Too much of a good thing? Using a spatial agent-based model to evaluate "unconventional" workplace sharing programmes☆

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ABSTRACT

Using a spatial agent-based model of transport, this paper explores various "unconventional" workplace sharing programmes that allow employees to work remotely at other work sites in Northeast Scotland, with Aberdeenshire Council as the focal employer. We attempt to answer the following research questions: (i) To what extent do systemic effects arising from agent interactions within the transport network mitigate or enhance any potential benefits of workplace sharing? (ii) How are these effects changed by informal workplace practices influenced by organizational structure and corporate culture, as opposed to formal business policy? We have been able to show that there are potential benefits to workplace sharing, particularly within a large organization with spatially distributed workplaces. Indeed, the greater the flexibility available, the larger the potential gains, especially with participation of the whole workforce across all employers. However, the apparent benefits of workplace sharing for commuting times and CO$_2$ emissions from transport can be negated by organizational structure and corporate culture. Informal policies whereby team leaders stipulate collocation of team members to facilitate day-to-day and face-to-face interaction can even lead to a worse situation than the case where there is no workplace sharing. The effect of the sharing programmes also depends on the spatial distribution of existing road network, as well as industrial and residential areas. The work acts as a warning that apparently attractive "win-win" policies with the potential to promote better staff welfare, reduce pollution and make more efficient use of infrastructure can be negated by informal practices in workplaces. It is a step towards a general policy simulation platform where the effectiveness of transport policies can be tested and potential unintended consequences detected before they are implemented in reality, by which time it may be too late or costly to correct any unintended negative effects.

1. Introduction

The nature of both work and workplaces has changed considerably over the last few decades, and increasingly organizations find themselves needing to question some of the traditional ways in which relationships between workers, workplaces and work are designed. In Northeast Scotland, UK, some local authorities, including Aberdeenshire Council (the case study organization studied within this paper), have been exploring different forms of flexible working as a potential response to some of these demands. By providing more flexible arrangements at work, including allowing employees to work remotely at other places, the council aims to cut costs and provide a better work-life balance for employees, including potentially reducing the amount of time they spend commuting to and from work.

Workplace sharing could have a profound impact on the transport system. Work-related commuting makes up a large proportion of traffic in urban areas, especially during peak hours. As a result, allowing employees to work in different workplaces could potentially alter the entire transportation system. In particular, due to the existing infrastructure and the location of work and residential clusters, workplace sharing may also alter the spatial distribution of traffic, causing some areas to be more congested and others less so.

As Perlow and Kelly (2014) note, simply allowing employees access to flexible working is insufficient to overcome entrenched working practices, or indeed perceptions of co-workers and managers that those working flexibly are somehow causing problems that have to be "accommodated" by organizations. Implicit factors such as corporate culture and organizational structure will greatly influence the implementation and the effectiveness of flexible work schemes at the local level. Studies find that organizational and cultural barriers may prevent people from making the full use of flexible work arrangements, negating any benefits the scheme is intended to bring (Felstead, 2012).

Aberdeen city and its suburbs have a population of about 400,000, of which around 100,000 people commute daily to and from work. Aberdeenshire Council is one of the largest local employers, employing more than 10% of the total labour force in the area. Since 2011, Aberdeenshire Council has implemented a combined programme of efficient facilities management (known as "workSPACE") along with mobile and flexible working profiles and patterns (known as "workSMART"). Within Aberdeenshire Council, the take-up of flexible working has been between 12% and 24%, and there have been notable reductions in business mileage and commuting miles attributed to these measures (MVA, 2015).

Notwithstanding any specific organizational benefits that might arise from schemes like workSMART, local authorities also play an important role in affecting regional travel and associated CO_2 emissions, because as an organization, they are both large and spatially distributed. Whilst intra-organizational space sharing is already being implemented within Aberdeenshire Council, other more radical ideas have been discussed by Aberdeen City Council (2015), such as the provision of "Remote Shared working hubs", as a way to avoid the need for workers living in rural areas to commute to city centre workplaces, and vice versa. The study presented here explores various scenarios that illustrate the outcomes of implementing a series of what might be described as "non-traditional" or even radical workplace sharing schemes on commuting patterns in the region.

Using an agent-based transport model, this paper explores various "non-traditional" workplace sharing programmes, i.e. programmes that provides flexible arrangements at workplaces and allows employees to work remotely at other places, with Aberdeenshire Council as the focal employer. Some workplace sharing schemes simulated are more radical than others, and not all are necessarily practicable in the real world. Nevertheless the results provide insights into what could happen were more employers to adopt such measures, without having to execute such programmes on a large scale in reality, by which time it may be too late and too costly to prevent any negative unintended consequences.

The research questions we aim to answer in this study are: (i) To what extent do systemic effects arising from agent interactions within the transport network mitigate or enhance any potential benefits of workplace sharing? (ii) How are these effects changed by informal workplace practices as opposed to formal business policy? We will extend an existing agent-based transport model (Ge and Polhill, 2016) to investigate the effectiveness of various workplace sharing schemes in reducing transportation demand, commute time and the associated CO_2 emissions. In addition, we will show how the interactions between workplace sharing schemes and corporate culture and organizational structure could lead to unintended consequences.

2. Relevant literature

Congestion and pollution are common problems faced by most urban areas. Due to space limitation, high cost and environmental concerns, it is often implausible or inadvisable to build new roads to relieve congestion. An alternative approach, therefore, is to reduce the demand for transportation and to use the existing roads more wisely. In other words, using "soft" transportation policies that help people make smarter choices in the way they travel. Cairns et al. (2008) estimated that these soft, smart choice measures could reduce total national traffic in the UK by about 11% on average, and by up to 21% in peak period urban traffic.

Since the daily commute to and from work makes up a large part of urban traffic, interventions at workplace is seen as an important way to reduce traffic, especially during peak hours. As a result, many workplaces have adopted work travel plans that encourage employees to take an alternative travel mode, such as car sharing, public transport, cycling, or walking. Studies find that for those work travel plans to be effective, employers often need to provide sufficient incentives to the

employees, such as financial incentives, free parking for car sharers and discounted bus tickets, free shuttle buses, or bike repair services (Meyer, 1999, Cairns et al., 2010, Van Malderen et al., 2012). Flexibility can also be provided regarding when and where work takes place. Compared with work travel plans, these flexible work schemes require little financial investment from the employers. They are also found to be associated with increased productivity (Coenen and Kok, 2014) and better work-life balance (Cowan and Hoffman, 2007).

Flexible working schemes can be categorized into two types: alternative work schedules and alternative worksites. The first allows people to work outside of the conventional working hours, and is often referred to as "flexitime". Researchers have been studying the effect of flexitime in alleviating congestion. For example, Ge and Polhill (2016) show that flexitime can significantly reduce congestion and commuting time, and is in some cases more effective in reducing commuting time than building new road infrastructure. Sundo and Fujii (2005) study the effect of a compressed working week (shortened working week with extended daily work times) in the Philippines, and found that commute time was reduced due to changes in departure times, with the reduction in commute time larger for employees with a long commute. Komma and Srinivasan (2008) and He (2013) find that commuters with flexitime arrangements are less likely to leave home at peak hours (when congestion is most severe), compared with those without flexitime. Saleh and Farrell (2005) find that travel time reduction from flexitime also depends on non-work activities.

The second approach, alternative worksites, allows people to work in a different workplace, such as an office in a different location, a café or work hub, or at home (teleworking). Compared with flexitime, less research has been done on workplace flexibility, although its general impact on the traffic system may be more significant. Schipper et al. (1989) for example note that the practice of working from home "alters both commuting and home energy use patterns, while reducing occupancy in places of employment and services". Several studies of telecommuting programs in California in the early 1990s found that the average travel distance per day of the individuals involved in the program can be reduced by anywhere between 56% and 77% on their telecommuting days, with significant reductions in emissions (Henderson and Mokhtarian, 1996, Koenig et al., 1996). A more recent study by Zhang et al. (2005) also finds that teleworking can significantly relieve bottleneck congestion in peak hours. As technology these days has made remote working more possible than ever, its potential in alleviating congestion and pollution needs more research attention.

We should not, however, be naïve about this issue. Just because the technical barriers to remote working have been largely resolved does not mean there are no other barriers. Culture, tradition, job design, and corporate hierarchy can all affect the way remote working is perceived and implemented. Millward et al. (2007) studied the impact of hot-desking (a flexible work arrangement where employees are not assigned their own desk but can use any available one each day), and found that the physical arrangement of workplaces will affect employees' team identification through the people with whom the employees engage in the workplace. Coenen and Kok (2014) show that although hot-desking and teleworking have a positive influence on productivity, many employees still consider a sufficient level of face-to-face contact as essential to offset the negative effects of teleworking. Páez and Scott (2007) find that colleagues' decisions to telework will heavily influence an employee's choice to telework as well. Finally, Rietveld (2011) argues that management and organizational structures need to be changed to fully exploit the potential of worksite flexibility.

3. Method: the agent-based model of work-related commuting in Aberdeen

Agent-based modelling is a computational modelling approach that simulates multiple heterogeneous, interacting individual agents that