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Door-to-Door Culture of Commuters: Its Impact on the Road Carrying Capacity

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Abstract: Barriers to exchange of goods and ideas have shrunk because of technology. Mobility is one of the greatest contributions of industrialization and urbanization. This has also changed the lifestyle of millions of people. The vision of seamless travel has been a byword in regional and urban planning. Providing intermodal facilities has become the top priority of the private and public sector. The concept of door to door, from home to work to places of recreation and other social activities should provide accurate, safe and comfortable travel for commuters. This concept is directed in long distance travel. However, the concept of door to door journey for commuters in the City of Manila specifically in the District of Sta. Mesa took a different epithet. The Polytechnic University of the Philippines was used as a model on how people would literally go out of a building and hop on a tricycle to go to another destination even when the distance is less than a kilometer. The paper investigates on the choices of the commuters specifically of the students, faculty, and staff of this university. It looks into how this phenomenon affects the carrying capacity of the road and explores complimentary and supplementary existence of this transport phenomena of door to door culture of the pedestrian in this case, the PUP community and the constituents of the District of Sta. Mesa, Manila.

Keywords: Door to door, sustainable transportation, walkability, pedestrian accessibility, carrying capacity

1. Introduction

Seamless travel in the shortest possible time is the primary goal of commuters, the government, and the private sector. Ease of transport has been synonymous with economic growth; the faster the transaction of goods and services, the quicker the return on investments. Transportation permeates our daily existence more than smartphones, more than television, more than food, culture, or commerce, more even than Twitter or Facebook. (Humes, 2016, p.8) Creating a transportation ecosystem means transforming our cities' transportation systems to provide a seamless transition across all modes. (Benway, 2017, Raghunathan, A. U, 2018) People will travel far and wide to address their wants and needs. Today, transportation accessibility affects a significant portion of the population, and many affected people (people with disabilities, learning disabilities, temporary restrictions, the elderly, and so on) are excluded from mobility (Bekiaris, E, 2020). Polytechnic University of the Philippines (PUP) has provided the intellectually but financially

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challenged youth of the Philippines. The sphere of influence of the university has extended outside the metropolitan area. Students would travel for hours to get their education at this prestigious university. The strategic location of the Polytechnic University of the Philippines allows several modes of transportation. Public utility vehicles such as buses, jeepneys, and taxis traverse two national roads, the Arsenio H. (A.H.) Lacson Avenue and Ramon Magsaysay Boulevard. Light Rail Transit (LRT) 2 traverses above several national roads, including that of Ramon Magsaysay Boulevard, Aurora Boulevard (Quezon City) up to Marcos Highway (City of Marikina), the location of its last station to date is the Santolan Station. LRT 2 is now on its expansion program, two stations will be added, and the terminal point will be in Masinag, Antipolo City. Inside the Mabini Campus is the terminal ferry station, the route of which is thru the Pasig River. The door-to-door concept becomes the ultimate goal of seamless travel. However, for a developing country such as the Philippines, faster means of transportation would not be an automatic choice. More often than not, the cost of transportation will determine the choice commuters would make. The burgeoning student population experienced by the City of Manila has grown exponentially in the past decade. It has become more evident in the steady increase of users of the LRT 1 and LRT 2, both of which pass through the university belt in the City of Manila. LRT 2, specifically Pureza Station, is a few meters away from the three campuses of the PUP. It is one of the most preferred modes of transportation by the staff, faculty, and students, especially those residing in areas of Quezon City and from the Province of Rizal. However, from Pureza Station, some will take a tri-bike (a non-motorized vehicle that can accommodate 1-3 adults) or a tricycle (a motor-bike with a side carriage that could carry up to 7 passengers, including the driver). The proliferation of tricycles and tri-bikes has exponentially risen as the pollution of the university grew. The growth of these types of transport was not a consideration when the metro roads were constructed but occupied a significant part of it. The tricycle industry has proliferated over the last 14 years despite the absence of formal policies from the Government. The demand for this mode of transportation will continue to grow with the increase in the tricycle-riding population. (ADB, 2005)

1.1 Objective of the Study

The study's objective is to determine how the door-to-door concept affects the carrying capacity of the road in a higher educational institution, such as the two campuses of the Polytechnic University of the Philippines, which NDC Compound houses Colleges of Engineering, Architecture, Communication, and the Mabini Campus. The research is vital to improve the mobility and safety of pedestrians and drivers and build better roads and sidewalks. With an end, finding a possible solution for the complimentary and supplementary existence of this transport phenomenon of the door-to-door culture of the pedestrian. In this case, the PUP community and the constituents of the District of Sta. Mesa, Manila.

1.2 Methodology

The research employed the observational methods and the survey method using the Input-Output-Process. The observational method was done by recording the observation by taking photos at different times and days of the week. It involves recording plans such as what information should be gathered, where it should be gathered, and how it should be gathered and recorded. The researcher had no control over any variables in the observational method. Therefore, the research must be carried out so that the findings do not contradict one another. In addition, the survey method was employed to understand the commuters' behavior in the door-to-door context of transportation. The questionnaires include the linear path description, which recounts the movement of the respondents from their house to the school and their preference for transportation or movement from their origin and destination; to illustrate the use of the two research methods, the Input-Output-Process model was employed.

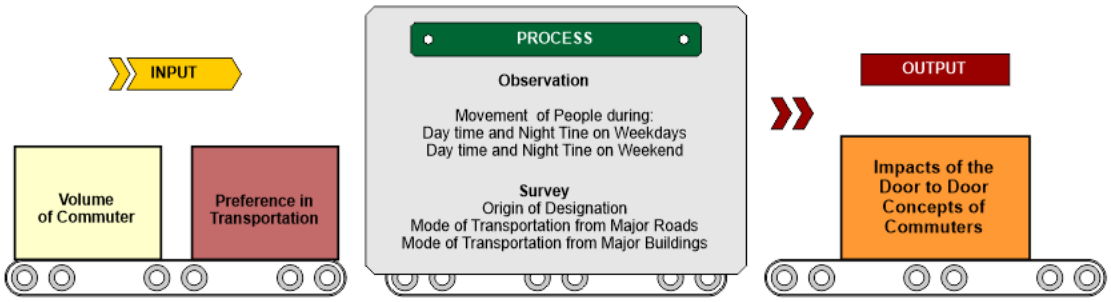

Fig. 1 - Input- Output- Process Model in Door-to-Door Culture of Commuters

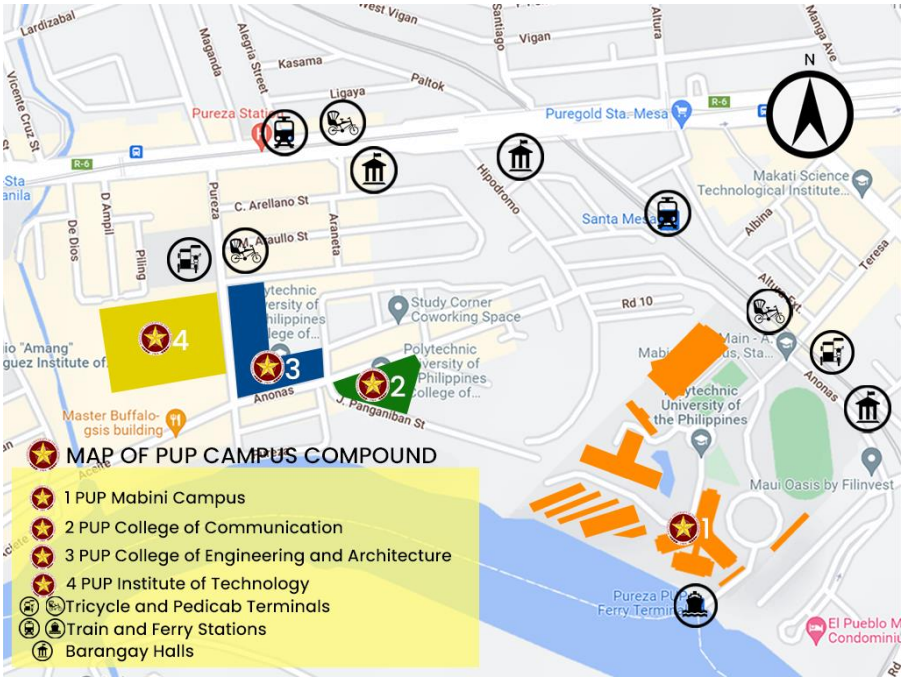

Fig. 2 - Map of Polytechnic University of the Philippines Campus

2. Transport History in the Philippines

The available transportation mode in the Philippines during the Spanish colonization was limited to horse or carabao-drawn carriage by land. The horse-drawn carriage is usually used by the elite and could be generally seen in the city streets while the carabao pulls sleds for farm folk and their produce. In the City of Manila, the Pasig River and its tributaries were an essential means of transporting goods and people. Roads were narrow, and Intramuros, the center of governance by the Spaniard's cobblestones, was used as the road, while most provinces were either asphalt or dirt road. The first car to roll in the streets of Manila was shipped from France to the Philippines in 1900. It was also around the years 1900 to 1946, during the American Colonial Period, that the Filipinos were introduced to the automobile industry. Soon after, more roads were built. During the American Colonial period, the horse-drawn carriage inspired horse-drawn trams and eventually electrically powered tramvias operated by the conglomeration of Manila Electric and Light Co.

During the 2nd World War, the tramvias were the most hard-hit transport mode. American cars were also converted into taxis and military vehicles to jeepneys. There were several studies with the same attempt to provide a mass transport system that would address the ballooning need of the population. In 1980, through Executive Order No. 603, the Light Rail Transit Authority was created under the chairmanship of then-First Lady and governor of Metro Manila, Imelda Romualdez Marcos. The construction started in 1981 and was operational in December 1984 from Baclaran to Central Terminal near Manila City Hall. The track from Central Terminal to Monumento became accessible to the public when it was opened on May 12, 1985. MRT 3 started in 1989, 4 years after the completion of LRT 1. MRT 3 runs from North Avenue, Quezon City, connects to LRT 2 via Araneta Station, and intersects LRT I in Taft Avenue Station. LRT 2 is the relatively newest; it began in 1996 and partially opened in 2003, with Santolan to Araneta Center-Cubao station in operation. In 2004, the remaining station from Cubao to Legarda Station was opened and eventually connected to LRT 1 via Recto Station. LRT 2 has been the mode of transport for students in the University Belt of Manila.

The tricycles and pedicabs largely proliferated when the LRT 2 became operational; the bulk of this 3-wheeled transportation can be seen near the stations of Pureza and Legarda. About 94% of these motorcycles and tricycles have 2-stroke engines3 emitting delicate particulate matter, which poses a danger to public health. (ADB, 2005) The pedicabs and tricycles near Legarda station cater to students in some of the most prominent schools in Manila, such as the University of Santo Tomas (UST), Far Eastern University (FEU), University of the East (UE), and the Mendiola Consortium (San Beda College, Centro Escolar University (CEU), College of the Holy Spirit, St. Jude College and San Sebastian College (SSC)). In Pureza, these modes of transport are servicing the schools such as Eulogio "Amang" Rodriquez Institute of Science and Technology (EARIST), De Ocampo College, and the PUP.

3. Manila as a University Hub

The genesis of higher education institutions can be traced inside the walls of Intramuros, which literary means within the walls in Spanish. Education was a tool used by the Spaniards to propagate the Roman Catholic faith. Religious orders ran the schools inside the wall. The luster of Intramuros as the center of government, education, and commerce diminished after World War II. It has taken a toll on both its physical and historical prominence. The American government focused on rehabilitating Manila, the Philippines' capital. Howard Taft and Forbes commissioned Daniel C. Burnham, a prominent architect, and urban planner, to rehabilitate Manila through his concept of the City Beautiful Movement. While there was a conscious effort on the part of the planners to the historical significance of Intramuros, it was not patronized by the people. Much of the areas in Intramuros were used as storage facilities and parking spaces for the trucks. Soon after the schools inside the walls of Intramuros were reestablished in other parts of Manila, Figure 3 shows the proliferation of schools. Due to these movements it has created the phenomenon of a University Belt, which Paul P. Zwaenepoel coined to describe the movement of the higher education system in the Philippines (Zwanenepoel as cited by Pinlac, 2016). The genesis of the university belt started in Intramuros (shown in dotted lines), and the relocation of the University of Santo Tomas to Sampaloc District triggered the movement outside the walls. As mentioned by Pinlac, the university belt today can be traced from the north University of Santo Tomas towards the south De La Salle University (DLSU), both of which belong to the top schools in the Philippines as rated by the Quacquarelli Symonds (QS).

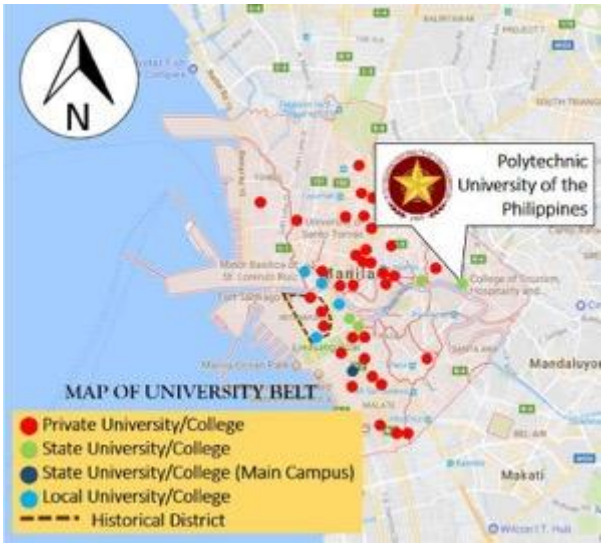

Fig. 3 - Map of the Manila's University Belt

3.1 Polytechnic University of the Philippines (PUP) and its Environs

The genesis of the PUP can be traced to 1904. The institution started as a business school to address the needs of the private and government sector established by the city school system. In 1908, its status from a city school became a primary business school named the Philippine School of Commerce (PSC). However, in 1952 through Republic Act 778, the school was renamed the Philippine College of Commerce (PCC) and took a new campus in 1965 in Sta. Mesa, Manila. The Bureau of Animal Industry formerly used the campus site with an adjoining multi-story tenement housing constructed for the Philippine Army. In 1972 the college took a new turn when it was given a new mandate through Presidential Decree (PD) 1341. The Philippine College of Commerce was converted into a chartered state university and was bestowed PUP. Through its new directives, new courses were offered, and the population increased exponentially. To date, the Manila Campus alone is a host to more than 50,000 students, faculty, and staff.

PUP is nestled in the highly-dense residential area of the District of Sta. Mesa. Along Pureza street, where the CEA is located, also host to the Pio Del Pilar Elementary School. The university's existence in the district became the catalyst in the area. It attracted entrepreneurs to convert their residences to accommodate commercial spaces and, in some cases, even converted their homes for student lodging. The increased population can also be attributed to some of the students from the provinces who have graduated and secured employment in the city, becoming permanent community residents. It has also triggered the need for more goods and services, including transportation. The direct access of PUP from the national road of Ramon Magsaysay Avenue is through Pureza St. Pureza is a two-lane street perpendicular to Anonas St., which serves as the entrance of the CEA, COC, and the Main campus. The photo essays show the proliferation of ambulant vendors on the streets where the sidewalks are narrow. When the sidewalks are a little wider, either the establishment owner will claim it or another ambulant vendor will occupy it.

Figure 4. shows that a more considerable percentage of the sidewalks in the vicinity of the study is less than 1.00 meters in width, which explains why people are walking on the streets, and Figure 5 provides an overall view of the width of the sidewalks, which significantly affects the individuals' reactions on how it is utilized. The sense of safety, comfort, and level of interest (Ewing and Hardy, 2017) cannot be considered an option for pedestrians. Options are not available to them since the sidewalks are relatively narrow concerning the number of users during school days.

a **b** **c**

Fig. 4 - Photo Essay; (a) Pedestrian Occupying the Streets; (b) Queuing of Tri bikes and Pedicab; (c) Ambulant Vendors on the streets)

Fig. 5 - Existing Sidewalk Map

3.2 The Growth of Inner Street Transportation

The phenomenon of tricycles and tri bike growth in the Philippines can be traced to the culture brought about by the jeepneys, which started after World War II. Filipino entrepreneur Leonardo S. Sarao converted the US Military Jeep left by the Americans during World War II to an eight-seater public utility vehicle. It became one of the symbols of the Philippines as a nation. The decorations are very flamboyant both on its interior and exterior. The jeepney would convey messages of a family's aspirations, as reflected in its graphical paints. Over time, the jeepney was customized. Moreover, it can now accommodate 16 to 20 passengers; some have upgraded to the air-conditioning system. The jeepneys stopped where ever and whenever the passenger would ask the driver to halt. This phenomenon started the culture of the Filipino context of door-to-door. The passenger would ride the jeep and would go down at the exact location they wish so as not to walk extra steps; even though provisions for jeepney stops and ordinances for penalties for not following traffic regulations have been created, if given a chance, both the passenger and drivers would violate the provision. When the Philippine government was created to control public transport vehicles by providing franchises on specific routes, the door-to-door culture of the Filipinos was somehow hampered but for a brief period. While tricycles have been plying some routes in rural and urban areas, it was limited.

Ultimately, the need to address the culture of Filipino not wanting to walk provided a window of opportunity for business through tricycles and tri bikes. Due to the sheer population of the PUP, numerous business establishments have gravitated toward the institution. The transportation sector is one of the groups that finds a good market in PUP. Two types of inner street transportation are available in the area of PUP. These are tricycles and pedicabs. Tricycles are 2-stroke engine motorcycles with a sidecar that can accommodate three passengers plus two passengers at the back of the driver; thus, it can accommodate 4 to 5 passengers. A pedicab is a bicycle with a sidecar that can accommodate a

maximum of 3 passengers, as shown in Figures 6a and b, while the route of Tribikes is shown in Figure 7. Table 1 shows the number of tricycles and pedicabs per Tricycle Operators and Drivers Association (TODA) and Pedicab Operators and Drivers Association (PODA). The accreditation of the tricycles and pedicabs does not reach the Land Transportation Franchising and Regulatory Board (LTFRB); however, the city or municipal council would serve as the accrediting authority. Approving the operation of tricycles and pedicabs would refer to the accreditation of the TODA and PODA. It would be the association's initiative to regulate the number of units. Therefore, it would be safe to assume that Route Measure Capacity is not considered, as it is evident in the number of units plying the route. From the main road of Ramon Magsaysay, where the LRT station is located, it is around 300 meters to the CEA Building, 400 meters to the COC, and 1.2 km. to the Main Campus. From Teresa St. towards Anonas St., the distance to Main Building is 120 meters, to the COC is 400 meters and 500 meters to the CEA.

a **b**

Fig. 6 - (a) Tricycle; (b) Pebicab

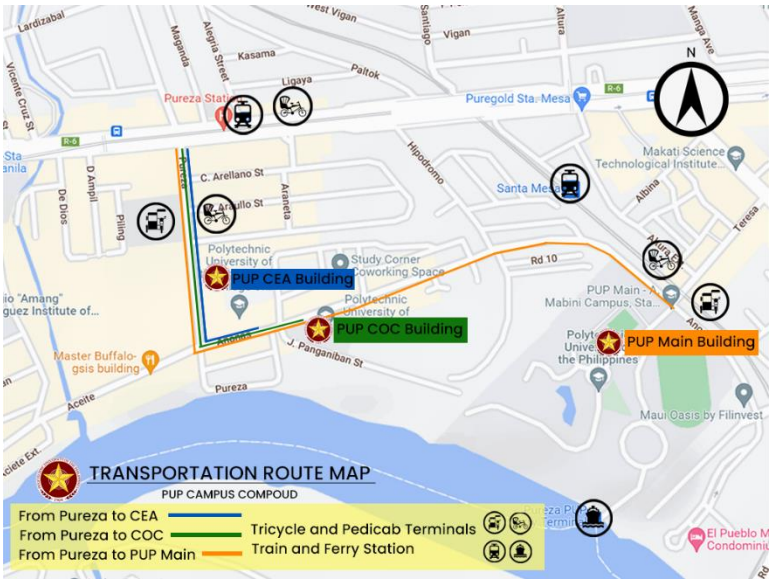

Fig. 7 - PUP -Transportation Route Map

Table 1 - Number Of Tricycles And Pedicabs Per Tricycles Operators And Drivers Association (TODA) And Pedicabs Operators And Drivers Association (PODA)

Type	Tricycle		Pedicab				Total
	Number	%	Number			%	
Number of Units	132	43 %	45	30	100	57 %	307 units
Station Points	Pio Del Pilar Elementary School and PUP Main		SMAPPODA PUP Main	PRM PODA Puresa – Ramon Magsaysay	PODA Puresa 7-11 Puresa		
Barangay Affiliation	Barangay 626, 628,629,630, 632		Barangay 630	Barangay 626	Barangay 626		

4. Results of the Study

The strategic location of the PUP and its strong standing in higher education as the number one choice of employers will continue to attract students to enroll in the institution. As a state-run institution, the university is constrained in accepting the number of students every academic year because of budget constraints; however, the institution finds ways to accommodate aspiring students. The burgeoning number of students has provided economic growth in the community as it has also taken a toll on the infrastructure of both the school and the community. Of the 300 respondents, 185 students used Pureza to visit their building—table 2. The number of students who take Pureza St. to their Building and the Mode of Transportation shows that 125 or 67% of 185 go through Pureza St. while 115 or 43% pass-through Anonas/ Teresa Sts.

Table 2 - Number of students who take Pureza St. and Anonas/Teresa St.to their Building and the Mode of Transportation

Destination	**Building**	**Mode of Transportation to Major Street**				**Mode of Transportation to Building**		
		Jeep/Bus/ FX	**Trains**		**Walking**	**Tricycle/ Pedicab**	**Walking**	**Vehicle**
			LRT	**PNR**				
Pureza (185)	College of Engineering and Architecture	65	50	0	10	3	120	0
	College of Communication	33	8	0	9	13	37	0
	PUP Main Building	1	8	0	1	8	2	0
	Total	*99*	*66*	*8*	*20*	*24*	*159*	*0*
Teresa/ Anonas (115)	College of Engineering and Architecture	13	0	14	8	35	0	0
	College of Communication	11	0	7	2	19	3	0
	PUP Main Building	29	12	9	8	14	44	0
	Total	*53*	*12*	*30*	*18*	*68*	*47*	*0*
	Grand Total	*152*	*77*	*30*	*38*	*92*	*206*	

Results show 159, or 86% of the respondents using Pureza, would walk rather than ride a tricycle or a pedicab, and 47, or 41% of respondents from Anonas/Teresa, walk instead of taking the tricycle or a pedicab. The choice of significant transport is the jeepney, followed by either Light Railway Transit (LRT) or Philippine National Railways (PNR). The total patronage of the tri bikes and pedicabs is 92 or 31% of the total respondents. This may seem low;

however, if 30% is subjected to the total pollution of PUP of 50,000, this will amount to 15,000 possible passengers daily on a school day from Monday to Saturday. Walking from Pureza to the College of Engineering and Architecture building receives the highest preference percentage of 120 or 65%. The volume of pedestrians, tri bikes, and pedicabs are relatively higher during the weekdays for the entire day compared to weekends. This is evident that the existence of the university and other learning institutions within the area contributes to the number of road users.

5. Conclusions and Recommendations

Urban designers are interested in the environmental qualities of places that make them better for walking, not only as settings for physical activity but also as sensorial and social settings (Mehta, 2008)—however, the carrying capacity of the roads in Metro Manila in general and the Sta. Mesa District, in particular, has steadily grown, and the congestion experience has also metastasized. This experience is seen to be the trend in the next couple of years as decentralization is not on the table for most schools in the City of Manila. The Polytechnic University of the Philippines will remain a lodestone as far as higher education is concerned. It has proven its significance in producing the competent graduates that employers seek. This is one of the indicators that would confirm that the students will continue to patronize and consider the university for their education. However, suffice it to say that this will also continue to take a toll on the capacity of the road networks around the community. The amount of air and noise pollution is contributed by the tricycles. The road networks around the community were not designed and have not adjusted to the road users brought about by the university and the business that gravitate because of their existence. The culture of Filipinos not wanting to walk the extra propelled the proliferation of tricycles and pedicabs. The volume of tricycles and pedicabs has taken the road space for cars and trucks in the streets of Pureza and Anonas, thus slowing down the traffic. The narrow sidewalks do not conform to the prescribed sidewalks of the Philippine National Building Code of a minimum width of 1.20 meters unobstructed. Some sidewalks are elevated around 1.0 meters from the ground because of the fear of lot owners flooding, which makes them non-navigable for physically challenged people. The narrow sidewalks expose pedestrians to danger because they would have to walk in the streets, as seen in Figure 3—photo Essay of Pureza St.

The situation of pedestrian obstacles maneuvering the streets of Pureza and Anonas, the noise and air pollution contribution of the tricycles, and the volume of tricycles and pedicabs occupying the streets might be perceived as a minor problem or, for some, not even a problem because people have seemed to survive the situation for years already. However, this phenomenon seems minuscule because people have assimilated into the situation, and students would come and go. It cannot be denied that the pollution the tricycles are creating will eventually take its toll on the health of permanent residents of the area. The noise affects the classes in the College of Engineering and Architecture, especially those held on the ground and 2nd floor since none of the classrooms are air-conditioned. The decibels the tricycles are creating are 38% above the tolerable prescription of the CHED Memorandum Order. The problem has to be addressed on the level of the city government together with the local officials and stakeholders such as the Polytechnic University of the Philippines and the Pio Del Pilar Elementary School (administrators, faculty, staff, and students), homeowners and business owner including the ambulant vendors. Initial recommendations to address the problem at hand are the following:

1. The issuance of the franchise of tricycles and pedicabs has to be regulated. In addition, a more scientific basis for using the RMC – Road Measured Capacity has to be implemented with the assistance of the Planning Division of the City of Manila in close coordination with the university.

2. The proliferation of motorized tricycles contributes not only to air pollution but noise pollution as well. Since the area is host to two public educational facilities where the air-conditioning system is not a priority, consideration of a phase-out of the tricycles instead of non-motorized vehicles such as pedicabs and bicycles can be an option.

3. The City of Manila needs to review its land use and zoning, mainly the issuance of building permits that can regulate the structure setback for a possible widening of the sidewalks. The need to identify the built-environment constructs and the measures that can be used to quantify walking with ease (Maghelal, P. K., & Capp, C. J. 2011).

4. It will help eventually promote walking for pedestrians with ease and safety. Regarding the physical characteristics of streets and their edges, five urban design qualities could be measured: imageability, enclosure, human scale, transparency, and complexity. (Ewing, R., & Handy, S. 2009).

5. Re-routing of the vehicular flow can be considered to allow safe passage to pedestrians and minimize the noise the tricycles create. It can be implemented on school days and hours when there is a greater volume of students in PUP and Pio Elementary School: figure 8, Proposed Transport Route along Pureza and Anonas Streets, Valencia St., where the Graduate School and the College of Tourism, Hospitality, and Transportation Management are situated. It is a one-way street towards Anonas Street; vehicles can exit to Pureza St. Pureza St. can be assigned as a one-way street going towards Ramon Magsaysay Boulevard

during schools days, Monday to Friday to allow half of the street to be walkable at 7:00 am – 5:00 pm. After this period, it can be a two-way street again because the classes start at 7:30 am, and the last class starts at 6:00 pm and ends at 9:00 pm. The tricycles and pedicabs in the blue line can go around Hippodromo Street to the main campus and the Colleges of Engineering, Architecture, and Communications. It will permit walkability in the streets, and decreasing the tricycles towards non-motorized transportation will reduce noise and air pollution. It will encourage people to walk as walking can help improve one's daily existence quality by increasing energy levels, improving sleep quality, assisting with mood, and overall life quality. (Frank, L.,2010). Researchers and urban planners may find the review helpful in developing walkability studies and defining policies to improve walkability. (Fonseca, F, 2022)

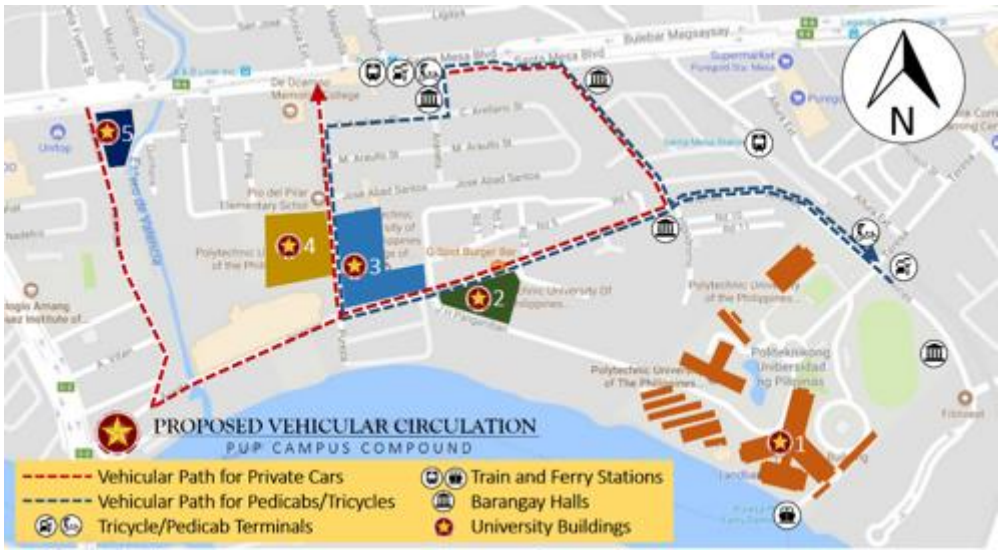

Fig. 8 - Proposed Transport Route along Pureza and Anonas Streets

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References

Asian Development Bank (ADB), Air and Noise Pollution Reduction from Tricycles : A Strategic Plan for Quezon City and Puerto Princesa City, Philippines (2005) https://aboutphilippines.ph/files/Air-and-Noise-Pollution-Reduction-from-Tricycles-Quezon_City-and-Puerto_Princesa_City.pdf Retrieved June 2, 2017

Bekiaris, E., Loukea, M., Panou, M., Földesi, E., & Jammes, T. (2020). Seamless Accessibility of Transportation Modes and Multimodal Transport Across Europe: Gaps, Measures and Best Practices. In *Towards User-Centric Transport in Europe 2* (pp. 43-59). Springer, Cham https://link.springer.com/chapter/10.1007/978-3-030-38028-1_4 Retrieved September 19, 2022

Choi, E. Walkability as Urban Design Problem: Understanding the activity of walking in the urban environment, Licentiate Thesis, School of Architecture Royal Institute of Technology Architecture and the Built Environment, 2012 Retrieved June 2, 2017

Chudyk Anna, M. Neighborhood walkability, physical activity, and walking for transportation: A cross-sectional study of older adults living on low income https://link.springer.com/article/10.1186/s12877-017-0469-5

Ewing, R. and Handy, S. Measuring the Unmeasurable: Urban Design Qualities Related to Walkability, Journal of Urban Design Routledge Taylor and Francis, Online, 2009 http://dx.doi.org/10.1080/13574800802451155 Retrieved June 2, 2017

Ewing, R., & Handy, S. (2009). Measuring the unmeasurable: Urban design qualities related to walkability. *Journal of Urban design*, *14*(1), 65-84. https://www.tandfonline.com/doi/abs/10.1080/13574800802451155 Retrieved September 19, 2022

Flores, P. (2016). Seamless Transportation Systems. *Institute of Transportation Engineers. ITE Journal*, *86*(8), 4. https://www.proquest.com/docview/1812833079?pq-origsite=gscholar&fromopenview=true Retrieved June 2, 2017

Fonseca, F., Ribeiro, P. J., Conticelli, E., Jabbari, M., Papageorgiou, G., Tondelli, S., & Ramos, R. A. (2022). Built environment attributes and their influence on walkability. *International Journal of Sustainable Transportation*, *16*(7), 660-679. https://doi.org/10.1080/15568318.2021.1914793 Retrieved September 19, 2022

Frank, L. D., Sallis, J. F., Saelens, B. E., Leary, L., Cain, K., Conway, T. L., & Hess, P. M. (2010). The development of a walkability index: application to the Neighborhood Quality of Life Study. *British journal of sports medicine*, *44*(13), 924-933. https://bjsm.bmj.com/content/44/13/924.short Retrieved September 19, 2022

Ginnapulos, G. Urban Mobility and Door to Door Strategy Center for Research and Technology Hellas , Hellenic Institute of Transport http://ec.europa.eu/invest-in-research/pdf/workshop/giannopoulos_b2.pdf ETP Conference 2012 Retrieved June 2, 2017

Gozum, B.C., and Guillen, M.D.V., Towards a Sustainable Transportation Environment: The Case of "Pedicabs" and Cycling in thePhilippines Retrieved June 2, 2017

Humes, E., Door to Door: The Magnificent, Maddening, Mysterious Word of Transportation, Harper Collins Publication. 2016 Light Rail Transit Authority https://web.archive.org/web/20070519193039/http://www.lrta.gov.ph/eo603.htm Republic of the Philippines. (July 12, 1980). "Executive Order No. 603". Archived from the original on May 19, 2007. Retrieved June 5, 2017

Maghelal, P. K., & Capp, C. J. (2011). Walkability: A Review of Existing Pedestrian Indices. *Journal of the Urban & Regional Information Systems Association*, *23*(2). https://tinyurl.com/26s5xu5w Retrieved September 19, 2022

Mayne, Darren J, et.al., An objective index of walkability for research and planning in the Sydney Metropolitan Region of New South Wales, Australia: an ecological study https://link.springer.com/article/10.1186/1476-072X-12-61

Mehta, V., Walkable streets: pedestrian behaviour, perceptions and attitudes, Journal of Urbanism : International Research on Placemaking and Urban Sustainability. Routledge Taylor and Francis, Online 2008 http://dx.doi.org/10.1080/17549170802529480 Retrieved July 6, 2017

Philippines: Transport sector assessment, strategy, and road map. (2012) Asian Development Bank, Mandaluyong City, Philippines https://www.adb.org/sites/default/files/institutional-document/33700/files/philippines-transport-assessment.pdf Retrieved June 2, 2017.

Pinlac, C., The University Belt of Manila and Laguna of the Philippines: The urban development effects of a conglomeration of higher education institution. Unpublished Thesis MSc. Urban Planning and Policy Design School of Architecture Urban Planning Construction Engineering, Politecnico Milano, 2016

Raghunathan, A. U., Bergman, D., Hooker, J., Serra, T., & Kobori, S. (2018). Seamless multimodal transportation scheduling. *arXiv preprint arXiv:1807.09676*. https://doi.org/10.48550/arXiv.1807.09676 Retrieved September 19, 2022

Refaat, M., & Kafafy, N. (2014). Approaches and Lessons for enhancing walkability in cities. *International Journal of Education and Research*, *2*(6), 301-322. https://tinyurl.com/mtusn6vt Retrieved September 19, 2022

Vergel, K.L., Cacho, F.T. and Capiz, CL E., A Study of Roadside Noise Generated by Tricycles, Philippine Engineering Journal, Volume 25 No. 2: 1-22, http://journals.upd.edu.ph/index.php/pej/article/view/2330/2229 2004