

June 2021

TECHNOLOGY OF MOBILITY HUBS IN AUTOPIAN FUTURISTIC CITIES

Mohamad AbdAllah M.Abdallah

MS candidate, Faculty of Architecture, Design and Built Environment, Beirut Arab University,
maa033@student.bau.edu.lb

Marwan Halabi

Associate Professor, Faculty of Architecture - Design & Built Environment, Beirut Arab University,
m.halabi@bau.edu.lb

Hiba Mohsen

Assistant Professor, Faculty of Architecture- Design and Built Environment, Beirut Arab University,
h.mohsen@bau.edu.lb

Maged Youssef

Associate Professor, Faculty of Architecture, Design and Built Environment, Beirut Arab University,
m.nabilyoussef@bau.edu.lb

Follow this and additional works at: <https://digitalcommons.bau.edu.lb/stjournal>



Part of the [Architecture Commons](#), and the [Automotive Engineering Commons](#)

Recommended Citation

AbdAllah, Mohamad M.Abdallah; Halabi, Marwan; Mohsen, Hiba; and Youssef, Maged (2021) "TECHNOLOGY OF MOBILITY HUBS IN AUTOPIAN FUTURISTIC CITIES," *BAU Journal - Science and Technology*. Vol. 2 : Iss. 2 , Article 6.

Available at: <https://digitalcommons.bau.edu.lb/stjournal/vol2/iss2/6>

This Article is brought to you for free and open access by Digital Commons @ BAU. It has been accepted for inclusion in BAU Journal - Science and Technology by an authorized editor of Digital Commons @ BAU. For more information, please contact ibtihal@bau.edu.lb.

TECHNOLOGY OF MOBILITY HUBS IN AUTOPIAN FUTURISTIC CITIES

Abstract

Utopias envision perfect societies, however in practice, when imperfect humans attempt perfection they fail miserably. Hence, if Utopia means no place, then *Autopia* is the alternative place where progress is steadfast and measured by securing a better world for tomorrow. In 2012, the UN issued a report stating that population growth will increase exponentially, reaching up to 9 billion by 2040. The report also states that melted ice due to global warming will eventually cover up to 7% of the world's land. At this rate, humans will require three times the earth's land area to keep up with their required resources, otherwise they will be faced with the scarcity of all resources. If nations are overwhelmed with problems of scarcity, then more conflicts will arise. Therefore, it seems that either war or the environment will be the causes of humans' downfall, making us all competitors in our fight for survival. Therefore, this research aims to explore automation and design strategies of mobility hubs of the futures to achieve self-sustained cities, in an attempt to secure a more humane world for all. It assumes that such technological applications and cybernetics will have the humans' and environmental concerns at heart. To achieve this aim, the paper used a scientific methodology, based on literature review by analyzing the potential of one case study near the sea, through exploring methods of visual thinking documented by sketches, computational design, and advanced simulation. As a conclusion emphasizing automation as a mean to liberate man from his daily survival needs in order to pursue higher goals and knowledge, which will achieve a society with equal abundance and equity for all.

Keywords

Architecture, Mobility Hub, Utopia, Automation, Autopia, Technology.

1. INTRODUCTION

The term Autopian future cities is derived from the word automation and utopia. Autopia can be defined as fourth industrial revolution. It is a world driven by robots to shape urban spaces and future life. It is a direct response to the various opportunities and challenges emerging in diverse sectors as economics, society, politics and health. By adopting automation within cities, humanity will be able to overcome many challenges and develop cities into better places to live.

Automation can be a great contributor to cities, since it maintains continuous traffic flow using autonomous self-driven cars. In addition, public transportation routes can be modified based on real-time monitored demand. In addition, intelligent traffic light systems can improve congestion by continuous observation and alterations. Automation can also help in improving energy efficiency by investing in existing clean energy resources, and closely monitoring and registering energy use in an aim to reduce consumption. Moreover, it has the potential to make cities a safer place through applying smart systems as Wi-Fi connectivity, IOT technologies, and CCTV cameras. By doing so, city planners can collect data and harness technology to improve the safety and security of residents and boost response times. Such measures of security will encourage citizens to collaborate and get more involved in their community. For example, using smart applications may allow citizens to easily report problems, or using community-based transparent networking platforms may encourage residents to connect and share resources. The data is streamed to a city cloud, which is the nucleus of the city, effectively creating a source map of data, and connectivity at all levels. [1]

It is evident that the more cities grow, the harder it is for humans to manage and plan. According to a report published by the UN in 2012, population growth will rise from 7 billion to approximately 9 billion by the year 2040. As a result, the demand for resources is expected to rise exponentially. Such projections state that by the year 2030, food requirements will increase by 50%, while energy demand will rise to 45%. Also, figures related to water demand predict an increase of 30%. So, humans are currently depleting all the planet's natural resources by 50% faster than the planet's ability to renew. At this rate humans need around three times the earth planet to provide the needed resources.

By the year 2050, 68% of the world's population, compared to the current 55%, are expected to be living in urban areas. Such projections show us that this shift in residence from rural to urban areas, will add around 2.5 billion people to urban areas. This rapid urbanization process will strain cities' resources by the exponential increase of the demand for food energy and water, public services, traffic, and delivery services. In addition, rapid urbanization will cause environmental damage and degradation, the groaning of social systems, shortage of proper housing and cities' infrastructures will exceed their limits. [2]



Fig.1: Infrastructure and Future of Mobility Strategic Intelligence
Source: World Economic Forum

“This research aims to propose several elements of architectural and technological value that can be utilized in designing mobility hubs in future cities. To achieve this, this paper will aim to explore certain design criteria as the flow of people, data, and wastes in future cities. In doing so, it will attempt to envision new design approaches of transportation and infrastructure in the forthcoming years.”

Moreover, the research will propose design methods for how these systems can correlate and be superimposed to form of future cities, and act as a connection with other cities.

Since cities prosper only when they are highly connected and accessible, governments and policy makers have started to regard automation as the key to enhancing governance by enabling the flow of people, data and objects. Hence, an automated city can be defined as one that leverages technology in an aim to improve the quality and efficiency of services and life of its residents. Automated city initiatives can encompass everything from power distribution networks and entire transport systems, to simple streetlights and garbage collection. The strategy is to utilize data and technology to make everyday life easier and better for people through providing an abundant and enhanced means of mobility and maximizing the use of resources.

In order to reach the stated aim, this paper follows a scientific methodology, based primarily on literature review. Next, it will analyze the potential of one case study near the sea, through exploring methods of visual thinking. It will document this study by sketches to envision the future of mobility and computational design strategies, to explore the cities connectivity system. Also, it will apply advanced simulation to test the effectiveness and efficiency of the proposed solutions. (Figure 02)

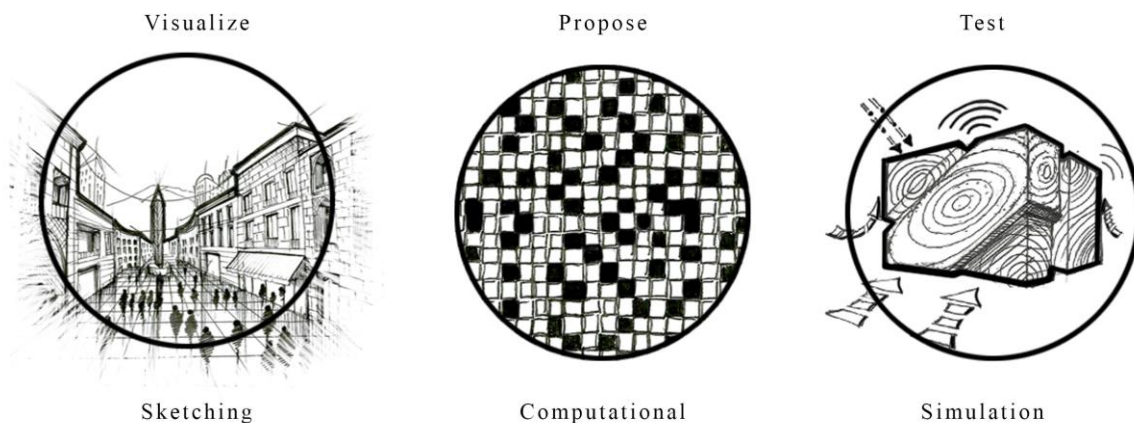


Fig.2: Research Process & Determinant (Author)

2. LITERATURE REVIEW

“Mark my words. A combination of airplane and motorcar is coming. You may smile. But it will come.”
Henry Ford, 1940

The literature review portrays designers and engineering current attempts, and future visions of mobility hubs inside cities that will shape the future. Then it will give a historical background of mobility in cities and depict current trends that will reform the future. According to previous readings one of the articles tackled, the future of flying car where, where its not a dream anymore all they need to take off is a place to land, the literature review will explore the infrastructure needed to make this happen. Moreover, an exploration of current and future similar projects, will be highlighted and explained, where these projects will be a transformation point for cities. Finally, from analyzing similar projects and developing trends in mobility, parameters of analysis will emerge, to analyze mobility hubs in Autopian futuristic cities.

2.1 Definition of Mobility Hub

Mobility Hubs can be defined as connectivity nodes within the city. They are locations where different travel options are centralized; walking, biking, transit, and shared mobility all come together in one place. Mobility Hubs have the ability to provide for an integrated suite of mobility and intermodal services, their relevant amenities, and all their supporting technologies. As a result, they are locations to connect high-frequency transit to an individual's destination. Spatially, mobility hubs can be distributed every two miles to provide for short trips around a city. Also, mobility hubs can be developed into neighborhoods that are environmentally friendly, infrastructure-efficient, walkable, bike and transit-oriented. [3]

2.2 Historical Background of Mobility in Cities

With the introduction of wheels, the transportation industry witnessed a turning point in history. This discovery was the trigger to other smaller devices such as wheelbarrows. Moreover, ever since then, all means of transportation have improved. For instance, horseshoes got to be common practice, and horse-drawn vehicles as carts or carriages became a new possibility. Quickly and with unprecedented momentum, transportation progressed across all domains. For example, submarines were invented around 1620. Also, modes of public transportation were made available by the 1660s. Hence, cities witnessed the introduction of passenger carriages, steamboats, and cycles on a large scale. (.....,

In the year 1862, the first gas engine vehicle was made by Jean Lenoir, setting the ground for the invention of the first motorcycle in the following year. By the year 1903, the Wright brothers invented the first aero plane with an engine. It was around twenty years after that the first liquid propelled rocket was launched. Following this, all modern age travel vehicles such as the helicopter, jets and hovercrafts were invented.

From that point onward, transportation means was continuously improving and leading to new inventions; steam engines led to the invention of bullet trains, while manned flights led to a jumbo jet. Hence, humans have come a long way from travelling on foot on to a whole generation of transportation inventions and vast networks. As a result, the current modes of transportation can be listed as: land transportation, railway lines, water transport, air transport or aviation, and space travel. [4]

2.3 Future of Mobility Principles & Theories

It is difficult to keep track of all the emerging trends influencing mobility systems nowadays. There are currently countless trends around the world, starting from vehicle electrification, to autonomous-driving technologies. The following trends will most likely have the leading role in the development of integrated mobility systems in cities. [5]

2.3.1 Shared mobility

Ride-hailing or the act of 'ordering a ride' is a new service that has dominated the mobility service market over the past few years. Now, people can utilize a simple smart application in an instant to 'customize' their travel and payment requirements. This service has grown rapidly is in competition with the traditional taxi services and car-pooling providers. People have grown to depend on this trend to reach their destinations as they are faster than public transportation means and more efficient than using private cars.

2.3.2 Autonomous driving

The technology of autonomous-driving, or 'self-driving cars' seems to be the future of all mobility vehicles. This emerging trend promises to increase road-safety and transform the user-experience of riding in cars by making it more pleasant and less stressful. By minimizing the dependency on human drivers, this bold technology will reduce the cost of transportation and expand access to all sorts of mobility vehicles. Autonomous vehicles (AVs) will transform driving time into attractive free

time where the user can have more 'free time' to engage in other activities while on the road to his destination. Finally, AVs can incur higher mileage for vehicles since users will make use of this trend to making more trips.

2.3.2 Vehicle electrification

In the automotive industry, an electric-vehicle (EV) represents the ongoing revolution in maximizing car efficiency while reducing energy costs. Nowadays, EV vehicles have been commercially accepted and widely spread in the market. This can be seen through their market statistics; their sales have risen from 50,000 in 2011 to around 450,000 by the year 2015. In many parts of the world, governments have often developed supporting policies to encourage the purchase of such environmentally-friendly cars. Such policies as subsidies, less battery cost, and fuel regulations have highly contributed to the increase of purchasing numbers. Bloomberg New Energy Finance has estimated that the cost of batteries will therefore drop below \$100 per kilowatt-hour. If this is likely to occur within the next decade, then EVs will be cost-competitive with respect to the conventional vehicles.

2.3.3 Connectivity and IoT technologies

The spread of the Internet of Things (IoT) is the network of physical objects which are embedded with electronic sensors and softwares for the sake of exchanging data over the internet. The introduction of such applications to mobility vehicles and infrastructure has generated a wide variety of data for endless goals and opportunities. For instance, residents can utilize IoT to plan trips and program their AVs to reach their destinations based on real-time environments. Other IoT applications can be data extracted from vehicle movements to analyze and predict the movement of people and vehicles, in order to predict traffic patterns and adjust infrastructure services to avoid such incidents.

2.3.4 Public transit

All over the world, public transit is constantly developing through modern strategies to improve efficiency and increase user's ridership. As a result, many trends for public-transit networks are already in use. For example, autonomous features to transit vehicles have been added to reduce operation costs. These AV are especially attractive to bus agencies who operate shuttle buses within cities or colleges. Another example is new deployment models such as fleets of shared vehicles which have made transit more flexible and accessible. Also, so many bus agencies have moved to zero-emission buses in an aim to decrease the dependency on fuel. [5]

2.3.5 Infrastructure

The United Nations Population Division has projected that the world's urban population will increase by more than two-thirds by 2050. This influx of people could add more strain on city roads, bridges, and tunnels. However, infrastructure upgrades that favor public or shared transit and bicycling could reinforce a shift away from car ownership. [5]

2.3.6 Decentralization of energy systems

Since the cost of renewable power generation is continuously dropping, then an intermittent distribution of this power will likely generate a significant share of the world's electricity in the future. Such trends will accelerate the uptake of EV since electrical power will be cheaper, cleaner, and more reliable. In addition, these systems will reduce demand on urban power grids, and in lower electrical bills.

2.3.7 Regulations

Public policy makers whether at the city, regional, or national scale have taken action by establishing many new regulations and procedures which aim at maximizing the benefits of integrated mobility. Moreover, governments should

consider setting regulations which encourage user-friendly developments while advancing and endorsing public benefits as clean air and reduced congestion.

2.4 Urban air mobility (UAM): the idea of the future

The use of emerging technologies to achieve easy urban air mobility (UAM) and liberate cities from the constant need of increasing roads, has gained significant momentum over the past decade. Hence, the current market is witnessing more than 250 industries planning to develop, build, operate, and/or manufacture urban-air-mobility (UAM) vehicles. This wide array of industry players is aiming at making this dream a reality. Ideas of air mobility are under constant research and development. Examples of VTOL systems (vertical-takeoff and –landing), electric propulsion, and advanced flight-control capabilities, could ultimately achieve compete with today’s taxi services. These flying vehicles are envisioned to be energy efficient, environmentally friendly, user responsive and pilotless. In addition, such UAM technologies can help with unforeseen events as the COVID-19. Such systems can increase the importance of safety during travel. The following are simply illustrative examples of what a UAM network must include:

Vertihubs are the largest structures. Envisioned as stand-alone buildings constructed in central, high-traffic areas. They are envisioned to comprise active takeoff and landing areas, and additional spaces for parking or maintenance. Vertihubs could also include some level of retail and other services for passengers. (Figure:03)

Vertibases are medium-sized structures, either newly built or created by retrofitting existing buildings as parking garages or corporate-headquarters rooftops. Usually located in medium-traffic areas, such as suburbs or prominent work or retail nodes, vertibases are envisioned to have around three active takeoff and landing spaces, plus six additional spaces for parking or vehicle maintenance. (Figure:03)

Vertipads. are the smallest structures of this network. They are envisioned to function as the spokes in the hub-and-spoke network. Similar to vertibases, they can be new buildings or within existing ones. Also, they are to be located within a suburban or rural area (up to 50 miles from the rest of the network). Finally, they comprise one takeoff and landing area, plus two spots for parking or vehicle maintenance. (Figure:03)

There are three potential archetypes for urban-air-mobility infrastructure.

Potential archetypes for urban-air-mobility infrastructure, illustrative

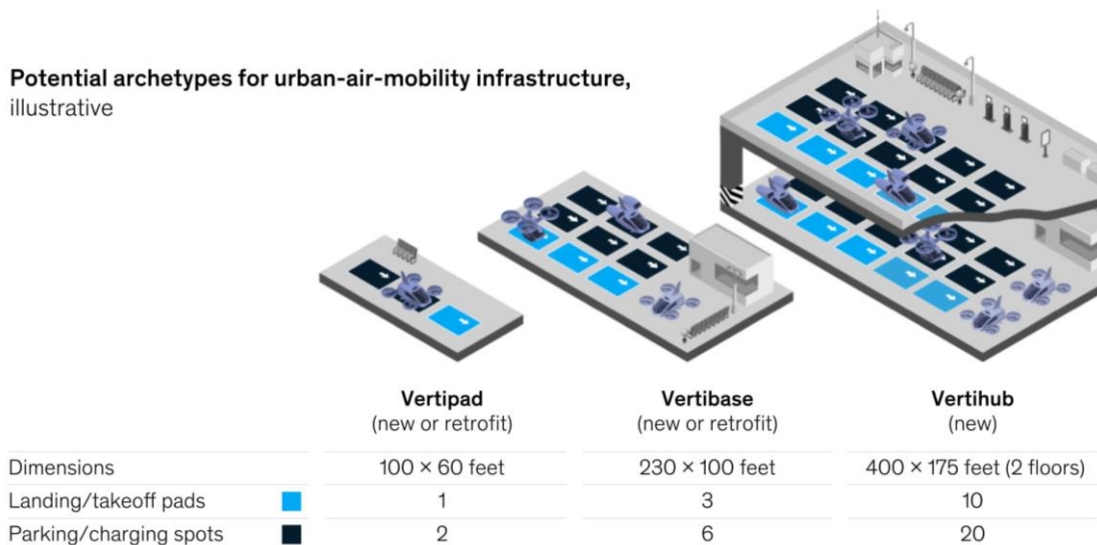


Fig.3: Arche Types of Urban Air Mobility
Source: Mckinesy.com

2.5 Examples of Urban Mobility That Will Reshape Future

The literature review will present two examples of how designers and engineers imagined the future of mobility that will reshape cities we know. The examples attempt to give a glimpse of the future.

2.5.1 The Cyclicity

The cyclicity is a 3D intervention for delta areas, it creates a relation with existing deltas, the project represents a productive floating urban development in contrast to the existing consuming cities. As a floating city it will adapt to any future water level and will not suffer any flood damage due to extreme weather events. Also, it can act as a wave breaker and protect delta areas. (Figure:04)



Fig.4: Impression, Floating City
Source: Cyclicity Project

2.5.2 Orlando Flying Car Hub U.S.A

From groundbreaking autonomous shuttles on the streets. Today, Lake Nona takes its biggest leap yet – announcing the creation of the country's first regional hub for high-speed, electric vertical takeoff and landing (eVTOL) aircraft. Known as the Lake Nona Vertiport, the first-of-its-kind aviation facility will serve as the central location for a regional mobility network in Florida designed to usher in a new era of city-to-city transportation (Figure:05) [6]



Fig.5: Flying Car Air Hub
Source: Lakenona.com

2.6 Parameters of analysis

The city of the future must meet the needs of its residents. Yet cities cited numerous inadequacies: crime, congestion, fire emergency response, waste management, active mobility options, police security, lack of basic utilities, public transit, as well as poor quality of housing and government services. Given the fierce competition for talent across cities, dissatisfied urbanites are likely to vote with their feet and leave for more attractive environments. The best cities of the future will likely have the following characteristics

- Zero to limited congestion.
- Pollution-free air and adequate exposure to sunlight.
- A clean and zero-waste.
- No physical or virtual crime.
- Traffic safety
- Travel Time
- Transit Capacity

3. METHODOLOGY

The paper use three types of research methodology first type is the deductive methodology where data is gathered around chosen case study of Tyre Lebanon by studying the future of mobility hubs, second is the field method where the author conducted site visits for main cities located near the sea , where interviews where made and took photographs. Beside the interview, a questionnaire was distributed to recognize people point of view regarding floating future, interpret the means of future of transportation. This research aims to propose solutions of mobility in future cities, and explore methods of flow of people, things, data and waste inside cities, through systems of transportation and infrastructure. The research methodologies are presented as follows:

3.1 Introducing the Case of Tyre

Tyre located in southern Lebanon, often known by Sour, since Phoenician time Tyre was recognized as commercial city throughout the Mediterranean. It's considered 4th largest coastal Lebanese city and known very well in its coastal and archeological sites, Tire has facilitated different civilizations throughout history, coming about totally different layers of built and cultural heritage, counting a few ruins presently submerged. Tire was included on UNESCO's World Legacy list in 1984, The island-city initially had two harbors, located on its north and south sides. These were instrumental in Tyre's notable rise to sea exchanging victory. Whilst the south harbor has silted up, the north harbor remains operational nowadays. [7]

3.2 Transportation Systems in Tyre

Transportation systems are divided into personal system, collective transportation and systems based on air and water transportation. Individual transportation is characterized as a transportation framework in which everybody has a transportation unit. Cases incorporate cars, e-bikes, motorized bikes, etc. Collective transportation comprises of transportation frameworks in which the foundation of the transportation framework and the vehicles are worked by a company or a government institution. Or can be financed by locals or society.

Collective transportation consists of mass and personal, mass transportation systems like trains, busses, metro's, trams etc. Whereas personal transportation system consists of units which they are small in size and operate collectively. [8]

3.2.1 Personal transportation

Because of the scale of the city of Tyre, it is possible that car transportation will be as important as it is at the moment in most places in the world. In addition, car transportation will be used that much when there is strong relation with nearby places. Whereas Slow modes have several advantages over faster modes. Slow modes cause almost no nuisances it is based on walking speed 4.3 km/h, like the use of bicycle. At some place it's important to relate the personal transportation with near water bodies and public spaces inside the city.

3.2.2 Collective transportation

The collective transportation system is designed for BRT bus transit. BRT is an organized system, In Tyre the system exists in a shy way with great potential to be organized, since it is managed with unexperienced people and with no financial support or future vision. The advantage of this system, it requires less space in a city, so more space can be used for pedestrians, cyclists etc., also it creates a different urban atmosphere than the use of car for transportation (Figure:07).



Fig.6: Fisher Boats
Source: Author



Fig.7: Personal rapid transit system
Source: Author

3.2.3 Water Transportation

Tyre historical relation with the sea made it dominant in trading and having one of the biggest fishermen ports in Lebanon (Figure:06), and boats are used for fishing or to transport divers to discover the coastal archeological sites under the sea, plus the city sky line has captured the tourists to discover the city from the sea.

3.3 Identifying Problems of Mobility in Tyre

In spite of the fact that a number of negative impacts have been related with the current transportation routes (such as car transportation), cars make it conceivable to attain speeds that make it conceivable to travel distances that are more notable than ever in history. Moreover, car transportation offers a certain level of consolation that individuals don't effortlessly grant up, and in spite of the fact that safety issues exist with car transportation, the is considered safe for travelers . The weaknesses of the current transportation framework exist of the disturbance caused by transportation systems, the CO₂ emissions and the diminish in walkability. Unused issues might emerge by building framework in a city. The amount of framework ought to for case be minimized within the city so that more space can be utilized for lodging and other capacities, such as shops or eateries. Framework is more costly in floating cities. The impediments of the current framework that ought to be taken under consideration, be; nuisance due to long travels, reduction in walkability and increase of emissions.

3.4 Selection of A Specific Area



Fig.8: Areas showing rich potential for coastal archaeology at Tyre
Source: Google earth

Investigate at Tyre has appeared the critical potential of Bronze Age to late Roman arrive surfaces surviving seaward, these suffocated scenes have colossal scope for the conservation of archeological prove and can possibly abdicate vital experiences into the nature, scale, and pace of the coastal alter.

3.5 Different Perspectives of The Public on Mobility Hubs of Future Cities

To seek reliability and opinion of people, the research aims to meet with people lives in the selected area of Tyre, and the research, followed two field methods by holding one on one interviews and distributing a questionnaire forms as follows.

3.5.1 Holding interviews

One on one interviews were made between 21 to 25 November 2020, with eight of the locals in city of Tyre. Who presented a defensive reaction for the rising sea, but deep inside they were imagining a future full of hope. During the interview, three questions were asked.

- a. What is your relation to the sea?
- b. How would you feel if the sea level rise, and you are forced to leave home?
- c. Would you use maritime transport and flying cars to reach your floating house?

Most of the answers were similar, sample of these answers are quoted bellow:

Nisrene Beyrouty, 39 years old:

The sea is my life. As someone who has lived in sour most of his life, I have experienced the sea on most days and through all seasons. Sour has always been my anchor true. It's where my family bought me up but my relationship to the sea is what makes me stay there. Now that I hear my city might be flooded, God forbid... I imagine I just can't relocate to the mountains. You see I belong to the sea and I can't imagine waking up without looking at its blue colors, feeling its breeze, or just gazing

at its horizon. So, the idea of moving to live away from the coast is not a choice for me. I would rather live in a city in the sea as you suggest! Who knows maybe I can fly to work or go by boat! What a fun means to get to work each day.

Ahmad Hijazi, 65 years old:

Just like blood running through your veins, Tyre runs in mine. I have lived her since birth and so have my parents and great grandparents. You see this orchard around you? My father planted every single tree. You see the house the house behind me? My grandpa built it. If the sea will swallow it, I will go down with it. How can I ever live here without my trees, my memories, my family. I guess if one day I was forced I would take these stones and trees with me.

Georgette Farah, 32 years old:

I moved to sour after I got married. You see I was once a mountain girl, but I fell in love... What is more to be said? So, I made a life here and I know everyone and everything in my neighborhood! Ask me anything! My friends and I used to take the kids every weekend to stroll by the sea and eat corn or termos. The kids would play for hours in the sand and when we got home, I would have them take of their dandy clothes at the door! These where the best times, the moments we felt free and fresh. I do not mind moving to the sea. I just want to take my family and friends with me. Also, make sure my children get a proper education. Will they have schools there? I can move my sewing machine there no problem and work from home, but can my husband drive his taxi? Maybe they would hire him to drive the boats. Who knows...?

3.5.2 Questionnaire

A closed questioner was distributed on 110 persons in the age group 18 to 60 years old, those people with different backgrounds and educational levels. The questioner was submitted to people who are geographically located near the sea mostly focused on people of city of Tyre, Beirut and Tripoli. Questioner questions were simple and direct as follows:

- a. Would you live over sea steads?
- b. Why would you choose to live on a sea stead?
- c. How do you currently commute? How far is your daily commute?
- d. How would you prefer to commute?
- e. If a reliable car sharing service was available, would you give up your personal car?
- f. In a floating city, would you rely on a Maritime transport as the main transport route of the city?
- g. Would you use rail transport over sea, as a mean to reach other cities and offshore?

4. FINDINGS

By applying the analytical methodology, findings of answers can be presented in form of sketching and charts.

4.1 Analysis of Interviews Results

When conducting the interviews, the below sketches of Tyre was shown to interviewers prior to asking the questions of the interview, to see the if the local can recognize their environment through vivid sketches and to spark their visual memories of the space.



Fig.9: Tyre Urban Sketching
Source: Author

4.2 Analysis of questionnaire results

Results are formulated through statistical charts that are based on specific cultural, social background, and economic level. Charts shown in Figs 10, 11 & 12 represents the results.

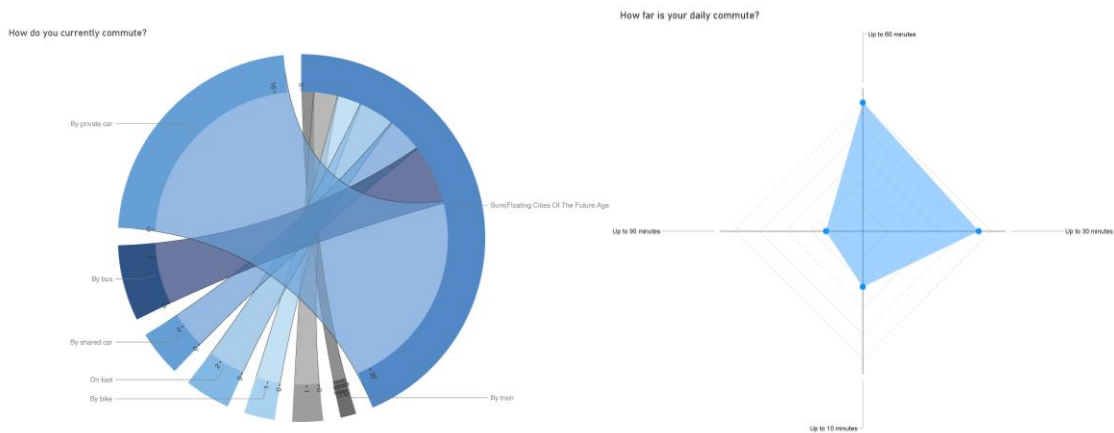


Fig.10: Chord chart to the left, Radar chart to the right
Source: Author

Chord chart to showing that most people use there private car as a main transportation option. Radar chart b) shows that the most people commute more than 60 min a day (Figure 10).

Radar chart (a) show that most people are likely to give up their cars and use another reliable transportation option. Radar chart to the right (b) shows that the most people prefer to commute using train and in special occasions to use their private cars more than 60 min a day (Figure: 11).

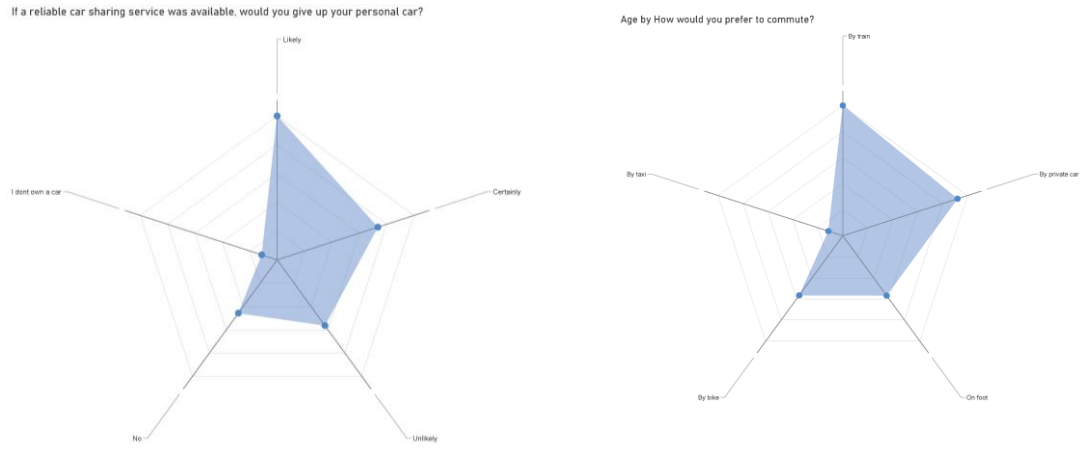


Fig.11: Radar chart (a) to the left & Radar chart (b) to the right.
Source: Author

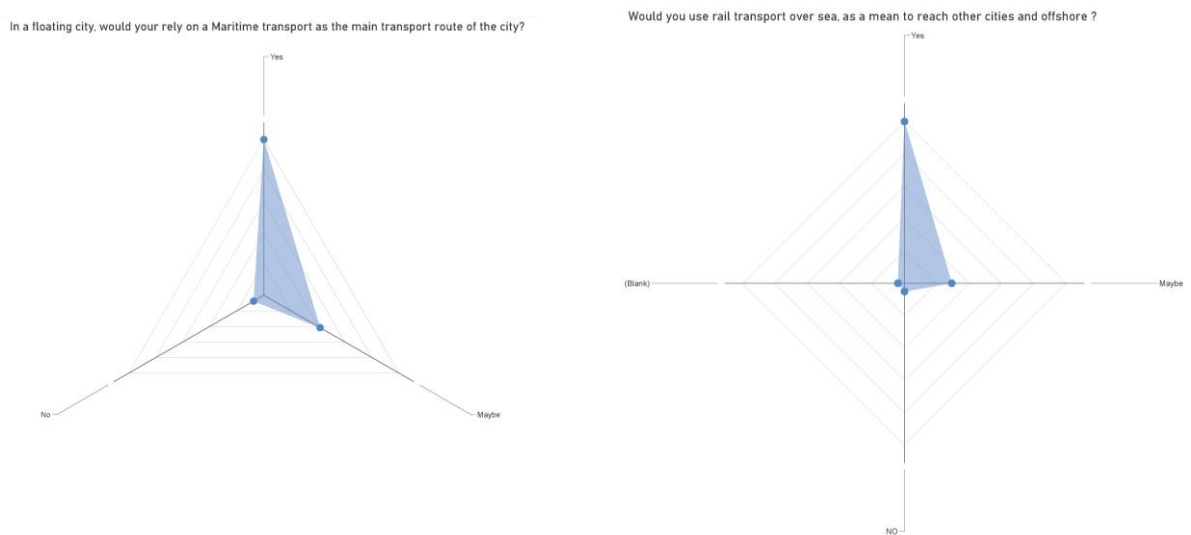


Fig.12: Radar chart (a) to the left & Radar chart (b) to the right.
Source: Author

Radar chart to the (a) shows that most people would rely on maritime transport as a main transport route of the city. Radar chart to the (b) shows that the most people would use rail transport over sea, as a mean to reach cities offshore (Figure: 12).

5. DISCUSSION

The previous findings showed the importance of transportation systems in shaping cities. To identify the future of transportation, a solution was derived from the current status of mobility and current technologies, solutions were identified according to financial value, social value and feasibility. This paper proposes applying the following solutions.

- a. Enabling technology and automation, to maximize spaces to carry more people and to decrease time travel more.
- b. Install intelligent traffic systems, that decreases waiting time and maximize movement.
- c. Create intelligent parking system that is connected to infrastructure and inform user with available parking spaces nearby.

- d. Adopt shared modes of travel in spite of private travel modes that would reduce congestions and reduce travel times.
- e. Dedicate a lane of shared vehicles, vehicles on these lanes will be faster and attract travelers.
- f. Adopt bicycles and electric scooters as mean of transport inside cities that would promote healthier lifestyle and cleaner environment
- g. Commercial delivery times to be shifted to off-peak hours , by allowing deliveries at night this would reduce congestions through the day and allow commercial delivery to use bigger trucks during the night, that would decrease number of deliveries .
- h. Use of urban consolidated centers (UCCS) (Figure : 13)where they might be located at the skirts of the city, where deliveries are collected and the dispatched, this allows shipment from multiple suppliers in one optimized load .
- i. Use of autonomous ground vehicle (AGVs) (Figure : 14)these vehicle are connected to a common infrastructure , these vehicles are driverless and need no human interventions, they can help to keep city clean , help police to keep streets safe or be used as a mean of transportation for good and people

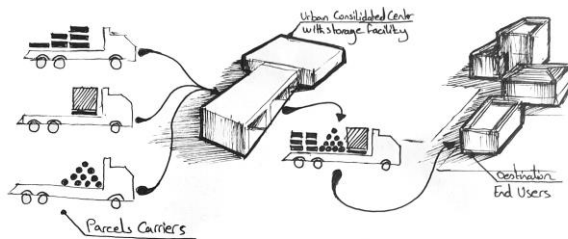


Fig.13: Urban Consolidated Centers Sketch
Source: Author

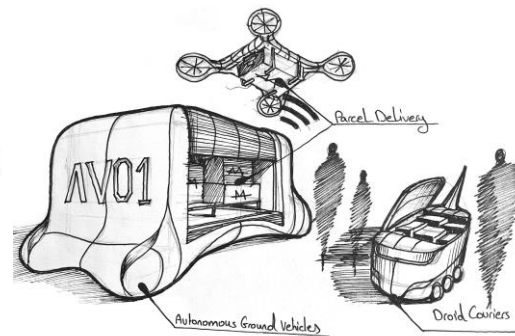


Fig.14: Autonomous Ground Vehicle Sketch
Source: Author

- j. The use of parcel lockers through creating delivery points the contains secure and convenient lockers, which allows users to pick up their packages 24/7. This can help cut vehicle emissions, decrease labor time and delivery costs (Figure: 15).
- k. Use of electric vehicles that reduces emissions of co2 NOx and particles (Figure: 16).

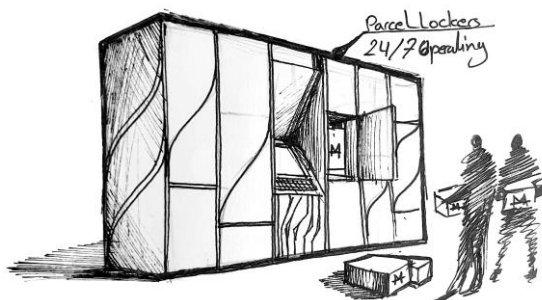


Fig.15: Parcel Locker Sketch
Source: Author

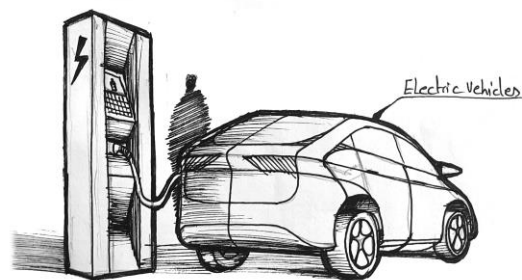


Fig.16: Electric vehicles Sketch
Source: Author

Most of the proposed solution can be adopted immediately, whereas use of droids, AGVs, autonomous are all realistic but they need time to be adopted, likely years away to be deployed, where the planning for future cities and reinforcing urban development methods, can be a catalyst to make this happen.

6. CONCLUSION

Finally, this paper ends with a set of a group of conclusions as follows:

- a) Mobility hubs with range of travel options can provide seamless travel experience.
- b) Frictionless integrated travel can create seamless travel modes with minimal stops and check points.
- c) Digital identity by transport agencies can provides secure transport for users and drive better experience for them.
- d) Operating system platform is necessary to be the brain of the entire transportation system, to manage the integrated data organize the movement of people and goods.
- e) Urban air mobility has a great promising future in transporting people and goods where as eVTOL cannot reduce emissions of CO₂ and traveling time and needs a robust infrastructure.

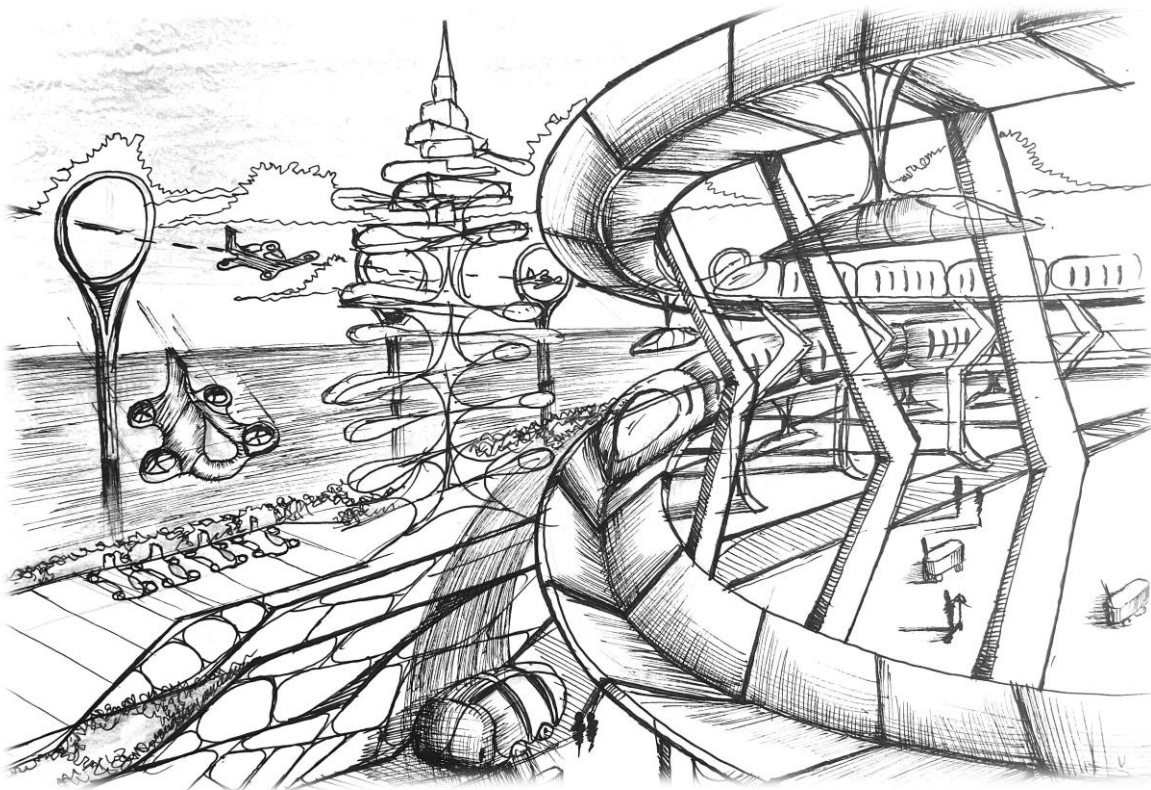


Fig.17: Sketch Envisioning Future Transportation Methods
Source: Author

REFERENCES

- [1] Danaher, J. (2019). *Automation and Utopia: Human Flourishing in a World without Work*. Cambridge, MA: Harvard University Press.
- [2] United Nations Raises Projected World Population. (n.d.). Retrieved October 08, 2020, from <https://www.prb.org/un-world-projections/>
- [3] Gazecki, W (Producer & Director). (2016). *Future by Design* [Motion Picture]. United States: The Venus Project
- [4] Meadows, R., Holt, J (Producer & Director). (2016). *The Choice Is Ours* [Motion Picture]. United States: Studio
- [5] McKinsey & Company. (2019). The future of mobility is at our doorstep.

- [6] Taking Flight. (2020, November 17). <https://www.lakenona.com/articles/taking-flight/>.
- [7] UN-HABITAT. (2017). Tyre City Profile. UNRWA.
- [8] Vreugdenhil, B. (2016). Transportation systems for passenger transportation in floating cities.
- [9] Lineberger, R., Hussain, A., Mehra, S., and Pankratz, D. M. (2018), *Elevating the future of mobility*, Deloitte Insights.
- [10] Lineberger, R., Hussain, Rutgers, V., Hanley, T. (2019) *Technological barriers to the elevated future of mobility*, Deloitte Insights