

Preliminary Findings on the Commute Travel Implications of Stated Preference Female Teleworkers in Kuala Lumpur

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Abstract: Teleworking has been recognized and promoted as one of the number of strategies for alleviating traffic congestion in urban areas, especially reducing rush-hour traffic. Substantial evidences in the literature suggest that teleworking is more suited to women who when compared to men, experience more work/non-work role conflict and more career interruptions. It is the purpose of this paper to verify and explore the commute travel implications of potential female telecommuters in Kuala Lumpur. Preliminary data analysis indicated an average saving of 312 vehicle-kilometers per teleworker per month as a result of teleworking, and an overall reduction of more than 160,000 commute trips per month. The financial burden of setting up a home office seems to be the biggest barrier preventing the propagation of teleworking among female employees in Kuala Lumpur.

Keywords: Teleworking, Travel, Traffic congestion, Female employees, Kuala Lumpur.

1. INTRODUCTION

Rapid motorization in Malaysia is posing an enormous strain on the ability of the existing infrastructure to cope with the ever increasing traffic volumes. During the period from 1986 to 2002, the number of vehicles in the country increased from 4.43 million to 11.97 million, almost tripling in the process. No other state in the Malaysia has to handle more traffic than the country's federal capital of Kuala Lumpur where almost a third of all registered motor cars in the country are found.

As of 2010, the federal territory of Kuala Lumpur had by far the largest number of motorcars compared to all other Malaysian states. More than 21% of all registered vehicles and almost a third of all motor cars (29.3%) in Malaysia are straining the infrastructure of Kuala Lumpur.

This trend is unlikely to change in the near future as evident from the number of cars registered in the year 2010. Kuala Lumpur has maintained the pole position in this regard with more than 208,000 new cars registered. A figure which is more than that of all newly registered cars in the next four states in the list, namely Johor, P. Pinang, Selangor and Perak combined.

The wide spread single occupancy vehicle trend in Kuala Lumpur is alarming. In the year 2008, the daily traffic flow figures on the Kuala Lumpur road network indicates that 70% of vehicle trips crossing the MRR I (42,600 vehicles), and the MRR II (86,500 vehicles) during the morning peak hour were single occupancy vehicles (SOVs). This figure was less by only 5% during the evening peak hour. The total volume entering the Central Planning Area (CPA) of Kuala Lumpur was estimated to be 1,411,200 PCU/day in 2008 (Leong, 2010).

The urban fabric of Kuala Lumpur's central area has further augmented traffic problems. The central planning area reflects the fact that until recently, access was dominated by cars, motorcycles and buses. Its employment density is low by international standards (Newman, 1999) with employment spread along several roads and into several sub-centers near major road intersections. Major shopping centers and hypermarkets are being located increasingly in close proximity to major expressways. Those include the Mid Valley Mega Mall, Sunway Pyramid, One Utama, Summit USJ and Carrefour at Bukit Jalil (Barter, 2004). All of the aforementioned would result in increasing dependence on the use of private motorcars.

Urban expansion has been based mainly on planned townships or new towns that have been developed in a style that adapted from the British post-war new towns model (Lee, 1987). They are somewhat car-oriented in their layout and their centers of activity rarely coincide with public transport nodes. They include among others Petaling Jaya, Shah Alam, Subang Jaya and almost 40 other new towns (Dasimah, 2001).

Another feature of the urban form that encourages the dependence on private motor cars is that successive townships or housing estates tend to be built with little attention to local connections to their immediate neighbors. The result of such a feature is twofold. On the one hand, it creates an impermeable urban form that forces commuters even for short trips into the main road, while on the other hand, it hinders efficient bus routing (Barter, 2004).

The poor public transportation forms another facet of the problem. The rate at which the modal share of public transportation has been deteriorating over the years is causing serious concerns. The modal share of public transport in Kuala Lumpur has declined from 40% in 1980 to a mere 16% in the year 2009 (Urban Transport Department, CHKL). Such a modal share distribution is now comparable to the usage levels found in relatively automobile dependent cities in Australia, Canada, and the United States (Barter, 2004).

Rail transport in Kuala Lumpur faces its own set of challenges and shortcomings as well, that is despite the fact that it accounts for about 50% of public transportation ridership in the city (Mohamed Azman, 2003). Barter (2004) highlighted a number of shortcomings of the rail network in Kuala Lumpur that included the poor integration between the different lines that form the network, the poor accessibility of stations and the poor integration with the land-use patterns since rail lines mainly followed low-cost or historical rail alignments and thus misses many important activity centers.

Barter (2004) argued that the very low public transportation modal share is due to the lack of any significant complementary and supportive measures such as Traffic Demand Management (TDM) initiatives and transit-oriented development patterns. With this background, it is imperative to take note that telecommuting could be considered as one of the effective measures to handle peak-hour traffic especially reducing number of trips and its associated person-km and vehicle-km travelled. Unfortunately, the likely potential of telecommuting to alleviate traffic congestion is overlooked by the planning authorities.

2. THE GENDER GAP IN TRAVEL BEHAVIOR

The increasing presence of women in the workforce has resulted in change in the travel patterns over the past few decades. More and more women in the labor force meant that the income of households has increased while the time available for performing household chores decreased, this phenomenon resulted in women needing to buy services such as childcare and meals from outside and thus increasing the number of non-work trips in the process (Levinson, 1997).

Two travel surveys conducted 20 years apart support this argument. The first was carried out in 1968 and the second in 1988 in the Washington D.C. metropolitan area. The surveys revealed that buying such services alone resulted in an increase of 25% in trips per person. Such has been the impact on travel brought about by the increased number of female workers.

Women in the workforce have developed unique travel characteristics that substantially differed from that of their male counterparts. A large body of research has dwelled on the subject of the unique travel patterns that men and women workers develop (Andrews 1978; Barbour 2006; Gordon, Kumar, & Richardson 1989; Hanson & Pratt 1988; Johnston-Anumonwo 1992; Levinson 1997; Madden & White 1978; Mauch & Taylor 1998; Mokhtarian 1997; Pisarski 2006; Preston, McLafferty, & Hamilton 1993; Pucher & Renne 2003; Singell & Lillydahl 1986; Taylor 1997; Wachs 1997). Virtually all have found significant and striking differences by gender. Women were found to make more but shorter trips (in both time and distance), and were more inclined to perform more child and home-oriented travel and trip-chaining (Crane, 2007).

At this juncture, it becomes very important to seek an explanation of the likely cause of this gender gap. MacDonald (1999) attempted to provide an explanation of the gender gap in travel behavior and listed three main reasons behind it; (a) the generally lower income of working women, which does not justify longer commute trips, (b) women's home and employment responsibilities that constrain their scheduling and distance options, and (c) the full and part-time opportunities that are more evenly distributed in space in the historically female occupations sectors such as retail, education and health.

It has been noted that men and women use transportation modes differently, and these differences have persisted over time. The root cause of such differences lies in society's expectation that each sex will fulfill distinct economic and social roles. In less affluent households, men are expected to use the family car for the daily commute to work, while women—employed or otherwise—relied on public transportation (Wachs, 1997).

Several studies (e.g. Taylor, 1997 and Pérez, 2002, Tingey, et al., 1996; Bielby and Bielby, 1988) have indicated that working women still bear a disproportionate share of household responsibilities in addition to their employment responsibilities that were traditionally shouldered by male employees. In the United States, for instance, despite the dramatic increase in women's participation rates in the American labor force which reached up to 46%, a study found that in the 25 years between 1978 and 2003, American women still performed 80% of childcare duties and two thirds of core household tasks, and that women simply add market labor to their existing domestic responsibilities (Travis, 2003). In fulfilling both their employment and household responsibilities, women workers became known to make more linked trips than men, mainly to drop-off children in the morning, and shop during the afternoon. Women also were found to make more trips than men do serving the needs of children, the elderly and other household members (Levinson, 1997). This dual role is obviously imposing considerable stress on the women workers.

In light of the so called 'gender gap' in travel behavior and the still prevailing trend of the two-fold responsibilities shouldered by working women, they (working women) are more likely than men to view teleworking as a potential solution to those extra pressures (Mokhtarian, 1997), and thus tend to favor teleworking because it allows them to fulfill household commitments while still remaining in the labor force.

Another study by Mokhtarian, Bagely and Salomon (1998) concluded that women on average rated the advantages of teleworking more highly than men, and that teleworking appears to appeal more strongly to women as a solution to problems they face. This fact goes in line with what Jack Nilles - the researcher who is credited with coining the term

‘teleworking’ in the 1970’s - had in mind when he described it to be “a way to make life better for women with primary childcare responsibilities” (Travis, 2003).

Having mentioned that however, studies in the United States have shown that while some women workers adopted teleworking for childcare and family reasons, a majority does not (Pérez, Carnicer, and Sánchez, 2002).

In the local (Malaysian) context however, a more relevant study on the matter revealed that ‘taking care of the family’ was one of five most important factors why Malaysian working women are tempted to adopt teleworking working arrangement (Karia and Asaari, 2006). Other studies highlighted even more benefits derived from teleworking from a woman’s perspective. It has been argued that the flexibility offered by teleworking to working mothers, can potentially liberate women from male control in the office and provides increased autonomy and creativity for them. For those worried about the degeneration of family ties, teleworking is perceived as bringing families closer together as well as bringing down the divorce rates (Ng, 1998).

In addition to the well established fact of women shouldering more household responsibilities than men, an interesting study compared the travel patterns of women and men of single-adult households and found that women made on average, 1.7 times as many child-serving trips as men. They also made 1.3 times more grocery shopping trips than men, a finding that indicates that the division of responsibilities may not be the cause of the variation in travel patterns between men and women but rather it is the gender that affects the way one travels.

Yet another unique behavior displayed by working women, is their readiness and tendency to adopt measures that enables them to avoid traffic congestion. A study found that women were more likely than men to adopt a particular strategy in order to cope with congestion and long commute trips. The study revealed that working women especially those with children were more likely to go for solutions such as working part-time, setting up a home-based business (essentially teleworking) or stopping work altogether. The study also showed that women in general regardless of the presence of children and marital status were more likely to change their work schedules by choosing arrangements like flextime and compressed work weeks. Working women of households with more than one adult were much more prone to changes than single women (Mokhtarian, 1997).

For the purpose of this research and with the type of data currently available, it was hard to determine the actual contribution of working women to the traffic congestion problem. However, it is safe to assume that the relatively high participation of women in the workforce is reflected in a proportionately high presence on the road during rush hours. Furthermore, according to data supplied by the statistics department, ministry of transport, a third (33.6%) of all motorcars and 29% of all vehicles in Malaysia were registered by women. In addition, existing literature on the travel behavior of women suggested that they tend to travel more than their male counterparts, and that the mere presence of women in the labor force resulted in a significant increase in the demand for travel.

To conclude this subsection of the research, it is important to mention that all of the aforementioned facets of the problem statement contribute in making teleworking a viable and realistic solution particularly suited to the context of Kuala Lumpur. The US Department of Transport stated that severe traffic congestion and the lack of public transit (both glaringly present in Kuala Lumpur) will typically be a powerful incentive for a successful implementation of teleworking (US DOT, 1993).

3. STUDY APPROACH

A self-administered questionnaire survey was used to obtain the necessary data from the targeted population. The targeted population consists of working women being employed in any of the four following industries: financial intermediation and banking, real-estate and other related business activities, education, and telecommunications industry. Within the four industries, four employment categories (namely managers, professionals, associate professionals and clerical workers) were identified as the most suitable for the adoption of teleworking.

The aforementioned sampling criteria were based on the findings of the only teleworking prevalence study to be carried out in Malaysia (Ng, 1998). That study identified the four industries and employment categories or types as the most suited to the practice of teleworking. The total population size was found to be 63,900 female employees in Kuala Lumpur, a figure that represents 24.3% of all female employees working in the Malaysian capital.

Data collection started in January 2013. It is important to note that only 54 completed surveys (out of the required 400) were returned to the researcher in time for preparing this paper. Therefore, the paper will discuss the initial findings based on the data obtained so far.

Two separate instruments (a questionnaire survey form, and a travel diary) were distributed to the selected female employees who satisfied the aforementioned criteria and were based in Kuala Lumpur. The questionnaire survey form consisted of four sections which are: occupational characteristics, attitudes and perceptions towards teleworking, household information, and finally personal characteristics. The travel diary, on the other hand, was a 'place-based' diary that required respondents to provide comprehensive information on every place visited over a five-day period. The required information included i) the start and end time of each journey performed ii) the purpose of the journeys performed iii) the mode(s) of travel used iv) distance covered, and v) delay time experienced.

5. ANALAYSIS AND PRELIMINARY FINDINGS

5.1 Employment and Socio-economic Characteristics

All of the four targeted employment types were represented in the obtained sample. Slightly more than a quarter of all respondents were employed as managers in their respective companies. 31.5% were professionals, 14.8% associate professionals, and the remaining 27.8% were clerical workers.

However, only three of the four targeted industries had representatives in the sample. 37% of the respondents are employed in the real-estate industry, while another 42.6% are employed in the financial intermediation and banking industry, 5.6% are employed in the telecommunication industry. The remaining 14.8% of the data was missing.

61.7% of the respondents have tertiary education, while 21.3% diploma certificates, and the remaining 17% equivalent high school education.

More than 65.3% of the respondents were married with an average of 2.8 children. 43.8% of the married respondents reported having between 3 and 4 children. 47% of all respondents reported having to care for an elderly parent(s) or relative(s). Table 1 shows the employment and socio-economic characteristics.

Table 1. Employment and socio-economic characteristics (n = 54)

Employment type	
Managerial	25.9%
Professional	31.5%
Associate professional	14.8%
Clerical	27.8%
Industry	
Financial intermediation and banking	42.6%
Real-estate and related business activities	37.0%
Telecommunication	5.6%
Education	
Postgraduate degree	12.7%
Undergraduate degree	49.0%
Diploma	21.3%
High school	17.0%
Marital status	
Married	65.3%
Single	34.7%
Age	
21-30	44.4%
31-40	22.2%
41-50	22.2%
51-60	3.7%
No. of children	
None	12.5%
1-2	34.4%
3-4	43.8%
5-6	9.3%
Caring for elderly parent(s) or relative(s)	
Yes	47.0%
No	53.0%

In order to shed some light on the compatibility of work activities performed on a weekly basis to teleworking, the respondents were asked to state the amount of time they currently spend on the following activities: ‘working by yourself’, ‘working face-to-face with others’, ‘working remotely using telecommunication devices, e-mail’, and ‘work related travel’. The respondents were also asked to specify how much control they had over scheduling of their time on the aforementioned activities.

The average time spent working by one’s self was found to be 20.2 hours per week, equivalent to 2.5 8-hour working days. With 38% of the respondents reporting having total control over scheduling their time on this activity (total control is defined as being permitted or entitled to schedule the time for the activity without the need for approval from other parties), and another 36.5% stating having ‘some control’ over scheduling their time on the activity (i.e. sometimes requiring approval) on a weekly basis. 21.3% stated having no control at all (i.e. always requiring approval). Only 4.2% stated that the activity was not performed by them on a weekly basis. This finding is indicative of the potential for being able to telework.

The average time spent face-to-face with others at the workplace was found to be significantly lower at 9.4 hours per week. With 14.6% of the respondents reporting having

total control over scheduling their time on this activity, and 62.5% stating having ‘some control’ over scheduling their time on the activity on a weekly basis. 18.8% stated having no control. 4.1% stated that the activity was not performed by them on a weekly basis.

The respondents stated spending an average of 10.4 hours per week working remotely, i.e. using information/telecommunication tools. With 36.2% of the respondents reporting having total control over scheduling their time on this activity, and another 36.2% stated having ‘some control’ over scheduling their time on the activity on a weekly basis. 21.3% stated having no control. 6.3% stated that the activity was not performed by them on a weekly basis.

Finally, the respondents spent an average of 8.6 hours per week on work-related travel. With 15.2% of the respondents reporting having total control over scheduling their time on this activity, and 32.6% stating having ‘some control’ over scheduling their time on the activity on a weekly basis. 28.2% stated having no control. Almost a quarter of all respondents (24%) stated that they did not perform that activity on a weekly basis.

These findings showed that there is a good opportunity for the potential telecommuters to get involve in teleworking based on the substantial amount of time spent on activities that could be easily performed away from the traditional work place, coupled with the fact that the majority of the respondents reported having at least ‘some control’ over scheduling their time spent on the respective activity.

5.2 Usage of Telecommunication and Office Equipment

The respondents were asked to state the frequency of using a number of telecommunication and office equipments. It should be noted that the more frequent usage of such tools is an indicator of the ability or suitability of one’s job scope to teleworking. More than 80% of the respondents stated that they surf the internet and send e-mails every day. More than 90% stated that they use a personal computer everyday of the week. Teleconferencing was found to be the least used and the least available technology. 22.9% stated that teleconferencing was not made available to them, while another 56.3% stated that they have never used it at work. Only 4.2% of the respondents stated that they use the technology every day.

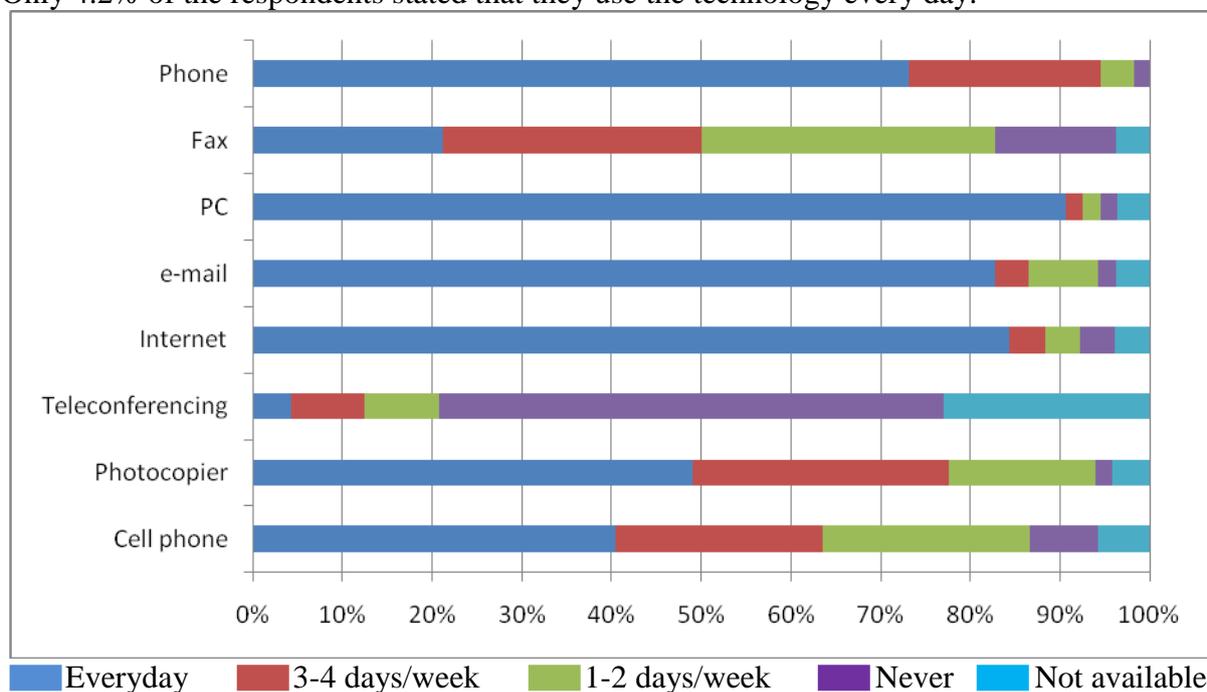


Figure 1. Usage of telecommunication and office equipment

5.3 Respondents' Travel Characteristics

The findings showed that only 25% (13) of the respondents used public transportation as the main mode of transport to commute. This is higher than the official figure for public transportation ridership of 16% in Kuala Lumpur for the year 2009. However, 11 of the respondents who relied on public transportation did so in combination with private automobiles. Only 2 respondents reported using the bus as the only mode for the daily commute. On the other hand, 75% (39) of the respondents relied entirely on private transportation. More than 40% of the respondents reported driving to work in a single occupancy vehicle. This figure is significantly lower than the 70% SOVs crossing some major roads in Kuala Lumpur during peak hours in the year 2008. 23.1% reported commuting by car (multiple occupancy) as drivers or passengers, 11.5% used motorbikes.

The average distance travelled daily by the respondents was found to be 61.4 km for all modes. All of the respondents – excluding the 11.5% motorbike users - reported experiencing delay as a result of recurrent rush hour traffic congestion. The average delay time experienced daily was found to be 33.2 minutes.

The average commute distance and delay experienced during the daily commute seem to play no part in influencing respondents to adopt teleworking. The average daily commute distance for the two groups of respondents (willing and not willing to telework) was an identical with 60.2 km. The delay time of 33.6 minutes experience by those who stated their willingness to telework was only slightly higher than that those who were not willing to telework (32.4 minutes).

Respondents stated a maximum of two journeys performed every working day i.e. the journeys to and from work in the Kuala Lumpur city centre. However, 81.5% of the respondents indicated performing a multiple number of activities in or on the way to their destination. The remaining 18.5% indicated performing work or returning home as the only purpose for the journeys performed. 68.5% indicated performing linked trips. 29.6% (16 respondents) indicated having to drop-off and pick-up children daily to school, another 29.6% of the respondents indicated visiting places for social and recreational activities in the evenings. 9.3% indicated linking trips in order to perform 'personal businesses' and 'every-day' or 'major' shopping. All trips recorded in the travel diaries have taken place during the morning and evening peak hours. Figure 2 and figure 3 show the findings on these trends.

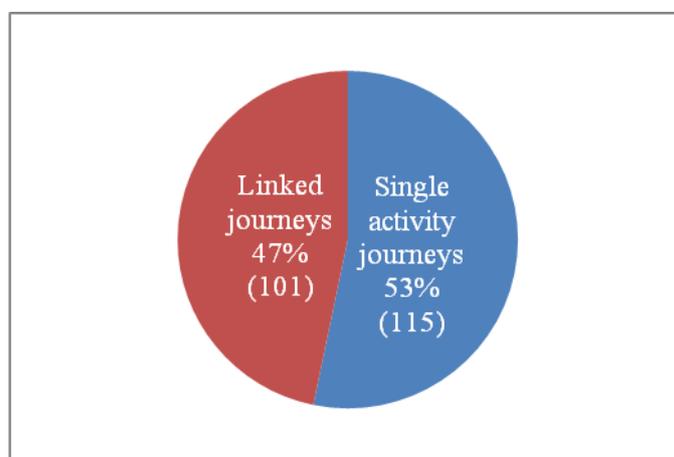


Figure 2. Journeys performed according to type

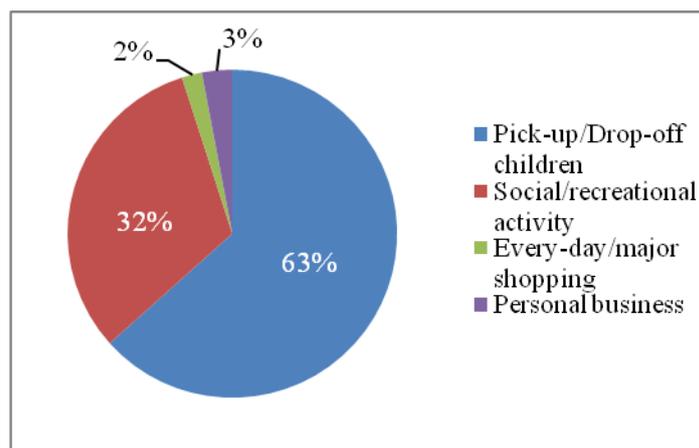


Figure 3. Additional activities performed in linked journeys

5.4 Perceptions of the Potential Telecommuters towards Telecommuting

The vast majority of the respondents (86%) reported having heard of teleworking. However, 58% stated that they have never performed any work at home. 27% stated that they experienced work from home on an irregular basis, i.e. in urgent situations in order to meet deadlines. 15% of all respondents stated that they experienced working from home on a regular monthly or weekly basis. Figure 4 shows this trend.

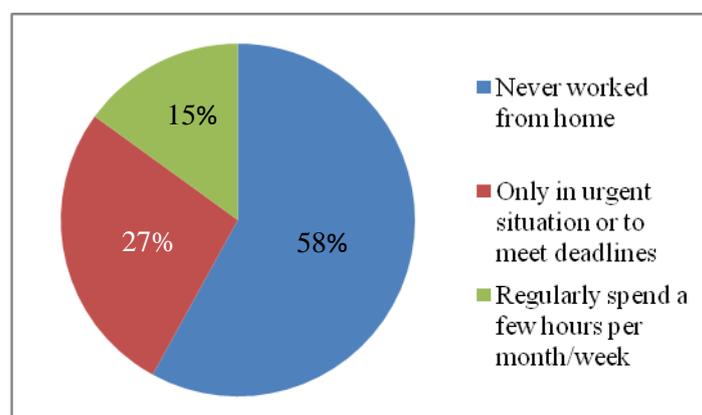


Figure 4. Work performed from home

It is important to mention that more than two thirds (68%) of those who stated having worked from home on a regular basis also stated that work performed from home was in addition to regular working hours. This indicates that even though there was some teleworking taking place, it did not result in any significant reduction in rush-hour trips since the work was performed at home outside the regular working hours. Only 10% of the respondents reported working from home as part of the regular working hours.

5.5 Practical Frequency of Teleworking

The respondents were asked to state how much would the nature of their current job allow for teleworking on a monthly or weekly basis. 41% of the respondents stated the nature of their job does not allow for teleworking, while the remaining 59% stated the ability to telework at a certain capacity. 40% of those able to telework stated that they could do so 1-3 days a month; and another 40% stated a frequency of 1-2 days a week; 17% stated a frequency of 3-4 days a

week; while one respondent stated being able to telework the entire week. Two respondents failed to provide the data.

50% of all managers reported being able to telework at least 1-3 days a month, while the remaining 50% stated that the nature of their job does not allow them to telework at all. 56% of all professionals reported being able to telework at least 1-3 days a month, while 67% of associate professionals and 60% of all clerical workers stated the same.

The average frequency of teleworking reported by respondents who were able to telework at any capacity was found to be 6.2 days a month. The average frequency stated by managers, professionals, associate professionals, and clerical workers were found to be 5.4, 6.8, 9.5, 4.2 days a month respectively. However, due to the small sample size (30 respondents stated their ability, and willingness to telework), these results should be used with caution.

About 55% of the respondents employed in the financial intermediation and banking industry reported being able to telework at least 1-3 days a month. A slightly higher figure of 59% was reported by those employed in the real-estate industry. However, there was a substantial differences in the average number of days of teleworking between the two industries. Respondents employed in the financial intermediation and banking sector reported the ability to telework an average of 4 days a month, while their counterparts employed in the real-estate industry reported an average of 7.2 days a month. This finding indicates that the real-estate industry may be more suited to the practice of teleworking; however, the finding remains preliminary and may not hold true until the entire data set of 400 respondents is collected.

Almost all respondents (97%) who were able to telecommute stated their willingness to adopt telecommuting if given the opportunity. The most preferred mode of teleworking was found to be working from home (83%), while the remaining 17% of the willing respondents preferred to work from a telecentre near their place of residence.

5.6 Motivators to Telework

Those who stated their ability and willingness to telework were asked to indicate the extent to which they agreed on the importance of a number of motivators. The list of motivators was compiled from the available literature. 12 out of the 13 motivators were highly regarded by the respondents. The highest rated motivators for adopting teleworking were 'saving on commute costs', 'eliminating the long daily commute', and 'remaining in a job after relocating place of residence'. Interestingly, the motivator that received the least rating among the respondents was the one concerned with increased productivity while working at home. Figure 4 illustrates this trend.

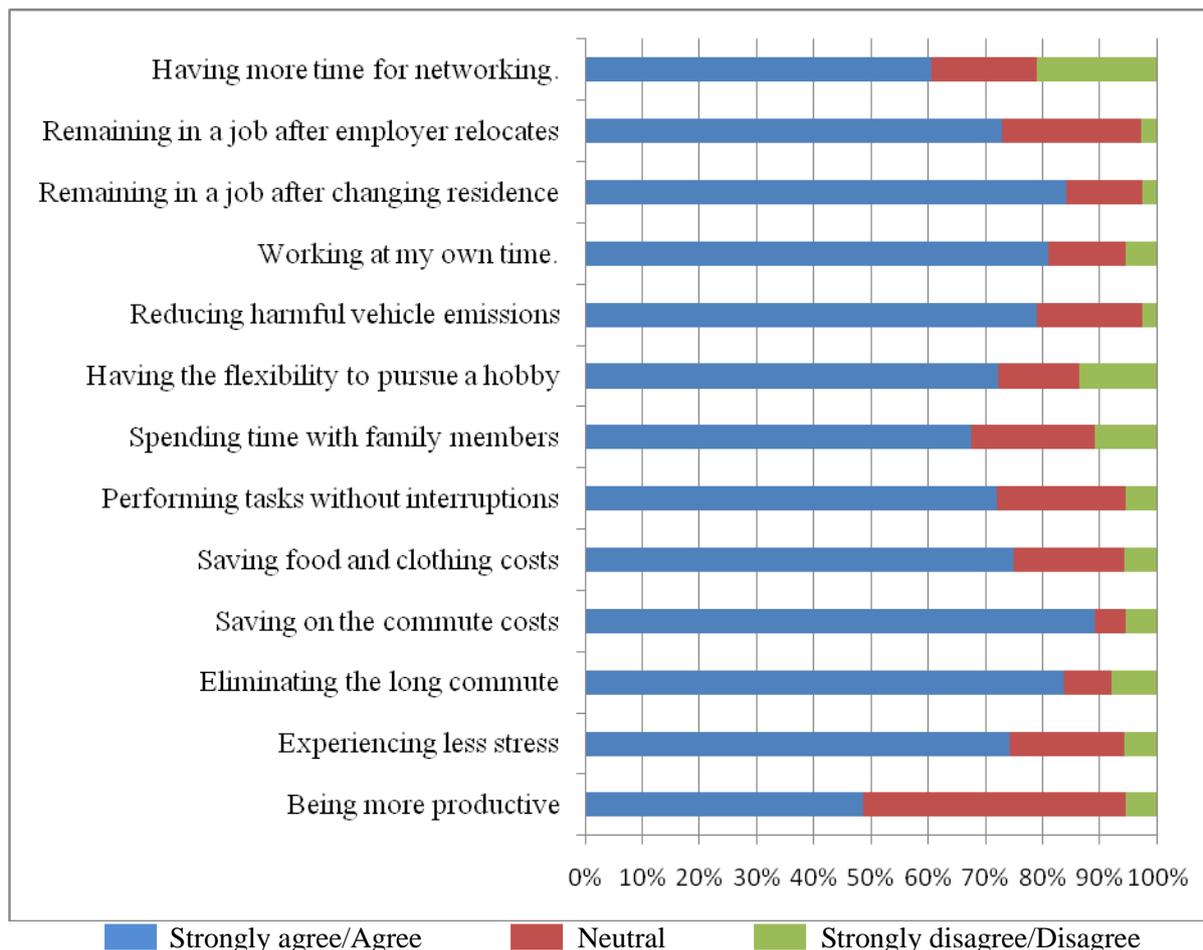


Figure 5. Respondents' agreement with main motivators for teleworking

5.6 Barriers to Telework

The same group of respondents were asked to rate a number of constraints or concerns related to the practice of teleworking according to their importance. Almost 40% of the respondents stated that 'having a conflict between home and work duties' was highly/extremely important constraint. Other highly rated concerns included: 'reduced interaction with colleagues and business contacts', 'being viewed negatively by colleagues for not being present at work', 'being induced to do more or extra work at home', and 'losing the chance for promotion due to the lack of visibility at the workplace'. The least concern for the respondents was found to be 'viewed negatively by neighbors for being present at home during working hours', 'losing office space' and feeling isolated at home'. Figure 6 shows this trend.

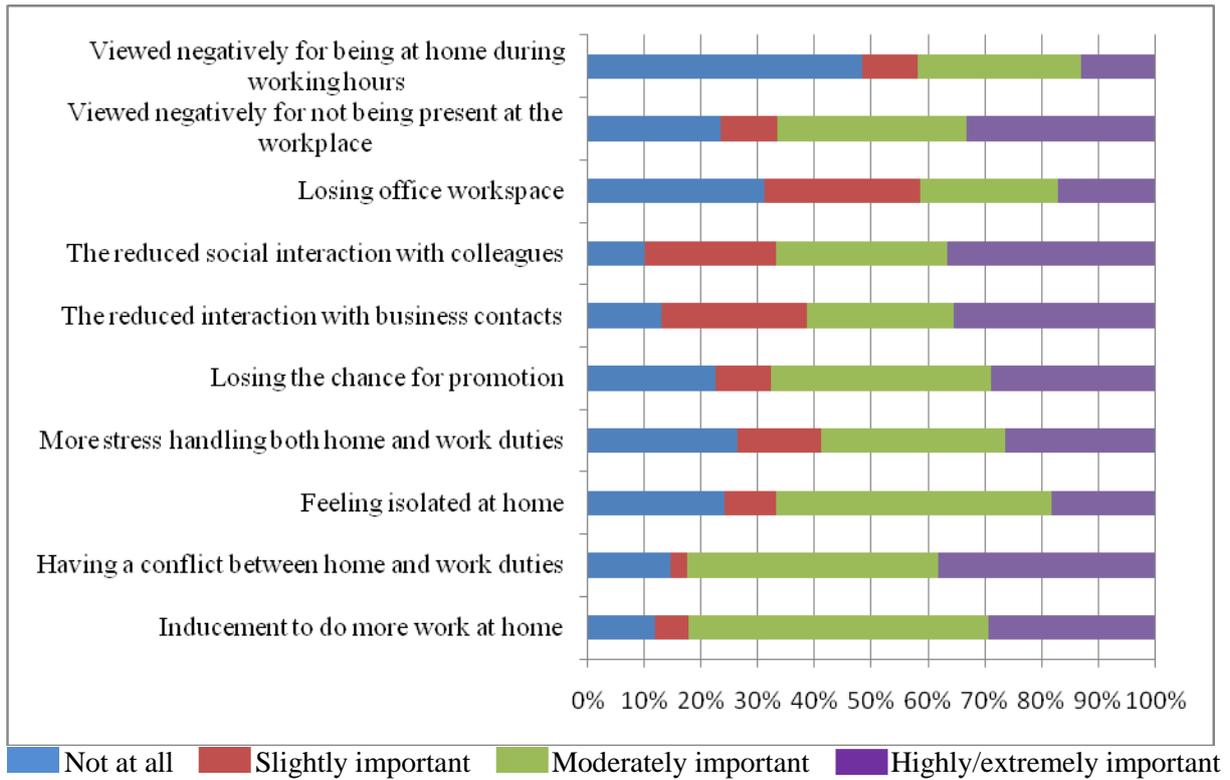


Figure 6. Respondents' rating of the major disadvantages of teleworking

Respondents willing to telework were asked to state whether they would require information and telecommunication tools if they were to perform their work from home. Almost all respondents (97.1%) stated that they would require a personal computer, 94.4% stated that they would require software as well. More than 88% stated the need for an internet connection (figure 7).

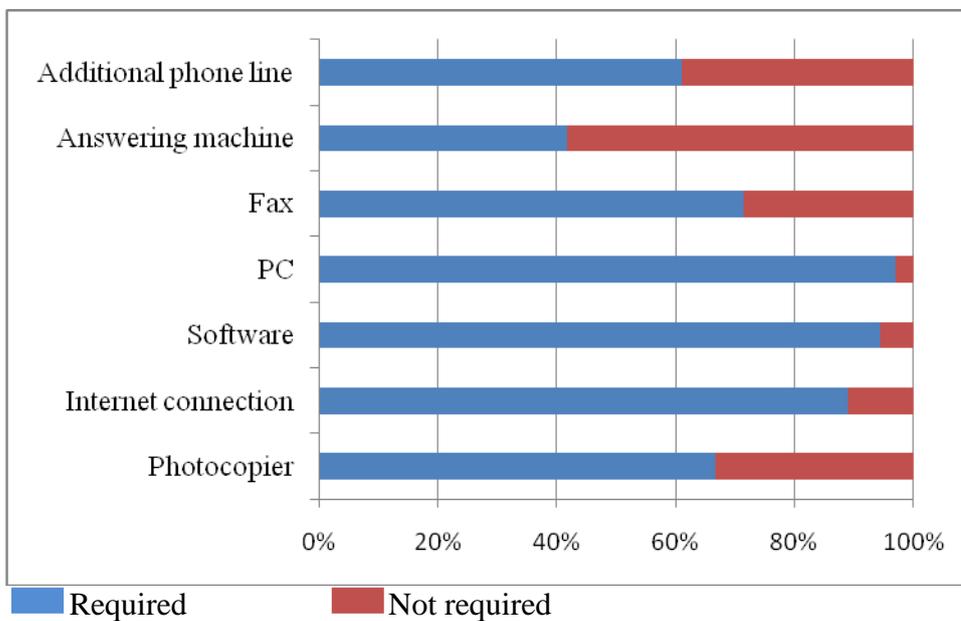


Figure 7. ICT requirements for setting up a home office

The same group was asked whether they were willing to pay the expenses involved in acquiring the ICT equipments to perform their office work at home. None of the respondents expressed their willingness to cover the expenses, 30.6% stated that they were willing to share the expenses with their employers, while the remaining 69.4% stated that they want the employers to cover all of the expenses (figure 8). The findings showed that investing in setting up a home office with the necessary equipments seems to be the main barrier towards practicing teleworking.

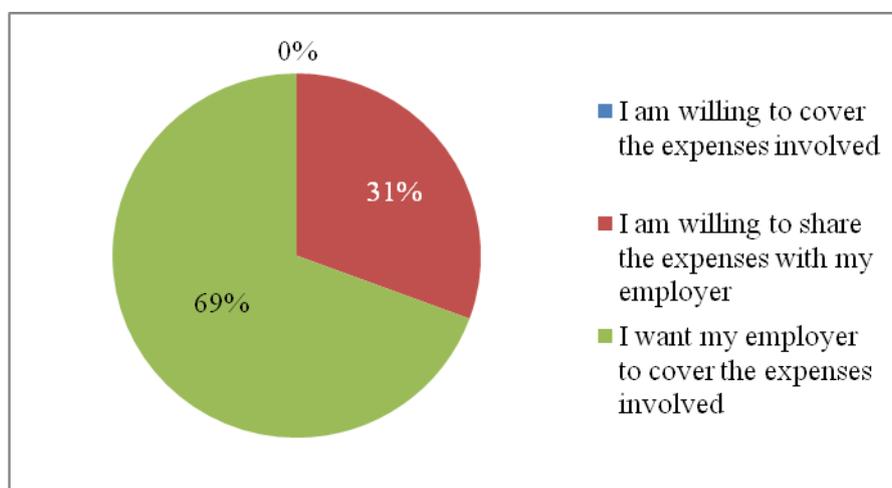


Figure 8. Willingness to invest in setting up a home office

Another possible constrain that can potentially hinder the propagation of a home-based teleworking culture is the availability of space for a home office. However, it did not prove to be a concern for the sampled respondents. 39% of the respondents reported having a space set aside for a home office. Another 53% did not have the necessary space, but stated their willingness to set up a home office. Only 8% did not have a home office, and were unwilling to set up one (figure 9).

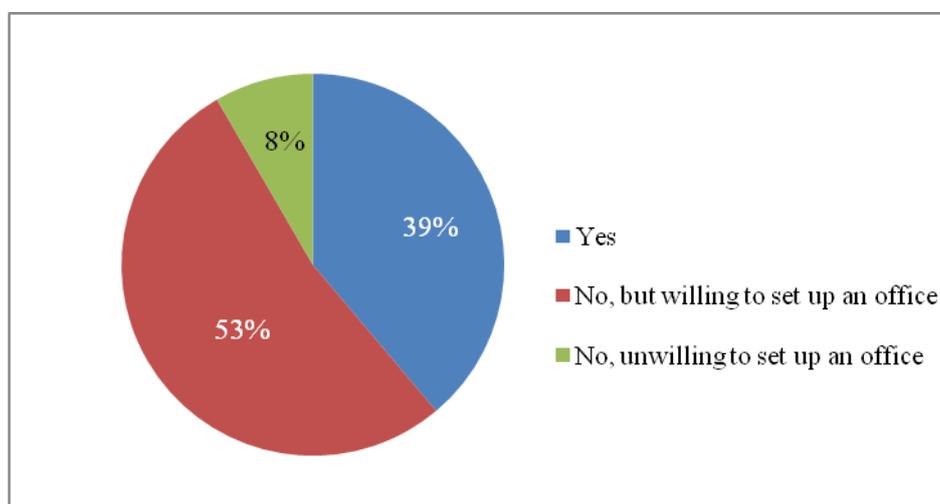


Figure 9. Willingness to invest in setting up a home office

6. TRAVEL IMPLICATIONS OF TELEWORKING BY FEMALE EMPLOYEES

Table 2 distributes the 33 respondents who stated both their ability and willingness to telework according to the mode of travel they rely on for the daily commute, the average distance of the one-way daily commute, and the frequency of teleworking events they can achieve given their job scope. The travel implications of teleworking were computed for the 24 respondents who stated ‘car as a driver’ and ‘car as a passenger’ as their main mode of travel (44.4% of all respondents). It is rather a hypothetical examination of the potential travel implications of teleworking if all those who stated their ability to telework did so according to the specified frequency.

Table 2. Respondents’ mode of travel, average commute distance, and preferred frequency of teleworking (n = 33)

Frequency of Teleworking	Mode of travel				Average commute distance (km)
	Car as a driver (single occupancy)	Car as a passenger	Train	Motorbike	
1-3 days/month	•				1-10
					11-20
	•••••	•	•	•	21-30
	•	••	•		31-40
					41-50
1-2 days/week					1-10
	•				11-20
	•••••	•	•	•	21-30
		•••	••		31-40
					41-50
3-4 days/week					1-10
					11-20
	•••			•	21-30
		•			31-40
					41-50
5 days/week					1-10
					11-20
					21-30
			•		31-40
					41-50
Total	16	8	6	3	33

6.1 Reduction in Commute Trips by Private Transportation

The potential number of trips forgone as a result of teleworking by the respondents on a monthly basis was calculated as the sum of multiplying the number of respondents by the preferred frequency of teleworking on a monthly basis (refer to table 2). This yielded the following:

$$\begin{aligned}
 &= \{10 \times (1+3)/2\} + \{10 \times [(1+2)/2]4\} + \{4 \times (3+4)/2\}4 \\
 &= (10 \times 2) + (10 \times 6) + (4 \times 14) \\
 &= 20 + 60 + 56
 \end{aligned}$$

= 136 one-way trips per month as a result of 24 (44.4%) teleworking respondents, equivalent to an average of 5.7 trips per teleworker per month.

The aforementioned figures can be used to estimate the potential reduction in trips for the entire target population, by multiplying the number of potential teleworkers by the average number of trips forgone per teleworker per month as follows:

$$[63900 \times (44.4/100)] \times 5.7 = 161,718 \text{ one-way trips per month.}$$

6.2 Savings in Vehicle-Kilometers Travelled by Private Transportation

The average vehicle-kilometers forgone as a result of teleworking on a monthly basis is the sum of multiplying the number of respondents by their preferred frequency of teleworking on a monthly basis and by the average commute distance they travel, as follows:

$$\begin{aligned} &= [(1 \times 2 \times 5.5) + (6 \times 2 \times 25.5) + (3 \times 2 \times 35.5)] + [(1 \times 6 \times 15.5) + (6 \times 6 \times 25.5) + \\ &\quad (3 \times 6 \times 35.5)] + [(3 \times 14 \times 25.5) + (1 \times 14 \times 35.5)] \\ &= (530 + 1650 + 1568) \\ &= 3748 \text{ vehicle-km forgone as a result of 136 one-way trips} \end{aligned}$$

Therefore, the total monthly vehicle-kilometers forgone

$$= 3748 \times 2$$

$$= 7496 \text{ vehicle-kilometers, equivalent to 312 vehicle-km/month/teleworker}$$

This finding needs to be further supported by obtaining a larger and more representative sample. However, for the purpose of this paper, the figures obtained can be used to estimate the potential reduction in vehicle-kilometers for the entire population as follows:

$$[63900 \times (44.4/100)] \times 312 = 8,851,939.2 \text{ vehicle-kilometers travelled per month.}$$

7. CONCLUSIONS

The preliminary findings discussed in this paper offer some positive insight on the potential of teleworking as a means for reducing rush hour traffic in Kuala Lumpur. The available data also shed some light on the actual compatibility of certain industries and employment types with the practice of teleworking.

All of the most commonly cited advantages of teleworking were highly rated by the female employees sampled. The main barrier preventing employees from being involved in teleworking was found to be the need for employees to be physically present at the work place with 55.6% of the respondents being unable to telework due to that constraint. A substantial portion of the sample reported the ability to telework at a certain capacity, but it is expected that they will be prevented from doing so because of the financial burden of setting up a home office with the necessary IT infrastructure. Therefore, a number of measures and policies need to be formulated in order to address that constrain, and consequently help realize the full potential of teleworking as a travel demand management tool.

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