Applications of Systems Thinking for Scooter Sharing Transportation System

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Abstract

The scooter sharing system is a service that enables individuals to rent electric scooters for short term rides. The scooters are mostly electric motor scooters but there are some that are electric kick start. The purpose of this system is to transport people short distances in a safe and efficient way. This research was done to define and analyze the scooter sharing transportation system. System thinking is applied to understand, engineer and innovate the scooter sharing system. The scooter transportation system is defined as an interdependent constituent system that applies systemic tools and diagrams like systemigrams. These tools allow for the system properties to be studied along with the interrelationships. There will be different models of the scooter transportation system examined. The stakeholders will be examined to view the interconnections within the system.

Introduction

The start of scooter sharing was in 2012, this is when the scooter networks launched their services in San Francisco [1]. In 2018, these services were mostly common in Berlin, Madrid, and Paris. Also, in 2018, Revel launched the first scooter sharing service in New York [2]. These scooter work as "dockless". This means that they do not have a fixed location like the bike sharing system. They have the capability to be dropped off and picked up at any arbitrary locations in the service area. This is convenient for people in urban areas because they are able to access these from any spot in town and not by a specific station. The reason that this service is pushed so much in an urban setting is because it decreases congestion along with the carbon footprint. This gives the options to get where you are going in a quick and easy time. They also have the advantage compared to Uber and bike sharing because they are lower in cost and have a more efficient and shorter trip duration [3].

As stated before, the first dockless electric kick scooter sharing services started to roll out in San Francisco, Washington, D.C., and Los Angeles at the end of 2017. After that, the services expanded to more cities in the U.S., as well as Europe. When it came to seeking approval, it was inexistent. They deployed these scooters independently to the sidewalk and then would work on the regulatory after. The market has grown aggressively, there are valuation of $1 billion in less than a year of operation for some of the new companies [4].

These dockless electric scooter services operates by contractors, known as 'chargers.' These contractors are responsible to collect and charge the scooters, so they are available for the users when they need them. This can work by allowing anyone carrying a smartphone with the proper app to become a charger, and get a prize for every scooter retrieved, charged, and delivered [5].

Compared to the other forms of shared mobility, scooter sharing can be more hyper-localized. The potential growth of this system can be exponential but right now since there not much market adoption because it is a new form of transportation, there are no academic studies that can effectively measure its impact or expansion. Overall, it provides urban mobility with fewer carbon emissions compared to automobiles. The scooter takes up minimal space compared to bikes and their charging station, so they have potential to increase transit ridership to and from bus lines [6].

Scooter Sharing Transportation System Value Adding Process

When looking at a system, it is important place to start is to look at the stakeholders and who it going to affecting. For a transportation subsystem there are some consideration that should be looked at. The first is the mode of transportation, these are the vehicles that are used to move the passengers or freight. Some can do both and others are limited to one. These include air, marine, rail and road. The next is the infrastructure of transportation these are what physically support the modes of transportation. These include, ports, airports, railroads, canals and highways. The next is the network of transportation, this is the organization of the transportation system by functionality and locations. These networks show the linkages between and within the system. The last is the flows of transportation which are the movements of people or freight over the transportation system. These flows have origins, intermediate transportation and destinations. The other considerations are the stakeholders.

The importance of stakeholders is that they can use Systemigrams as a systemic tool that help them to learn about each other's perspectives and to identify organizational and communicational bottlenecks of their interrelation. As for the term "Systemigram," it is derived from the use of systemic diagrams. These diagrams have been used to bring context to the meaning of togetherness. When the stakeholder understands the systemigram this results in the understanding of the system and produce a more effective and efficient decision.

For the scooter sharing system the main categories of stakeholders can be classified as government, operations and communities. Some of the government stakeholders can be local transport authorities, neighboring cities, politicians, partnering groups, project managers and professional staff. Some of the operation stake holders can be engineers, contractors, utility services, local businesses, private financiers and transport consultants. The community's stakeholders can be the media, local community organizations, local interest groups, public transport users, citizens and visitors.

The purpose of the system is to get people and goods where they need to go on time and efficiently. Transportation refers to the activity that facilitates physical movement of goods as well as individuals from location to another. Value is measured by if the stakeholder's needs are met. An efficient transport system is essential for sustainable economic development of the country and plays a significant role in promoting national and global integration. An efficient transport helps in increasing productivity and enhances competitiveness of the economy, thus creating value.

Creating efficient ways that are faster to get where you are going is what the scooter sharing system is doing. The systems allow for bikes, drivers, scooters and people walking to all get to their destination using the same roads and in a more effective way. Offer employment opportunities and processes because they hire contractors to charge these scooters. The value of this also enables mass amount of people to travel at the same time. These processes allow for the transportation system to achieve its goals.

Systems Thinking Methodologies

Systemigrams methodology can be applied to the scooter sharing system because it provides the stakeholders with the right knowledge about the architectural structure. It also provides them with information about the activity network, the interaction of their environment along with the relevant information on understanding systemic issues. Systemigrams enable the stakeholders explore diversity in their perspectives while maintaining a single objective. Systemigrams can be used as a powerful tool for capturing strategic ways that provides the stakeholders of the system with the common ground for communication and participation in decision-making.

The importance of this methodologies is to examine the system from different viewpoints. This is crucial to the system because it increases the depth of perspective in analysis. For the scooter sharing system, it is essential to include knowledge and perspective of all the constituent systems in making decisions and adopting strategies for the entire system. These methods can give a way to provide a foundation for architectural design and modification for the scooter sharing system.

One of the methodologies that were used to examine the system was to look at the systemic forces that shape the system. The first of these forces was openness. This is referring to the influence on where new routes can be made and what the best mode of transportation is. The next is purposefulness. Meaning, if there is not a significant reason why or how an infrastructure should be built then it won't be. This is the main difference between the scooter sharing system and the bike sharing system because with the bike sharing system they have the charging infrastructure stations that are not necessary because they have the contractors that are responsible for charging. The next is the shape of multidimensionality. This is referring to the fact that transportation can have many dimensions. Scooter sharing transportation not only help the efficiency of people getting where they need to go but are also eco-friendly for the environment. The emergent properties reference the interactions within the transportation subsystem do not communicate property, which result in the system not function properly.

Some of the other forces were path dependencies. The scooter transportation system is the outcome of substantial capital accumulation in assets that takes place over decades. This is what shapes operations and additional investments. This is crucial to the development of these scooter sharing services in new cities. The next shaping force refers to asymmetry. Large transport firms have more information and the capacity compared to small firms. This is because they operate a larger network and are thus able to better understand and shape the systems they are operating in. Another important force that shapes systems in the internalization. The information within the firm must be collected efficiently and organized to all parts of the company. For the scooter sharing systems and most other systems this is important because if the internal functions within the company do not run efficiently then the entire company will fail. When the internalization of a company is done correctly this will correctly directly externality along with the client.

The next shaping force is the uncertain future which need to be evaluated in any system or business. This is when the company estimates a range of future demands, stresses, and opportunities, and fighting to plan for the future. Planning for the unexpected is essential, whether it be a natural disaster, financial stress or customer demand must be evaluated from every angle. A risk mitigation plan is great way to plan for this for the business and system. The next is the repairable, resilient, and responsive parts of the systems. The idea of this is to build a system right the first time so it does not have to be rebuilt in the future. There will always be trial and error when creating a system, but the plan is to create a system in a way if it needs to be altered it will not have a devesting impact to the system and will not have to be rebuilt completely. In other words, the company will be prepared to pivot. The last shaping force is the shift from lines to networks. This is organized around central hubs with the lines running as spokes to the cities they are established in. For a scooter sharing services, like Bird. There is a central hub where all the overall business is done but there are also representatives at each city to ensure the business is running smoothly at each region.

The next methodologies that were used to examine the system was to look at the concepted that effect the system. The concepts all evaluate the system and ensure that all parts of the system are meeting set standards. The boundary of the system is limited by the infrastructure of the cities. The system is also limited to the laws that are already in place in the cities. For the scooter sharing system to be developed in a city it must be a city that scooter have the capability to be driven by visitors and residents along with be able to be integrated with the laws on the city. The interior concept of the system consists of the scooter sharing system, the traffic system, communications between the charging contracts and the scooter sharing payment system. The exterior concept consists of commuters, pedestrians and traffic. These are the aspects of the system that the business has no control over.

The whole concept of the system is when stakeholder is expected to state their needs, the charging contractors and scooter users are expected to state their concerns and it is expected that all are working together and communicating. The parts of the system refer to each part should be communicating and improving communications among the parts and the system as a whole. The relationship concept is the interaction between stakeholders, contractors and commuters need to all constant and efficient. These relationships can make or break a system because the more relationships that are made and the stronger these are, will help the system thrive. The transformation concept of the system will take payments from the commuters along with capability of the scooters to ensure that people where they need to go. The inputs of the system consist of payments, electricity and system information. The outputs consist of scooter users arriving at their destinations safely. Another output is that the scooters are placed back in area that is safe.

The structure concept of the system is successful with the communication for the system along with the charging and operating system. The function concept is to transport commuters, encourage people to take the scooters are transportation and provide a safe trip. The process concept of the system should be to take traffic flow and ensure that riders get to their destination using a reasonable route. The emergence concept is based on feedback and there may need to have more scooters and the system and way they charge them may need to change. The hierarchy concept for the system is that the stakeholders and admin in the business have the ultimate decision-making capability. The concept of openness is the ability to be open the feedback for the system in order to improve the system. This will allow the technologically advancement of the system to ensure the software in up to date.

The harmony concept is when the system must work together to increase the satisfaction of commuters and users to encourage more use of scooter transportation. The variety concept can be used to ensure that users have to ability to access the scooter wherever they are in the city and they do not need to be by a station. The parsimony concept ensures that system will be efficient. This means that all commuters will get their destination safely and profit will be made for the scooter sharing company. The command concept is that the state officials and city government have command over the operations of the system. The control concept refers to stakeholders and scooter users having the control because they can offer feedback. The communication concept is one of the most important to any system. This is ensuring there is constant and effective communication between the stakeholder, scooter commuter, charging contractors and other staff.

Systems thinking has been described as a language for talking about the complex, interdependent issues managers face every day. The next methodology is the framework of systems thinking, which are causal loop diagrams. These are constructed by identifying the key variables in a system and indicate the causal relationships between them via links. By linking together several loops, you can create a concise story about a particular problem or issue. A causal loop diagram consists of four basic elements: the variables, the links between them, the signs on the links, and the sign of the loop.
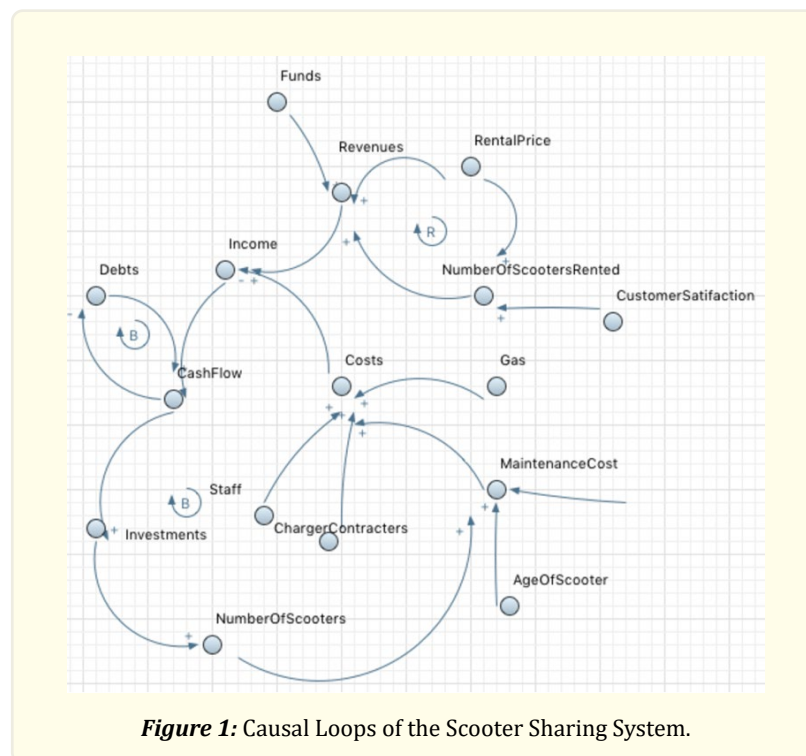

Figure 1: Causal Loops of the Scooter Sharing System.

Figure 1 is the development of a causal loop diagram of the scooter sharing system. There are two balancing loops and one reinforcing loop that is represented. A reinforcing loop is a cycle where the variation in any variable propagates through the loop and returns to the variable reinforcing the initial deviation. On the other hand, a balancing loop is the cycle in which the effect of a variation in any variable propagates through the loop and returns to the variable a deviation opposite to the initial one. As you can see in Figure 1, there are variables that can either positively or negatively affect another variable within the loop. The purpose of causal loop diagrams is to provide a language to enhance the understanding of the interconnections among the system. These are constructed by linking together key variables and indicating the causal relationships between them. There is also the stringing of loops together which are used to create a coherent diagram for a system or problem.

Conclusion

The electric scooter sharing transportation system is the next innovated transportation method happening around the world. Large electric scooter sharing companies like Lime and Bird are estimated to be worth over US $1 billion after raising hundreds of millions in venture capital. On the other hand, there are smaller companies, such as Skip and Scoot. are operating with much shallower pockets but have the potential to grow. Survey have been done that show that the public loves electric scooter sharing. There is a vocal minority that advocates against scooter sharing programs based on the companies' safety and responsibility records, but most of the public has been more than welcoming.

This electric scooter sharing system is positively effective the environmental impact for cities. This gives visitors and residents a convenience of going wherever they want in the city in a safe short ride.

Applying a system thinking approach to the scooter sharing system empowers the stakeholders to have a better understanding about the system. This also gives knowledge and capability for the stakeholders and users to ensure they are using the system in the most efficient way. Systemigrams and system methogolies allows for the stakeholder to gather tools to understand each other's perspectives, organizational requirements, and strategies in a participatory environment. This also can equip them with the appropriate toolset for designing resilience within the architectural structure of the entire system. These electric scooters are the innovation for the future and the public loves them along with being a sustainable approach for the cities.

Acknowledgment

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