Teleworking and Online Shopping

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Work and shopping constitute two of the main purposes for urban mobility, and are responsible for the largest share of passenger transport activity. The transport sector is the second largest source of Greenhouse Gas (GHG) emissions in Europe mainly due to road transport activity and -given the importance of Climate Change- is in need of solutions that minimise its environmental footprint. Teleworking and e-commerce are two technology-enabled options that can modify individual daily mobility patterns and potentially reduce total transport demand and its associated impacts (energy consumption, CO2, pollutant emissions, congestion, etc.).

Keywords: telework ; online shopping

1. Background

Teleworking and online shopping became widespread in recent years thanks to the massive introduction of Information and Communication Technologies (ITC). Nevertheless, these two trends follow different paths. While online shopping has already become a common practice in Europe and worldwide [1], teleworking was barely considered as a main option before 2020 [2]. The COVID-19 pandemic, however, led to teleworking being the *de facto* option for a considerable share of the labour force in several countries [3].

Teleworking may have a positive effect in terms of reducing the emissions of greenhouse gases, since it reduces the number of trips to work. It could nevertheless also stimulate changes in the habits of telecommuters that could reverse such savings. These include changes in lifestyles that alter the daily mobility patterns [4][5]. For example, a lower frequency of trips can be linked to a longer trip distance or a higher share of car trips, resulting in higher levels of pollution.

The urban model of European cities may change significantly if the expansion of telework encourages urban sprawl [6]. At the same time, online shopping can also influence city attractiveness, enabling wider accessibility for consumers at the benefit of low-density cities and rural areas. In this context, understanding the factors that influence the adoption of teleworking and online shopping is important for measures addressing transport demand and its consequences, but is also highly relevant for wider policy priorities in urban and regional planning.

2. Teleworking

The concept of telework was conceived in the 1970s as a tool to reduce petrol dependency and traffic congestion [7][8]. Since then, the concept and the technology have evolved, with new tools and business models. The options available today cover a wide range of setups, from home office to mobile office, virtual office or Telework ICT-based Mobile work (TICTM).

In this paper, the concept of telework encompasses individuals who work from outside their usual workplace (according to the International Labour Organization (ILO) [9]) and—as a result—do not need to physically make a work-related trip. The classification of remote work can be based on location, the technology used and the frequency. Work can be performed at home using ICT tools (home-based telework) or without using ICT tools (home-based remote work), but can also be carried out outside the worker's home. The frequency and mobility may also differ within each category. **Figure 1** summarises the different types of workers based on the location where the work is performed, the use of ICT tools, the frequency of use, and the corresponding mobility patterns.

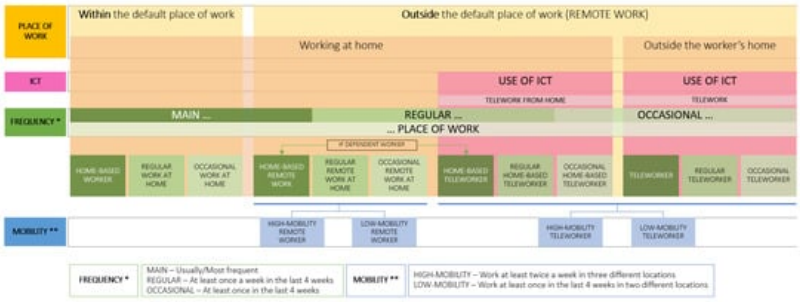

Figure 1. Types of teleworkers. Source ILO [9].

The term *teleworkabililty* refers to the technical possibility of providing labour input remotely into a given econo mic process [3]. In Europe, according to Sostero et al. [3], around 36% of employment (employees and self-employed) is potentially *teleworkable*. Similarly in the USA, 37% of jobs may be performed from home [10]. The adoption of occasional or frequent teleworking grew significantly during the pandemic, from 11% in 2019 to 39% in April 2020 and 48% in June/July 2020 [11], due to lockdown in several EU countries because of the COVID-19 pandemic.

Various lines of research have explored the type of employee profile that is more likely to telework, the frequency of teleworking, the reasons for the choices and the impacts of the new behaviour [12].

In terms of who is more likely to telework, a definition of the profile of teleworkers based on socio-economic characteristics often suggests a strong correlation with high education level, high income, being male or having children [13][14][15]. Other features like household location have been associated with telework, especially in larger urban areas [13], as well as with the type of work performed, as in the case of managers or independent professionals [16]. In terms of frequency of teleworking, occasional teleworkers, for example, tend to be men, with secondary or tertiary education, self-employed and managers or professionals, while highly mobile teleworkers are more likely to hold a tertiary education level, working as an associate professional, technician or manager [16]. Nevertheless, the profile of teleworker is rapidly changing, since more employers are encouraging (at least occasional) telework and more IT tools are available [13].

Most studies suggest that telework leads to a reduction in energy use, travel distance and emissions [13][17][18][19][20][21][22]. In some cases examined teleworking may increase energy consumption [23] or have unclear impacts [4].

Regarding the distance travelled by teleworkers, some authors find a decrease in the number of vehicle-kilometres travelled [24] and congestion levels [25], while others report an overall increase taking into account commuting and non-commuting travels [5][26][27][28]. These discrepancies could be explained by the data used or the assumptions made, like the use of older data from a period when the profile of teleworker was not as heterogeneous as today [15] (typically a man with high education, high income, and a top position), the methodology, or assumptions made by the authors (as assuming teleworking just one day per week).

Considering GHG emissions avoided by telework, some authors suggest that adopting telework decreases GHG emissions [29] and the number of pollutants [25]. However, to some extent teleworking could actually increase the amount of GHG emissions according to Larson and Zhao [4] and future scenario projections made by Alonso et al. [23].

Teleworking may have a rebound effect in urban planning as we know, due to a potential dispersion of residential homes by enabling urban spreading to suburbs with lower prices and bigger houses [4][5].

Other motivations to telework usually mentioned in the literature are job satisfaction, productivity [30], or an improvement in the work-life balance [31]. However, once people telework, some drawbacks appear, as identified in several articles [32][33][34], even those firstly seen as beneficial. For instance, health issues like musculoskeletal problems, isolation, depression and stress may appear [30][32], although they can be partially solved by minimising the risks with ergonomic equipment, virtual communication or mental health support. Companies must address these problems while dealing with the work organisation under this new labour scheme.

3. Online Shopping

Shopping online has become more and more popular in recent years. In Europe (EU-27) 32% of individuals made an online purchase in 2009, rising to 60% in 2019 [35], growing in all age groups. On that year (2019), 49% of Europeans declared to made an online purchase in the last three months, according to Eurostat [35].

There are different types of stores regarding sales channel, depending on whether the store is selling entirely online, in the physical store or in combination. This classification is usually named as “Pure player”, “Bricks & Mortar” and “Bricks & Clicks”, respectively.

E-fulfilment methods (the entire process from receiving the order to final customer delivery) play an important role in terms of energy efficiency. The structure of the retail store regarding the delivery channel depends on how and from where the parcel is sent. For “Pure Players”, the order can be delivered from the warehouse by owned van delivery, through a parcel delivery network, or dropped-shipped directly from the supplier via a parcel delivery network. For the Bricks & Clicks case, the delivery can be done by vans from the physical store, directly from the warehouse or by the “Click & collect” system, where the customer picks up the order directly from the selected local store. Another possibility is to sell directly from the manufacturer through a parcel delivery network without the retailer intervention.

The profile of the online shopper is heterogeneous since the practice of buying online is widespread. Nonetheless, the profile is usually linked with young people, highly educated, with high income and living in dense urban areas [36][37], although this practice is expanding to rural areas as broadband internet reaches more places [38]. The use of e-commerce varies depending on the product to be bought and therefore the profile in each product category is also different. For instance, Dominici et al. [39] found that buying groceries online is more likely for women, young people, with mid-high education level, high income and living in a small family. The channel selected by the customer is also a determining factor: multichannel shoppers are on average younger than traditional shoppers and pure online shoppers younger than multichannel shoppers [40].

The main reasons to buy online are price, comfort, product offers and comparison, purchase process (order, payment and delivery time) and time-saving [37][41][42]. The drivers to buy online are related to time-saving and having health problems, while car possession seems not to be a predictor for shopping online [39].

Online shopping is getting more and more value in consumer behaviour as ICT is becoming more widespread and adopted by citizens, but usually customers use multiple channels while purchasing some types of goods [43]. This shopping modality has the potential to improve efficiency in the time we spend and the trips we make to buy, but it must be analysed in global terms to identify savings in terms of energy and emissions. Online commerce represents potential energy savings that may differ according to the modal split of the analysed city [44]. Regarding distance travelled by online shoppers, to buy online does not replace the trip to the store totally, and according to Hiselius et al. [45], people shopping online make the same number of car trips as traditional shoppers.

Shahmohammadi et al. [46] show that Bricks & Clicks reduces the GHG footprints compared with traditional shopping for Fast-Moving Consumer Goods (GMCGs), while Pure Players with parcel delivery network often have the higher GHG emissions share. Van Loon et al. [47], shows this relationship between different fulfilment methods and the basket size, being more effective as the basket size grows. This statement could change in the future when electric vehicles and other efficiency measures (larger basket size, reduction in failed deliveries, routing improvement, freight consolidation) become more widespread, changing the GHG footprint for online shopping.

The structure of the city is also essential when comparing emissions from different types of shopping channels. Car intensive cities could present a higher emission share for the brick-and-mortar channel, linked with extensive cities and inefficient public transport. On the contrary, compact cities, with a high modal split of public transport and active transport modes, could be more efficient in terms of emissions for this channel [46].

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