

Transport Research Arena (TRA) Conference

A Methodological Study to Operate a Gender-driven Paratransit Supply at Sapienza University of Rome for Staff and Students

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Abstract

The literature on the relationship between gender and transport suggests that gendered transport policies are very few and so are dedicated services, especially when it comes to women security at night. At the same time, problems of harassment on transit are common. This is a serious issue also for the Sapienza University of Rome female staff and students (i.e. “Sapienza Women”) attending lessons very late in the evening, with a long commuting way back home. A specific night service provided by Sapienza would be a solution, but the two research questions behind are those of its acceptance and affordability for the Sapienza Women, and the profitability for the university, as its operator. The feasibility study presented answers to both, with the research goal to showcase an example of a methodology to design a women-reserved night service replicable in other university campuses.

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Peer-review under responsibility of the scientific committee of the Transport Research Arena (TRA) Conference

Keywords: Gender; Paratransit; Women.

1. Introduction

The importance of gender equality is stated by the United Nations “Agenda for sustainable development by 2030”, in its 5th goal (United Nations 2015). It has been also stated by the OECD - Organization for Economic Co-operation and Development that Countries that segregate and discriminate women are unlikely to reach the goals for sustainability (Duchene 2011). Also, the transport employment sector has historically been considered male-dominated, at both planning and operational levels. Decision-makers were mostly “mature men” (Duchene 2011), who favored the private car instead of public transport, the latter more used by women, who historically did not even have access to a car or a driving license. The lack of female decision-makers is behind the generation of non-gendered policies, unable to meet women’s needs in public transport services when it comes to security, reliability, and accessibility. The majority of problems in transport services is related to security: women who use transit are usually victims of robbery and sexual harassment (non- verbal, verbal, and physical); they are preferred victims for crimes as the feminine figure has always been considered as easier to overcome (Hanlon 1998). What is more, in studying the

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problem, it is difficult to find data about sexual harassment associated with transit because the phenomenon is often unreported (Ball and Wesson 2017) and even less about the fear related to the walking leg of a trip, usually the initial or ending one, for night transit travels. In fact, women who travel at night, independently from the purpose of their trip, prefer to spend for a taxi instead of using public transport, because the former performs a door-to-door service (Plyushteva and Boussauw 2020). Often transport planners propose mollifying solutions which might mitigate the negative effects of the cultural gender inequality, but not solve them until such cultural gap is filled. Yet, literature reports several cases of successful experiences across the world, mostly in emerging economies or developing countries (e.g., in Dunckel-Graglia 2013; Plyushteva and Boussauw 2020; Rahman 2010; Kim 2021) which were inspirational to the case study here reported.

1.1. Structure of the paper

The literature review and the analysis of the many areas of investigations in this field (e.g. in Law 1999, Rivera 2007, Gardner et al. 2017, Hortelano et al. 2021) were the starting point to develop a case study on the possibility to operate a night service specifically designed for the female community of Sapienza University of Rome, Italy. Here, the phenomenon of harassment on-board of buses or underground trains is often reported by the local press, at city level, but never addressed at policy level; very often victims are student girls. The designed service called “MinervaMove” (being Minerva the Roman goddess of wisdom and the symbol of Sapienza University) relies on two research questions: i) the acceptance by the “Sapienza Women” (i.e., the whole community of female teaching and administrative staff, and students) of a women-reserved night transport service operated by Sapienza; ii) the economic feasibility of such service for the University. The multi-step methodology is described in Section 2 and results elaborated and discussed in Section 3; some concluding remarks, eventually, are provided highlighting the study potential.

2. The methodology for MinervaMove

The design of MinervaMove service relied on a multi-step methodology to answer to the two research questions above mentioned, starting from a survey among the Sapienza Women. The survey was aimed at identifying Sapienza Women’s mobility choices and at stating their acceptance of a women-only transport service. To this end, a questionnaire was designed and complemented by a multi-session focus group, composed by respondents who agreed to participate in, once having filled in the questionnaire. The focus group was specifically targeted to corroborate the questionnaire’s stated preferences and especially the respondents’ willingness to pay.

At the same time, a context analysis was performed to understand the current situation in Rome in terms of gender-driven transport policies and services and the potential for MinervaMove to comply with current regulations. Results from both survey and context analysis enabled to identify the main user’s needs and to build two demand scenarios: a) optimistic, and b) pessimistic, as the basis to design MinervaMove. The service supply (schedules, terminals’ locations, fleet and staff sizing) was designed and described via performance indicators.

The survey evidenced that Sapienza Women would be interested in two specific night service options: a station shuttle service and a door-to-door one. The former is to be a service operating to and from over short routes, within a selection of destinations stated by the respondents and originating from Sapienza venues. The latter would be a typical demand-responsive service, with routing of vehicles as the major feature to consider; to this end a routing simulation was performed by a route-optimization software.

Though survey respondents and participants in the focus groups reiterated their preferences to travel with no men on-board, to dispel any potential issue of exclusion from the Sapienza male community, and with the goal to achieve more profitable operations, a study on how to exploit the night service fleet during the day was eventually carried out. As a result, a day-time and open-to-all transport service for Sapienza community was also developed, which is the MinervaMove third option. Facts and figures on MinervaMove were, at this point, sufficient to answer to the second research question, i.e., that of the economic feasibility, the study of which was carried out according to the European Commission funded project TIDE approach (2015). TIDE was specifically chosen as it combines aspects of Benefit-

Cost Analysis (BCA) and Multi-Criteria Analysis (MCA). The study results highlighted the full profitability of the three MinervaMove options, as further described.

3. Context analysis

A context analysis was developed to investigate MinervaMove's compliance with local regulations and to highlight constraints (if any) to the service due to the large number of Sapienza facilities across Rome to potentially serve.

For what concerns Rome Municipality, a Sustainable Urban Mobility Plan (SUMP) and an Urban Traffic Plan (UTP) have been long enforced. The SUMP is strongly oriented to foster progress from the past conservative policies (Musso and Corazza 2006, Corazza and Carassiti 2021) and, as the UTP, to decrease the use of private cars and promote sustainability, yet measures included in both plans are gender-neutral. This is in line with what observed by Woodcock et al. (2020) about contemporary SUMPs in general, which are tools poorly conscious of gendered imbalances in transport, due to the lack of research and data on gendered policies.

Sapienza University of Rome, in turn, given its status of largest educational institution in Rome, in 2018 developed its own Sapienza Sustainable University Mobility Plan (SSUMP). This plan was needed for several reasons: i) the large amount of facilities and properties scattered across the whole urban area (for a total of 21 off-campus facilities), some of which distant more than 10 km from Sapienza main campus (the so-called "Città Universitaria"; ii) the usual transport-related problems, which vary according to the area where each facility is located (Azzali and Sabour 2018), in many cases resulting in poor safety for pedestrians and lack of cycling lanes and racks; iii) to shift the commuting demand from motorized to non-motorized and collective modes, also meeting the goal to reduce the local high rate of accidents involving powered two-wheelers, mostly used by young riders (Sgarra et al. 2014, Corazza et al. 2016). The SSUMP is exhaustive and its goals are to rebalance the modal share of those commuting back and forth from the Sapienza premises in favor of non-motorized modes, and promote sharing modes and public transport (Sgarra et al. 2022), thus progressing in the city's path towards full sustainability in transport. However, measures specifically regarding women's inclusion and security seem to miss, even though the Sapienza women population is composed of 61,362 students and 4,249 staff units (i.e., 1,939 academic and 2,310 administrative units, as from MIUR 2021).

From all of the above, it is clear that MinervaMove is coherent with, and might complement, the city's SUMP and the Sapienza's SSUMP by increasing inclusiveness in both; it also meets the potential travel demand of a large number of female students and staff commuting to and from 22 different destinations in the city.

4. Profiling the Sapienza Women

Given the magnitude of the potential demand and in order to identify mobility choices, a questionnaire was submitted to the Sapienza Women during the second semester of 2021, sent via email and posted on social networks (Facebook and Instagram). The questionnaire was divided in several sub-sections, i.e.:

- Personal data, including ZIP codes to identify origins
- Home-university and university-home travel behavior (including the modal choice among private car, public transport system and cabs)
- Experiences of harassment and/or similar problems when traveling in the evening
- Preferences about a possible shared night taxi service to commute home at the end of the day
- Voluntary participation in a subsequent focus group to analyze the results of the questionnaire and design the MinervaMove service.

The 291 respondents (147 staff and 144 students) were considered representatives of the Sapienza female community, according to the most common statistical assessment, as in Riley et al. (2014), and their replies provided the snapshot of the Sapienza Women's travel patterns.

4.1 Sapienza Women's travel behaviors and preferences

Most respondents, both students and workers, live in Rome within its metropolitan limits and, as expected, their favored modes to commute are typically private car for academic and administrative staff, and transit for students. Respondents also stated a general feeling of insecurity when using transit, reporting adaptive behaviors according to the different times of the day.

The modal choice partly explains the responses to the key question, i.e., whether they were ever harassed when commuting back home at the end of the day. Positive answers were given by 56% of the students and 28 % of the staff and this might result from the fact that staff members generally use their cars to commute; for the students, a factor to consider might be also their age (Ball and Wessons 2017). All of the above is unacceptable, and even less acceptable is the fact that the majority of respondents felt insecure on the way back home after the harassment, causing some of them to change path (more than 30%) or mode of transport (more than 20%), not to relive the experience. Unsurprisingly, the acceptance of a university-home, women-only, dedicated transit service was high: 70% among staff and 64% among students. Most favored options were either a shared door-to-door taxi service (88% among students and 83% among staff) or a shared shuttle service to the closest rail or subway station (79% among students and 67% among staff). The door-to-door service's higher percentage means that travel comfort might also contribute to the perception of security.

4.2 The focus group to profile MinervaMove customers

A focus group was further organized to better understand the respondents' choices on some part of the questionnaire and, especially, those concerning the willingness to pay. A total of 25 participants were selected among those who previously agreed to be involved in this round of the survey, and subdivided into sub-groups, each with up to seven participants. They were initially asked to identify themselves with a typical profile, among the following four, as identified from the questionnaire results:

- Type 1: Student using either car or transit to reach always the same Sapienza venue; car is preferred when she has to combine other activities beside studies and due to her poor satisfaction with local transit; she considers security, safety and comfort as a value to take the door-to-door night service
- Type 2: Low-budget student using only transit to reach several Sapienza venues, who considers security as a value to take the door-to-door night service, having already experienced sexual harassment in the daily commute to the university;
- Type 3: Academic staff relying on private cars and working at several Sapienza sites, as transit is too risky at night. For this profile, costs associated with parking and time spent to find it are considered negatively, but necessary if she wants to hang around the campus area after working hours. Comfort is the main driver for the door-to-door MinervaMove service.
- Type 4: Administrative staff at Sapienza university; she is not familiar with her colleagues and the local transit system; therefore, the night station service is perceived as a moment of social inclusion to get to know better her co-workers and share with them the way home.

Focus group participants identified themselves with the four profiles above as follows: 15% Type 1, 35% Type 2, 45% type 3, and 5% Type 4.

5. MinervaMove service design and economic feasibility

All of the above was used to assess the potential demand as well as to design operations. Potential demand was determined by upscaling the rate of the respondents' acceptance of the service to the whole female university population, considering the differences between students and staff. This led to assume two demand scenarios: a) optimistic (actual customers would be just 10% less than those who accepted the service); b) pessimistic (20% less), to compensate possible errors and change of opinions (in line with what suggested by TIDE 2015). Resulting figures are reported in Table 1.

Table 1. MinervaMove night service potential demand scenarios.

	Optimistic case (<i>pax</i>)	Pessimistic (<i>pax</i>)
Students	36,573	30,437
Non-academic staff	1,246	1,015
Academic staff	1,046	852
Total	38,865	32,304

5.1 Operations design

Respondents clearly stated the preference for a fixed schedule for MinervaMove, with night services operating from Mondays to Fridays between 19:00 and 22:00, with a departure every 15 and 20 minutes, respectively for the door-to-door service and the shuttle one. This type of schedule for both services conform vehicle routing and driving staff assignment to those of the static public transport services, thus simplifying the service management (Dessouky and Adam 1998). Focus groups participants also stated that fixed timetables help them organize their working activities (as already observed in literature by Al-Ayyash et al. 2016). This and the consideration of the differences between periods when classes are hold and not (“term” vs “no-term”) led to design two options: Alternative A – “term” and Alternative B – “no term”, the former operational during Fall and Spring terms and the latter for the remainder of the year, excluding Christmas times.

For what specifically concerns the door-to-door option, operated like a shared-taxi night service, the coverage area was delimited by the destinations reported by the survey participants across the whole Rome urban area which, to this end, was subdivided into 4 main sectors (North, South, East and West) to facilitate the solution of the routing problem. Origins were located at two central sites, the “Meeting Points”, within the university campus. Full-hybrid, 5-seat vehicles seem to be the most suitable option to meet the security and comfort requirements. Also, the use of full-hybrid cars might be more reliable for a public service than electric vehicles, still generating a higher reduction of fuel consumption and greenhouse gases emissions with respect to conventional cars (Hassouna and Assad (2020). Route optimization relied on a software (Optimoroute 2021), originally developed for city logistics but consistent with the routing problem in hand, since the Meeting Points as origins and the respondents’ address as destinations replicate typical logistic operations between depots and delivery destinations. The software relies on a vehicle routing algorithm “fed” by traffic data from one of the most popular web-mapping platforms and provides the best routes using a vehicle routing algorithm based on the shortest paths. Last to consider is the willingness to pay stated by the respondents which gave rise to a zonal fare system: 4 concentric areas with fees varying from 5 to 20 Euros, according to distance.

The approach to design the operations of MinervaMove’s second option, the night shuttle service, is similar to that of the night-taxis. The shuttle service operates from the two Meeting Points to Rome’s two main railway stations: Termini and Tiburtina, according to the stated preferences. Both stations are interchange nodes with both urban bus and underground services. The shuttle service would be operated via 9-seat minivans, thus replicating a successful paratransit experience occurred in Rome around 20 years ago (Musso and Corazza 2006). Drivers for the service, with a work shift ranging from 18:00 to 23:00, could be hired among female students (to comply with the “no-men on board” preference stated) within regular scholarship programs. The focus group participants agreed on a fee of 5 Euros per single ride.

Each of the two night options were designed considering typical operational parameters like those in Table 2, specific for the night shuttle service “optimistic scenario”, as a case in point.

As said, to avoid any problem of exclusion, the third MinervaMove option was planned to supply a daytime service for the general university population, which corresponds to two different options according to the two types of vehicles operated in the night time service. The night shuttle minivans would be operated as a daytime shuttle service from the main campus to two different destinations: the Philosophy Department - PD and the Oriental Studies Department - OSD. Both destinations are representative of the 21 Sapienza premises in terms of distance from the campus (with PD representing a close destination within 5 km and OSD a far one, more than 10-km distant). The operational parameters of this daily option are like those of the night shuttle service. According to the preferences from the focus group participants, costs vary from 3 Euros (one-way ride) up to 7 Euros (daily ticket). As observed by Dell’Olio et al. (2014) and Azzali and Sabour (2018), this type of service among different university premises might support

ridesharing among Sapienza staff and students and foster the sense of community typical of higher educational institutions (Balsas 2003). In the daytime, the hybrid vehicles operated during the shared-taxi night service can be exploited, with the same operational features of the daily shuttle service and at the same costs of the night operations, to connect 4 institutional bodies (the school of Engineering and the Social Studies Faculty, each located off-campus at specific compounds; the Psychology Faculty and the School of Architecture, both with several premises scattered across the city).

Table 2. MinervaMove night shuttle service operational parameters

	Alternative A - term		Alternative B – no term	
	Termini Station	Tiburtina Station	Termini Station	Tiburtina Station
Travel time (<i>min</i>)	10	10	10	10
Lap time (<i>min</i>)	40	40	40	40
Commercial speed (<i>km/h</i>)	6.9	6.0	6.9	6.0
Average fuel consumption (<i>l/day</i>)	1.1	0.9	1.1	0.9
Average travelled distance (<i>km/day/veh</i>)	13.8	12	13.8	12
Vehicles-km (<i>veh*km/day</i>)	27.6	24	27.6	24
Seats-km (<i>seat*km/day</i>)	248.4	216	248.4	216
Number of drivers (<i>unit/year</i>)	2	2	2	2
Seats-km/Driver (<i>km/day/unit</i>)	124.2	108	124.2	108
CO ₂ emissions (<i>g/day</i>)	4692	4080	4692	4080

5.2 Economic feasibility

The request to have MinervaMove managed by Sapienza introduces the second research question, i.e. the economic viability of the service and its profitability for the University, without depending on subsidies. To this end, the reference approach was that developed within the previously mentioned European Commission-funded TIDE project, where a methodology relying on both Cost Benefit and Multi Criteria analyses has been specifically designed to assess the affordability of innovative transport measures (TIDE 2015).

The study was developed by comparing a do-something scenario vs a Business-As-Usual (BAU) one, over a 4-year horizon. The do-something scenario includes the two alternatives A – “term” and B – “no term”, and more specifically:

- Alternative A: MinervaMove daily and night services operated from mid-September to mid-December (Fall term) and from mid-February to mid-May (Spring term), for a total of 140 days. Considering the long break between the two terms, market research highlighted short rental as the most appropriate way to lease the vehicles during each term.
- Alternative B: MinervaMove service operated from mid-September to the end of July, with only a break during the Christmas holidays, for a total of 240 days. In this case, the market research suggested a long-term rental for the vehicles.

Once all the parameters were identified, they were clustered in three main evaluation categories: economy, society and environment. For the economic impact, a 5% discounting rate was applied (consistently with Hüging et al. 2013). Qualitative impacts (comfort, security and social inclusion) have been evaluated using references available in literature and focus groups preferences, and reported according to a “-10 to 10” scale, in line with the TIDE methodology. As an example, Table 3 summarizes the main outcomes for Alternative B, in the optimistic scenario (i.e., the case with actual customers being just 10% less than the potential demand, as explained at the beginning of this section).

Table 3. Alternative B effects (optimistic scenario)

Parameters	Year	0	1	2	3	Total
Vehicle investment costs (€/year)		-356234	-217366	-207015	-197157	-977,773
Vehicles operational costs (€/year)		-42957	-40911	-38963	-37108	-159,938
Personnel costs (€/year)		-697997	-664759	-633104	-602956	-2,598,815
Routing software costs (€/year)		-11674	-11118	-10588	-10084	-43,464
MinervaMove support charge (€/year)		1206740	1149276	1094549	1042427	4,492,992
Revenue's day service (€/year)		603	1881	6768	10426	19,678
Revenue's night service (€/year)		15620	48686	175166	269863	509,334
CO ₂ emissions (€/year)		-1383	-1317	-1254	-1194	-5148
Passenger comfort		6	6	6	6	
Passenger security		8	8	8	8	
Social inclusion		4	4	4	4	

Among the parameters itemized in Table 3, there is the “MinervaMove support charge” which is needed to reduce the overall investment expenditures and can be obtained by adding 10 Euros (optimistic scenario) or 7 Euros (pessimistic scenario) to each student’s tuition fees. These values were proposed during the survey and deemed as acceptable costs, if compared to the benefits achievable thanks to MinervaMove.

According to the TIDE approach, all considered parameters were further normalized and weighted; the results per evaluation category are synthesized in Table 4. It is evident that in both scenarios alternative B seems to be the best solution: even if the evaluation category “society” has the same score in the two alternatives, B becomes definitely more advantageous when “economy” is considered.

Table 4. Alternatives performances with respect to the areas of interest.

Scenarios	BAU	Alternative A	Alternative B	BAU	Alternative A	Alternative B
	(Optimistic)			(Pessimistic)		
Evaluation Category						
Economy	0.0	-25.7	13.2	0.0	-36.1	21.7
Environment	-150.0	-0.2	-0.3	-200.0	-0.3	-0.4
Society	-81.3	550.0	550.0	-63.8	300.0	300.0
Total	-231.3	524.1	562.9	-263.8	263.6	321.2

6. Concluding remarks

The above-described survey results and the economic assessment highlighted that the service is viable, well accepted and highly beneficial in terms of security, social inclusion and comfort, with the best scenario relying on alternative B. Investment costs play a major role in this, but probably more favorable leasing terms and conditions would apply for longer rental periods, thus reducing the overall expenditures. Yet, MinervaMove’s 4-year horizon risks to be negatively affected by the SSUMP 5-year duration, forcing to hypothesize that MinervaMove starts and consolidates within this timeframe, so as to be replicable in the next SSUMP and become an asset for Sapienza. Profitability might increase when upscaling the service. A limited number of origins and destinations were considered when designing the service, but should this be operated across the 21 off-campus premises and more railway stations or other intermodal nodes in the city, revenues would increase and costs be mitigated by the larger scale of operations. Further opportunities would come if the service could be upscaled to other universities in Rome, several of which, like Sapienza, encompass several premises in the city, with the goal of creating both a dedicated paratransit option for the women community at night and a complement to the regular transit supply during the day.

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