will be obtained by gathering data on activities carried out by the traveller while on the move, considering the available supporting infrastructure, including its performance (e.g. Internet connectivity, advanced transport connections, frequency of connections, available seat places, environmental design, availability of shared mobility facilities, exclusive bicycle lanes), and wish-list of possible improvements.

4. *To elaborate specific actions and recommendations for mobility policy makers and solution developers that shape the value propositions of travel time.*

Specific actions and recommendations for short-medium term and longer term will be delivered and include social, economic and environmental considerations on the role of ICT, particularly smartphones and tablets, as well as on transport systems and supporting infrastructure in shaping VTT. A cost-benefit analysis relevant to the European context will be carried out: among others, this is expected to identify areas in which the shift away from the “speed paradigm” has already happening and will become more relevant in the coming years. In these areas, the employment of the MoTiV conceptualisation of VTT would provide useful indications to policy makers for the assessment and development of policies as well as to businesses for delivering new or improved mobility solutions. These indications will be complemented by an assessment of the role and importance of significant factors in VTT, addressing also the question of how relevant actors should modify value propositions to foster sustainable mobility behaviour.

5 Conclusion

Value of travel time is highly variable, including a small portion of travel with very high time values, to a significant portion of travel with little or no cost, since travelers enjoy the experience and would pay nothing to reduce it. The MoTiV project introduces a broadened definition and methodology for estimating VTT, acknowledging the shift away from a purely economic view of VTT and the incorporation of behavioural aspects such as personality, preferences, and expectations in its assessment.

To do so, the MoTiV conceptual framework builds on Sheth [17] model to investigate motivational factors behind systematic transport mode choices. These factors will be analysed thanks to a European-wide mobility and behavioural data collection through a smartphone application during the project. This dataset will allow, among others, comparisons across gender, age, and geographical contexts. The dataset also will incorporate “qualitative” input from travellers (e.g. “purpose of travel”) that will be used to derive the general mobility context (e.g. leisure/work), activities carried out within mobility, to what extent ICT and transport services/infrastructure supported (or disrupted) such activities, and overall satisfaction/dissatisfaction.

The challenge of an integrated transport and mobility planning is the understanding of the complexity of the parameters involved and their influence on people’s choices when they travel. Therefore, understanding effective factors in people decision-making process about travel and activity participation could help planners, policy makers and authorities to make them more attentive to the consequences of their policies in short, medium and long-term. Several managerial implications will emerge from this project: the results will highlight the importance of taking a holistic approach to travellers experience management in terms of preferences and expectations. Outcomes of this study will allow drawing specific policy and business recommendations to signify the role of ICT, transport systems and infrastructure and influence factors in shaping VTT in European context. The expected outcomes of MoTiV would provide useful indications to policy makers for the assessment and development of policies as well as to businesses for delivering new or improved sustainable mobility solutions in European countries.

References

1. Becker, G.: A theory of the allocation of time. *Econ. J.* **75**(299), 493–517 (1965)
2. Berger, M., Platzer, M.: Field evaluation of the smartphone-based travel behaviour data collection app “SmartMo”. In: 10th International Conference on Transport Survey Methods, Transportation Research Procedia, vol. 11, pp. 263–279 (2015)
3. Yianni, S.: Mobility as a Service. Exploring the Opportunity for Mobility as a Service in the UK. Catapult Transport Systems (2016)
4. Choi, J.T., Coughlin, J.F., D’Ambrosio, L.: Travel time and subjective well-being. *Transp. Res. Rec. J. Transp. Res. Board* **2357**, 100–108 (2013)
5. DeSerpa, A.C.: A theory of the economics of time. *Econ. J.* **81**(324), 828–845 (1971)
6. Duarte, A., Garcia, C., Giannarakis, G., Limao, S., Polydoropoulou, A., Litinas, N.: New approaches in transportation planning: happiness and transport economics. *Netnomics* **11**, 5–32 (2010)
7. Jacoby, J., Szybillo, G.J., Berning, C.K.: Time and consumer behavior: an interdisciplinary overview. *J. Consum. Res.* **2**(March), 320–339 (1976)
8. Leclerc, F.H., Schmitt, B.H., Dube, L.: Waiting time and decision making: is time like money? *J. Consum. Res.* **22**(June), 110–119 (1995)
9. Lyons, G.: Briefcase travelling: time use and value. inaugural learned society lecture of the institution of highways & transportation. In: Inaugural Learned Society Lecture of the Institution of Highways & Transportation, London, UK (2008)
10. Mackie, P.J., Worsley, T., Eliasson, J.: Transport appraisal revisited. *Res. Transp. Econ.* **47**, 3–18 (2014)
11. Mogilner, C., Norton, M.I.: Time, money, and happiness. *Curr. Opin. Psychol.* **10**, 12–16 (2016)
12. Maslow, A.H.: A theory of human motivation. *Psychol. Rev.* **50**(4), 370 (1943)
13. Mokhtarian, P.L., Salomon, I.: How derived is the demand for travel? Some conceptual and measurement considerations. *Transp. Res. A* **35**, 695–719 (2001)
14. Mokhtarian, P.L., Salomon, I., Singer, M.E.: What moves us? An interdisciplinary exploration of reasons for traveling. *Trans. Rev.* **35**(3), 250–274 (2015)
15. Okada, E.M., Hoch, S.J.: Spending time versus spending money. *J. Consum. Res.* **31**(September), 313–323 (2004)
16. Poushtner, J., Stewart, R.: Smartphone ownership and internet usage continues to climb in emerging economies. Pew Research Center (2016)
17. Sheth, J.N.: A Psychological Model of Travel Mode Selection, Bureau of Economic and Business Research of the University of Illinois, Working Paper #291, Urbana, IL. (1975)
18. Stopher, P., FitzGerald, C., Xu, M.: Assessing the accuracy of the Sydney household travel survey with GPS. *Transportation* **34**, 723–741 (2007)
19. Wardman, M., Chintakalyala, V.P.L., de Jong, G.: Value of travel time in Europe: review and meta-analysis. *Transp. Res. Part A* **94**, 93–111 (2016)
20. Wolf, J., Loechl, M., Thompson, M., Arce, C.: Trip rate analysis in GPS-enhanced personal travel surveys. In: Stopher, P., Jones, P. (eds.) *Transport Survey Quality and Innovation*, pp. 483–498. Elsevier Science, Oxford (2003)
21. Catapult Transport Systems: Mobility as a Service. Exploring the Opportunity for Mobility as a Service in the UK (2016)