**CHAPTER TWO**

**LITERATURE REVIEW**

**2.1 Introduction**

This chapter attempts to review literatures related to carpooling system. It starts with a conceptual clarification of carpooling down to its history, benefits and demerits. At further dives into reviewing various carpooling systems in place and conclude the chapter with a declaration of choice of programming language to be adopted for the attainment of the phenomena under investigation.

**2.2 The Concept of Carpooling**

Carpooling, also known as ride sharing, can be seen as a situation where two or more people travel together in a car. Carpooling can be well suited for work trips as there is a major movement of people from home locations to common work locations and vice versa, over relatively confined time periods. However, it is more regularly carried out on an informal basis with family and friends for other types of trips (Paterson, 2004).

Formal carpooling schemes tend to be site-based in that they focus on a single workplace as the destination, with staff commuting from multiple origins (i.e. their home locations). Participants can then be matched up with others from similar origins so that they can travel to the same destination (the workplace) together. Such schemes work well when the number of employees at the organisation is high, there are staff travelling long distances to get to work, and the initial mode share for car driver trips at the organisation is high (DeGruyter, Rao & Meiklejohn, 2005). However, site-based schemes can become less successful when there are other travel alternatives available (i.e. public transport), there are lower numbers of staff at the organisation, there are staff who are not paying for the use of their vehicle, and where the initial mode share for car driver trips at the organisation is low.

Huang et al., (2000) perceives it as the sharing of transportation to work or school in a private vehicle with other workers or students. Alongside these definitions, there exist different types of carpoolers. Teal (1987) outlined three types of carpoolers: (1) household carpoolers; (2) external carpoolers who share driving responsibilities; and (3) carpool riders who do contribute the use of their vehicle to the pool and therefore only ride (technically rideshare participants).

**2.3 History of Carpooling**

Ever since the mid-seventies the carpooling has been a reoccurring concept among people employed at the same workplace or going to the same place. The open atmosphere of the seventies mixed with the political pushes for carpooling and the opening of specific carpool lanes on highways made the concept very popular and although carpooling has become less covered by the media in later years it is still very common that people form carpools, either in their workplace or via the internet (Ferguson, 1997).

Interest in carpooling has ebbed and flowed over time. Carpooling appears to come into focus as a possible mode choice, receiving widespread attention from the public and policy makers in times of favourable exogenous conditions (e.g., high fuel prices, or fuel shortages).

Carpooling was initially brought to the attention of the United States government during World War II, as one policy to help with rubber and oil shortages (Ferguson, 1997). Post war commuters essentially returned to car use and continued this practice until the next crisis of oil which happened around 1970s.

This crisis was once again revolved around issues with oil supply; taking place in the mid 1970’s. This was caused by political disruptions that led OPEC (Organization of Petroleum Exporting Countries) to take control of the international market supply by imposing an embargo against Western Europe and the United States (Ferguson, 1997). Once the crisis subsided by the early eighties, carpooling once again appeared to disappear from the policy makers and public’s attention (Ferguson, 1997). In fact, carpooling experienced the most shocking denouement, particularly after having done better than all other alternatives to driving alone in the immediately preceding decade (Ferguson, 1997). For example, between 1980 and 1990 there was a decline in carpooling from nearly 20% to 13% (Ferguson, 1997).

Most recently from 2008 onward, resurgence in the desire for alternative forms of transportation has re-ignited interest in carpool initiatives. Evidence of this trend is exhibited in the statistic that between 1996 and 2006, there was an increase of Canadian commuters traveling as passengers (6.9% to 7.7% respectively) (Buliung et al., 2009). It is difficult to pinpoint the single reason for this new appreciation for carpooling. However, one may hypothesize that concern for the environment, namely, the production of carbon emissions and climate change, is stimulating interest in carpooling. Just as likely is the possibility that rational decision making around the rising cost of auto ownership and use is giving rise to some interest in carpooling and ridesharing. Since 2008, however, the North American economy has headed into a recession. Reductions in personal capital could produce increased interest in cost-reducing travel initiatives like carpooling, although it remains too early to tell. Among the array of possibilities for moving the carpool formation process along, governments and others are experimenting with on-line systems designed specifically for carpooling, and systems that were designed for other purposes, like social networking, that also facilitate the production of connections between people, with a view to sharing mobility (Christopher, 2012).

**2.4 The Environmental Importance of Carpooling**

Calvo et al’s (2004) asserted that, the increased human mobility combined with high use of private cars increases the load on the environment and raises issues about the quality of life. The use of private cars lends to high levels of air pollution in cities, parking problems, noise pollution, congesting and the resulting low transfer velocity (and thus inefficient use of public resources). Environmental improvements from implementing car-pooling are considered more so as a general side benefit (Smith, 2006). However promoting environmental aspects could be another positive motive along with social frustrations at lengthening travel times (Buliung and Soltys, 2009; Smith, 2006) for establishing carpooling programs particularly to the success in politically progressive area and many university campuses.

Carpooling clearly has a wide range of positive impacts. It fulfills a need for both drivers and passengers. Obviously, the main consideration carpoolers have in mind is financial. In the United States, car maintenance, repairs and gas account for approximately 18% of an individual’s monthly budget (Consumer Expenditures, 2009). Sharing rides also means sharing costs for drivers. And saving money on such a large chunk of personal budget turns out to be really attractive. On the passengers’ side, carpooling guarantee an affordable and time-saving alternative to public transportation. We have a win-win situation.

Research conducted by the Sightline Institute in 2008 shows that for an average car with a single driver, the amount of carbon dioxide (CO2) emitted per passenger per mile is 1.1 lbs (Peterson, 2004). The indicator goes up to 1.6 lbs of CO2 per passenger per mile for SUVs with solo drivers. A 2012 report by the US Environmental Protection Agency revealed that light-duty vehicles are the source of nearly 25% of the country’s greenhouse gas emissions (Peterson, 2004). Consequently, cutting on this significant source of emissions is crucial. For that matter, carpooling tackles a major environmental issue. Some institutions put the emphasis on the reduction of carbon print linked with ride-sharing, with tools designed to calculate savings on gas and emissions for carpoolers.

**2.5 Factors that Influence Carpooling**

Carpooling requires the public to make changes to their commuting behaviour. It is, however, difficult to alter people’s behaviour, and changes in travel behaviour usually require strong support from the business community and planning organizations (Meyer, 1999). This section discusses factors that influence carpooling.

Stevens, (1990) posited that, understanding the personal motivations to carpooling can greatly assist in steering carpooling schemes towards success. For example, promotional efforts can be much better targeted when the motivation for carpooling is known, as will other aspects of a carpooling scheme such as the provision of incentives. His findings revealed that motivational factors most commonly mentioned in the literature included:

1. To save money.
2. To help the environment.
3. Presence of parking restrictions or a lack of parking.
4. To reduce traffic congestion.
5. Presence of priority parking.

Whilst helping the environment was seen as a common motivation to carpool, this should be treated with caution since it is ‘socially unpopular’ to not state that one is helping the environment by carpooling. Indeed, it is possible that helping the environment has little or no impact on people’s motivations to carpool (Stevens, 1990). This is consistent with findings by Ledbury (2005) who states “only a small proportion of target audiences would ‘buy into’ the environmental and social benefits; the main motivation for people to car share will be personal financial gain.”

Also, Christopher (2012) outlined the factors that influences carpooling as either internal or external. He opined that internal factors (those that are internally specific to carpooling schemes) most commonly mentioned in the literature that make carpooling schemes successful included:

1. Marketing and promotion of the scheme.
2. Support from senior management.
3. Reimbursement of parking charges for carpoolers.
4. Provision of priority parking for carpoolers.
5. Efficient management of the carpooling scheme through a dedicated coordinator.

External factors (those that are likely to occur regardless of whether a carpooling scheme is set up) most commonly mentioned in the literature included:

1. Presence of High Occupancy Vehicle (HOV) lanes.
2. Lack of parking.
3. Absence of convenient alternative modes.
4. Increase in petrol price.
5. Having the carpooling scheme as part of a wider package of initiatives.

It is therefore important to ensure that the internal factors mentioned above are incorporated into the design of any carpooling scheme to ensure a greater level of success. It is also important to recognise the existence of any external factors that may impact on the success of a carpooling scheme, and to ensure that the scheme takes full advantage of these external factors, where possible (Christopher, 2012).

**2.6 Disadvantages of Carpooling**

The most common potential disadvantages of carpooling schemes mentioned in the literature included; people switching from public transport to carpooling, thereby reducing public transport patronage; additional travel time spent picking up and dropping off carpooling partners and use of car by other household members during the day (Christopher, 2012).

Public transport operators may consider carpooling as competition that can potentially reduce patronage. For example, in the early 1970s, express lanes were made available to carpoolers in North Virginia, resulting in 30 percent of the people carpooling being actually previous bus users (Ritchie & Richardson, 1979). Furthermore, during the early 1990s in Melbourne, around six percent of carpoolers using a new transit lane were previous public transport users (Sweetland, 1993). However, reduced patronage on public transport may be in fact beneficial if services are over capacity during peak times, since capacity could be ‘freed’ up which would otherwise be very expensive to provide (Cairns, Sloman, Newson, Anable, Kirkbride & Goodwin, 2004; Rose, 2006).

Whilst it is likely that additional travel time will be associated with picking up and dropping off carpool partners (Victoria Transport Policy Institute, 2005; Sweetland, 1993), there will still be a reduction in Vehicle Kilometres Travelled (VKT) by the carpooling group overall. This is because every member of the carpooling group will not be making the full journey that they would have made before when they were driving alone. Despite this, it is still important to recognise that the need to make detours to meet carpoolers may be a potential constraint, resulting in some people being deterred from carpooling.

Also, Christopher, (2012) in his work opined the various concerns and constraints related to carpooling with their possible solutions. The summary is presented in table 2.1

**Table 2.1 Concerns/constraints related to carpooling and possible solutions**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Concern/constraint** | | | **Possible solution** |  |
|  | Fear of | travelling with | | Hold postcode lunches in workplace |  |
|  | strangers | |  | Use case studies with photos of participants |  |
|  |  |  |  | Suggest trial period before committing to an arrangement |  |
|  | Reduced | flexibility in | | Stress that participants do not have to carpool everyday |  |
|  | working hours | | | Provide a guaranteed ride home program |  |
|  |  |  |  | Focus on the benefits of carpooling, particularly financial, |  |
|  |  |  |  | together with any incentives provided for carpoolers |  |
|  | Uncertainty | | over legal | Reassure potential participants through promotional material |  |
|  | liability | or | insurance | Outline potential liability/insurance implications to participants |  |
|  | implications | |  | Use disclaimers as appropriate |  |
|  | Having to be reliant on | | | Provide guidance in promotional material on setting up |  |
|  | others |  |  | successful carpooling arrangements |  |
|  |  |  |  | Provide a guaranteed ride home program |  |
|  | Loss of privacy | | | Explain how any information collected will be handled |  |
|  |  |  |  | Collect information only necessary to carpool matching |  |

**Source: Christopher, (2012).**

Furthermore, Cairns et al (2004) reports that there is potential for a greater use of cars that have been left at home by other household members. However, the scale of this has shown to be relatively small at an extra 10km per week per family (ibid.), meaning that it is highly likely that there would still be an overall reduction in VKT.

**2.7 Review of related literatures**

**Jayride**

This is a free, easy to use New Zealand based carpooling website, that defines the carpooling service as ‘rideshare’, giving it a friendly clarification for new comers. Getting in contact and addressing the possibility to a website branch from this site could both aid community identity and offer an easy free to use means for car pooling.

**Carpooling.co.in**

It is an Indian carpooling site established in 2008 and is one of the most successful Indian carpooling website (Carpool.co.in, 2011). It has about 1300 members and many carpools. It has not been marketed as well as it should have and thus the number of people aware of such a site is less.

**Waze.com**

The application is a social mobile application provides the navigation based upon the condition of road. It gets better, the more you drive and is 100% powered by users (Waze, 2009). Waze is developed by Israeli start-up Waze Mobile for mobile phones. The platforms which Waze supports are Android, Symbian , Blackberry, Windows Mobile and iOS. Application is a realtime application , it takes information from users’ driving time and provides routing with real-time traffic updates. The information about the route, map data and other conditions regarding road is gathered from the users using this service, thus it is a free application to download and use. The users of this service, can also provide additional information, like, hospitals, landmarks, traffic jams, accidents, etc (Waze, 2011).

Waze is available for use in every part of the world, with some countries having full basemaps and others still needed to be updated by the users. Currently Waze has a complete base map in the United States, Canada, France, Germany, Italy, Netherlands, Belgium, Israel (claimed to be the best map for that country), Ecuador, (parts of) Argentina, and Panama, but the company has plans to make it available in other countries in Europe and elsewhere (Waze, 2009). The Waze provides additional benefits such as, sending anonymous information, including speed and location, back to its database to improve the service, along with turn-by-turn voice navigation, real-time traffic, and other location-specific alerts. The Waze community is able to detect mapping and navigation errors, as a result of crowdsourcing which is easily achieved by running the app while driving. It uses gaming conventions such as cupcakes for involvement of users in providing more information to the Waze (Waze, 2009).

**Zimride.com**

Logan Green, Matt Van Horn and John Zimmer, initiated Zimride in year 2006. Zimride was the first online carpooling site to integrate Facebook to show potential riders who might be riding with them (Tejas, Gauresh and Parimal, 2012). It received $250,000 from Facebook in 2008 and is profitable with millions of rides served. The major drawback of Zimride is that, it is only available in US and doesn’t have a mobile application but is still one of the leading ridesharing sites in US.

**Zebigo.com**

Zebigo is an on-demand, ride share matching site. Basically it keeps track of two people with respect to location and time. It is a dynamic ridesharing system. The information which a user provide during the trip is only available to the users who are paired with the user. Zebigo manages the monetory transaction between the driver and hitchhiker (Tejas, 2012). Zebigo is another website which primarily focuses on US for its user base. Although there is a lot to be learnt from the existing initiatives, the project is unique in that it rectifies the collective shortcomings of the present products.

**Lyft**

One of the biggest names in the ridesharing space, Lyft lets riders instantly and easily connect with drivers to get to their destination. It is an online based app that is user friendly, secure and fun to use. They offer a linking service that connects riders on similar routes to drop your rate and reduce the impact of your drive.

**Getaround**

[Getaround](https://www.getaround.com/) describes itself as peer-to-peer carsharing and rental. It’s an easy app that lets people share their car instead of letting it sit idle in the garage. Similar to a carshare program, but with the added bonus of connecting with neighbors with a range of cool cars. The app helps find and unlock the cars easily, so the pooler can get on the way quickly. It is available in San Francisco, Berkeley, Oakland, Portland and Washington D.C.

**Jekalo**

Jekalo is the only Nigeria based carpooling system in place. It is an online platform where people can share ride based on similarity in route. Within its scope, it ensures convenience and affordability. Therefore, to increase awareness and adoption of the system in the country, it is the responsibility of every stakeholder to contribute their quota towards realizing this objective and therefore, this study is not an exception. In this study, web based approach will be used to develop a carpooling system.

**2.8 Choice of Programming Language**

The programming languages used in developing this application includes PHP, HTML, CSS, Apache and MYSQL database. PHP is a [programming](http://en.wikipedia.org/wiki/Scripting_programming_language) language suitable for web development. PHP has gained popularity in recent times, and it is one of the forerunners in the Open Source software movement. Its popularity is derives from its C-like syntax, with its speed and simplicity. Apache and MYSQL are the most widely used open source web server and database server respectively.

**2.8.1 PHP**

PHP is a widely used general purpose server-side scripting language that is especially suited for Web development and can be embedded in HTML. It allows Web site to be truly dynamic. PHP stands for: PHP Hypertext Preprocessor. PHP’s popularity continues to increase as businesses, and individuals everywhere embrace it as an alternative to Microsoft’s ASP language and realize that PHP’s benefits most certainly outweigh the costs (Glass, et al, 2004).

**2.8.2 HTML**

HTML serves as the backbone of all webpages, hence one of the core technologies in use on the internet today. It is a standardized markup language, used for structuring and formatting web contents. Its structure tool supports elements like heading, text, links, coloring, etc (Raggett, 2008). Regarding its evolution, it has experienced several development and advancement. At its inception, it started as HTML 1.0 and now we have HTML 5.0. The core aim of this advancement is to improve the markup of the language to support latest multimedia (Peter, 2013).

Regarding its usability and implementation, HTML uses more than a hundred different tags to reference and identify contents. These tags are the elements that provide instructions about how the text would be displayed and in what format. The tags are represented by open and close brackets within which the content is passed (Hickson, 2012). More so, its markup language nature makes it not to require a compiler, special editor or even server. Hence, it can be written and modified in any text editor. Therefore, the perfection in usability of HTML strictly depends on number of tags the developer knows. However, while HTML forms the core of all web pages on the internet, it is important to understand that it alone isn’t enough and designers may need to use other platforms and programming languages too to come up with a brilliant page or site (Martin, 2015).

**2.8.3 CSS**

CSS or Cascading Style Sheets is rather a markup language (Meyer, 2006). On the same note, Niyot (2012) perceives Cascading Style Sheets as a style-sheet language that allows web developers to “set it and forget it”. HTML paired with CSS, allows a programmer to define the look and format of multiple webpages at once. Similarly, Etemad (2010) asserted that, CSS is a markup language that can be applied to several types of documents including Plain Extensible Markup Language (XML) documents, Scalable Vector Graphics (SVG) documents as well as XML User Interface Language (XUL) documents. He further stated that, most websites across the world uses CSS as the platform for creating visually attractive web pages for web applications.

Some of the elements which CSS has an impact on include font size, font style, the overall layout, the colors and other design elements. The language’s syntax is pretty similar to that of HTML and XHTML, which work well in synchronization and combination of one another. The Style sheets included in CSS consist of a selector and a declaration (Martin, 2015). The former decides the element(s) on which rules are to be applied, whereas, the later decides the action to be taken on the element(s). The simple syntax of the language uses several English language words to define the styling properties (Bos, 2009).

These two languages (HTML and CSS) provides the basic structure and styling tool for creating static and dynamic web pages. However, client side scripting comes to play when there is need to create more advanced and complex web pages in a web application (Martin, 2015).

**2.8.4 WAMP SERVER**

WAMP Server is a merging open source software installer package for Windows. It is a powerful suite of application that imitates the web server on a local machine (Glass, et al, 2004). Due to the time taken and problem encounter when Apache, PHP, and MySQL are separately installed, WAMP Server has the concept of easy installation. WAMP Server has a fully featured of Apache Web Server, PHP Script Language, MySQL Database, PHPMyAdmin Database Manager, e.t.c which are easy to setup (Glass, et al, 2004).

**2.8.5 MySQL DATABASE**

MySQL is a popular choice of database for use in web applications, and is a central component of the widely used LAMP open source web application software stack—LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python" (Glass, et al, 2004). The MySQL Database powers the most demanding Web, E-commerce and Online Transaction Processing (OLTP) applications. It is a fully integrated transaction-safe, ACID compliant database with full commit, rollback, crash recovery and row level locking capabilities. MySQL delivers the ease of use, scalability, and performance that has made it the world's most popular open source database.

MySQL is the database construct that enables PHP and Apache to work together to access and display data in a readable format to a browser. It is a Structured Query Language server designed for heavy loads and processing of complex queries. As a relational database system, MySQL allows many different tables to be joined together for maximum efficiency and speed (Glass, et al, 2004).

**References**

Bos, H.L, (2009). Cascading style sheets: designing for the Web (2nd ed.). Harlow, Essex, England: Addison-Wesley. [ISBN](https://en.wikipedia.org/wiki/International_Standard_Book_Number) [0-201-59625-3](https://en.wikipedia.org/wiki/Special:BookSources/0-201-59625-3).

Buliung, R., Soltys, K., Habel, C., & Lanyon, R. (2009). The “Driving” Factors Behind Successful Carpool Formation and Use. Transportation Research Record. In press.

Cairns S, Sloman L, Newson C, Anable J, Kirkbride A & Goodwin P (2004). Smarter Choices – Changing the Way We Travel. Final Report to the Department for Transport, London, UK. Chapter 9 – Car sharing schemes. [Online] Available at: www.dft.gov.uk. Accessed on 15 December 2005.

Calvo, W.R, de Luigi, F, Haastrup, P & Maniezzo, V (2004), 'A distributed geographic information system for the daily car pooling problem', Computers & Operations Research, vol. 31, no. 13, pp. 2263-78.

Carpool.co.in, 21/10/2011, http://www.carpooling.co.in/worldmap/home.php

Christopher, D (2012) Investigating a CBD-wide carpooling scheme for Melbourne. 29th Australasian Transport Research Forum. Department of Infrastructure, Melbourne VIC, Australia

Consumer Expenditures report (U.S. Dept. of Labor, U.S. Bureau of Labor Statistics, 2009)

DeGruyter C, Rao D & Meiklejohn D (2005). Tools for Travel Behaviour Change. Presented at the 28th Australasian Transport Research Forum. Sydney, Australia.

Etemad, E. (2010). ["Cascading Style Sheets (CSS) Snapshot 2010"](http://www.w3.org/TR/css-2010/#css). [World Wide Web Consortium](https://en.wikipedia.org/wiki/World_Wide_Web_Consortium).

Ferguson, E. (1997). The rise and fall of the American carpool: 1970-1990. Transportation, (24)4, 349-376.

Glass, M. Scouarnec, Y. L. Naramore, E. Mailer, J. Stolz, G. and Gerner J. (2004) Beginning PHP, Apache, MySQL Web Development. Indianapolis, Indiana: Wiley Publishing, pp. 233-241.

Hickson, I.(2012) ["HTML Is the New HTML5"](http://blog.whatwg.org/html-is-the-new-html5)

Huang, H., Yang, H., & Bell, M. (2000). The models and economics of carpools. Annals of Regional Science, 34(1), 55-68.

Ledbury M (2005). Overcoming the barriers: how to steer car sharing schemes into a successful future, in Local Transport Today, News Extra 17 February 2005. pg. 13. UK.

Martin, E. (2015) How Basic Web Development Languages HTML and CSS work. Entrepreneurial Insights.

Meyer, M. (1999). Demand management as an element of transportation policy: using carrots and sticks to influence travel behaviour. Transportation Research Part A, 33(7), 575-599.

Niyot, T. (2012). ["Incorrect MIME Type for CSS Files"](https://developer.mozilla.org/en/Incorrect_MIME_Type_for_CSS_Files). [Mozilla Developer Center](https://en.wikipedia.org/wiki/Mozilla_Developer_Center). [Mozilla](https://en.wikipedia.org/wiki/Mozilla).

Paterson D (2004). Car pooling – targeting for success, presented at the 27th Australasian Transport Research Forum. Adelaide, Australia.

Peter, B. (2013). ["Netflix coming to HTML5 just as soon as the DRM ducks are in a row"](http://arstechnica.com/information-technology/2013/04/netflix-coming-to-html5-just-as-soon-as-the-drm-ducks-are-in-a-row/). Ars Technica.

Raggett, D., (2008). HTML Evolution and Usage.

Ritchie S & Richardson A (1979). On the Demand Implications of Priority Lanes. Department of Civil Engineering, Monash University. Victoria, Australia.

Rose S (2004). Assessing the Effectiveness of TDM and Land Use Strategies for a Corridor Study in the Puget Sound Region, in TRB 2003 Annual Meeting CD-ROM. DKS Associates, Oakland, Canada.

Smith, M.G (2006), ‘Convincing Commuters to Carpool’ Environment, vol. 398.

Stevens K (1990). Private communication with Manager Legal Services, Executive & Legal Branch, Corporate Resources Division, Department of Infrastructure. Victoria, Australia.

Sweetland A (2005). Private communication with Director of Operations, NuRide. U.S.

Teal, R. (1987). Carpooling: Who, How and Why. Transportation Research,21A(3), 203 214.

Tejas, T, Gauresh, P. and Parimal D., (2012) Dynamic Ridesharing Using Social Media. International Journal on AdHoc Networking Systems (IJANS) Vol. 2, No. 4, October 2012

Waze Iphone App, 6/8/2009, http://news.cnet.com/8301-13772\_3-10305132-52.html

Waze Now Available Internationally, 10/11/2009, http://www.waze.com/blog/waze-now-availableinternationally/

Waze: Way to Go, 21/10/2011, http://world.waze.com/about/about\_us/