What motivates people to work while travelling and what determines the associated productivity? A case study of the UK rail travellers using a SEM approach

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SHORT SUMMARY

Limitations in quantifying productive travel time may prevent transport investment from providing appropriate infrastructure or services to commuters. We contribute to these shortcomings by presenting a holistic conceptual model that reflects the stages and determinants of a productive mobile work episode. The model breaks the events leading to a work episode into different moments, thereby allowing to identify each factor's impact on productivity. The model is then operationalised using Structural Equation Models (SEM), which are estimated using data that has been collected among 500 mobile workers on UK trains. Expected results will show how single elements of transport infrastructure or ICT boost or hamper productive mobile work episodes, while taking in account commuters' expectations and their preparation for the journey.

Keywords: Productivity, travel time use, knowledge worker, ICT, travel-based multitasking, Structural Equation Modelling

1. INTRODUCTION

Conventionally, travel time has been perceived as a necessary burden when moving from one point of interest to another. Perception of travel time as 'wasted time' (Mokhtarian, 2015), reflected in public policies, has resulted in investment appraisal being focused on the reduction of travel time (Wardman & Lyons, 2016). Nonetheless, such assumption was challenged already in the 1970s by David Hensher (Hensher, 1977) , later formalized in the form of a framework, so-called Hensher's equation, or HE (Batley, 2015) in which the burden of travel can be outweighed by productive or pleasant activities. During the last two decades, this discourse surged in importance, in particular, access to Information and Communication Technology (ICT) that ease the participation in work tasks in mobile context has been indicated as one of the motives behind this renewed interest in what has been termed 'travel-based multitasking' (Kenyon & Lyons, 2007).

Following the rising awareness of the potential productivity of travel time, the last two decades have seen a growth in research on performing activities while travelling. Two reviews have been produced in this space. Keseru and Macharis (2018) provide a comprehensive review of empirical studies

focusing on multitasking. Another review by Pawlak (2020) focuses on the role of digital activities and connectivity in the context of travel-based multitasking. The author highlights the lack of research on modelling the role of ICT together with the choice of travel activities and the on-board productivity of work activities. In addition to quantitative research, some theoretical works have expanded to capture the quality of travel time activities. Classical time allocation frameworks do not account for activities that occur parallel to the travel time, only allowing the individual to maximize utility in the choice of the travel episode (Jara-Díaz, 2017). Some recent frameworks extend this perspective and model on-board activities (Banerje & Kanafani, 2008; Pawlak, 2015; Pudāne, 2018). Yet, to our knowledge just a few of these frameworks explicitly include a term productivity of work done while traveling, proposing a rather crude measurement for productivity.

Despite this growing academic recognition of travel time being valuable, it has not yet had a strong impact on present day public policy assessment methods. Only a small number of countries, mostly in northern Europe, have adopted simplified versions of the HE (Wardman, 2015). The main alternative to the HE is the willingness to pay approach (WTP), which quantifies the monetary value attached to the travel time savings. Yet this approach has limited usability, as it is not straightforward to disentangle productivity form other factors influencing WTP. At the same time, the impact of activities as well as tools such as provision of connectivity, on value of travel time, has been proven in multiple contexts. (Molin, 2020; Wardman et al., 2020). Such findings highlight the necessity to gain a more in-depth understanding of the dynamics that drive productive on-board activities, as well as a more detailed understanding of tasks carried out during travel (in the presence of ICT).

An additional complexity is posed by the difficulty to measure the productivity of knowledge workers, given the intangible nature of the work output (Brynjolfsson, 1998). When individuals are asked about the productivity of their mobile work episode, the focus resides in the outcome quality of the activity (Abeille, 2022). Nevertheless, this approach ignores that productive behaviour is a complex construct, which largely depends on the worker's choices, planning and expectations. We start from the premise that mobile work and productivity is a rather planned behaviour, especially in work related journeys. Such willingness to work influences aspects of the trip as work activity choice, ICT bundle choice, time of commute and, according to recent evidence, also modal choice (Malokin, 2019). This intuition brings us to the recognition that productive mobile work is a complex behaviour, which needs to be modelled holistically, contextually and on a focused time scale, in order to observe separately the environment's effect on commuter behaviour.

In conclusion, the comprehensive conceptualisation and quantification of mobile work, including the questions surrounding the decision to participate in it or how it is experienced (productivity) represents an ongoing and urgent challenge. Furthermore, granular information on mobile work activities and their interaction with ICT and infrastructure conditions is still lacking. Lastly, limited evidence is available on productivity on mobile activities of knowledge workers. Such shortcomings prevent transport investment appraisal frameworks from appropriately reflecting the travel-based multitasking phenomenon, potentially missing on opportunities for designing appealing transport alternatives and achieving a better infrastructure utilization by encouraging suitable modal shifts. Moreover, recent findings have shown how the value of travel time savings will be positively affected if individuals are lifted from the burden of driving during car commutes (Kolarova & Cherchi, 2021). Although questions have been raised regarding the possible effects of occupant experience on on-board activities (Schoettle & Sivak, 2015), the ongoing technological progression in autonomous driving is feeding a renewed relevance to the discourse on the value of travel time use and the value of travel time savings. On a different note, such policy leverages can help in reclaiming the public transport ridership, following the Covid-19-induced reduction in the use of public transport. While progress in vaccination and development of therapeutics contribute towards moving out of the emergency, substantial segments of population remain wary of public transport (Zhang, 2021). Therefore it is important to offer compelling transport solutions, in order to meet the necessities of mobile workers, and optimize investments in transport infrastructure.

2. AIM

The purpose of the present study is to develop a model of productive travel time use, looking at specific mobile work tasks and their interaction with trip planning, expectations, ICT and travel conditions, as well as effects of personal attitudes. The intent is to offer insight on factors that affect productive behaviour, and hence affect value of travel time (savings). To this end, the present effort looks at two objectives.

- Firstly, we propose a conceptual model of the process of mobile work that decomposes the phenomenon into different moments of the process, ambition, anticipation, decision, execution and reflection. This is a novel approach that permits representing the complex set of processes that lead to decisions concerning mobile work participation.

- Secondly, we operationalize the model using data from the UK rail context collected between fall and winter of 2021. The operationalisation, in the form of a structural equation model (SEM) allows quantification of the direction and magnitude of specific factors on the work activity productivity, including those characterising the traveller, the journey context, as well as the quality of travel environment, e.g. available connectivity.

3. METHODOLOGY

3.1. Conceptual framework

The process of engaging in mobile work requires recognition of its multi-stage nature. Towards this end, we propose a model that assumes existence of 5 behavioural stages in the process of mobile work decision-making (Figure 1).

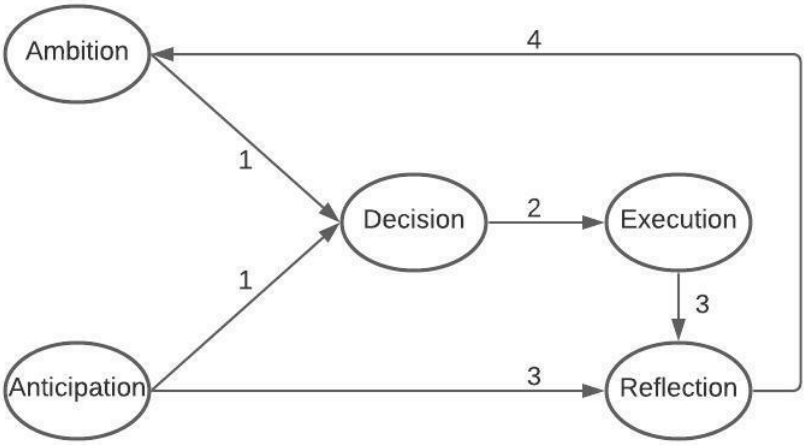

Figure 1. Behavioural stages of mobile work

Initially the decision maker will have an *Ambition* to work during travel. In addition, an individual will have a certain set of expectations (*Anticipation*) concerning the set of mobile environments that they can choose. Based on these two elements they will come to the moment of the *Decision* to work while travelling, which will subsequently lead to the *Execution* of the productive work activity. Lastly, there will be the moment of *Reflection*, when the productivity of the activity will be evaluated. For the aim of this paper, we chose to focus the model on train travel.

Following this underpinning behavioural structure, our conceptual model is divided in 4 moments (Figure 2), which represent the moments of the progression of the activity; note that these are not aimed to indicate the temporal separation of the moments, nor the length of the activity.

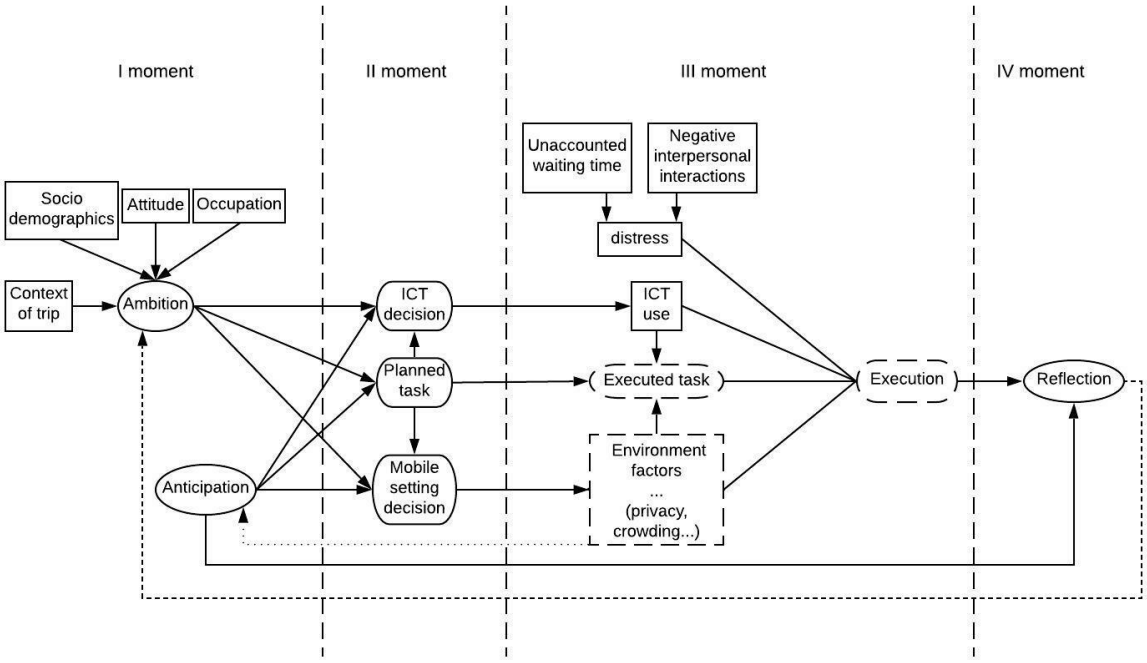

Figure 2. Conceptual model of mobile work

In the figure above squared boxes indicate external factors, while rounded boxes contain choices made or actions taken by the decision maker. The dotted boxes indicate factors or choices that may vary during the course of the travel, such as the availability of a seat. Lastly, plain arrows indicate events that happen during one commute, while dotted arrows show events that happen with a greater lag, and will affect future commutes.

In Moment I, the individual has the ambition to work, which is driven by the context of the trip (i.e. leisure, work commute) as well as attributes of the travellers, including occupation, socio-demographics as well as their attitudes. If the trip is work related, the traveller may have a stronger drive to perform work. Additionally, the ICT would represent less of a burden to carry compared to a leisure trip or a grocery trip, which affects the ICT decision in Moment II. Job characteristics also account for the potential effect of work beliefs of specific occupation, such as a drive/possibility to work beyond office hours. One additional effect on the ambition to work may be the effect of work done in previous trips during the day; depending either on the quantity of time used to work or a high productivity achieved, it might e.g. have an exhaustion or satisfaction effect.

Another aspect at play in Moment I concerns anticipation of the context that the worker is going to encounter. Such expectations are typically formed based on previous experience, but can also include opinions' of others or information provided by the transport operator.

In the Moment II, the decision maker makes three types of decisions. Firstly, they decide on which mobile setting (mode choice, class of travel) to choose and timing of the travel. They may also decide on the equipment to take, including ICT. Additionally, the decision makers may decide in advance what work activity to carry on based on the expectations of the conditions. Additionally, the activity decision may have an impact on the decision concerning which equipment to bring, ICT bundle choice and potentially on the mobile setting decision. The latter case is a reflection of the possibility of travel time activities affecting mode choice or travel timing decisions.

In Moment III the traveller faces the actual travel environment and executes the task. In this moment, the "executed task" term is a sum of decisions that will depend on the attributes of the mobile environment during the stay, and may therefore vary during the journey. For instance, as the train gets

more crowded between stops, the decision makers may change their work task in order to adapt to the new environment. In this instance, the available ICT bundle may also have an effect in facilitating this process. All these factors then have an effect on the productivity, together with the experienced distress, which might be the effect of a negative interpersonal interaction that day or unwanted waiting time, for instance due to unreliable transport mode.

In the IV moment, the person reflects on the quality of the activities, i.e. their productivity during mobile work. This reflection is also affected by the expectations of the decision maker, as extreme positive or negative expectation may skew the worker's perception. Lastly, such reflection will affect motivation to work in future trips.

3.2 Modelling

In order to operationalise the conceptual model presented above, we propose the use of Structural Equation Modelling (SEM). The advantage of using this method compared to its alternatives, is two-fold. Firstly, the SEM allows us to replicate the structure of our conceptual model, which includes several direct and indirect effects. Secondly, the SEM allows incorporation of latent variables measured by observable indicators, which combination is particularly useful to reflect and measure the intangible nature of productivity in the present context.

Due to the recent Covid19 pandemic outbreak, the original model was extended in order to account for potential distress caused by the pandemic outbreak. Therefore we include a set of questions to account for possible inhibitions deriving from the discomfort or unease of travellers.

3.3 Data

To conduct this study we collected our data among train users within the UK that have travelled by train during the two weeks preceding the administration of the questionnaire. The focus on train travel is motivated by the length of the journey, which offers more time to engage in travel activities. Data was collected between September 2021 and December 2021, as train usage rates largely recovered after the pandemic outbreak. Our sample consists of 500 respondents, which were asked to complete the online survey within two weeks after the journey has taken place. The sample includes employed individuals from all UK regions, aged between 18 and 65. The survey also collects information about sociodemographic attributes as well as attitudinal indicators, as the poly-chronic attitude and the respondent's personality traits. About a quarter of the sample consisted of respondents who did not engage in work activities, although their work permitted so. This allows us to observe drivers behind the choice of not working, which otherwise would go unobserved. The sample is also split among outbound and inbound travel experience, accounting for a smaller share of respondents engaging in work activities during the inbound trip due to fatigue.

4. ANTICIPATED RESULTS AND CONCLUSION

The analysis of the data collected is currently being carried out. During data collection, the SEM model has been calibrated to a mock dataset derived by the UK Time Use Survey of 2015. The data contained in the Time Use Survey had little indication over train condition and work tasks carried out, therefore little can be said about the anticipated magnitude of such effects. Nevertheless, the mock analysis showed positive relations between the motivation to work and the commute context, as well as occupational, sociodemographic indicators and ICT. Final results are expected and will be ready to be presented by April 2022. We expect such results to provide unique insight into factors such as the expected commuting conditions as well as the condition of the carriages and productive work episodes. Such findings will provide useful guidelines for transport providers when communicating to the travellers about travel condition, as well as an indication on effectiveness of on-board facilities as silent carriages and on-board wi-fi.

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