

BRASILIA METROPOLITAN REGION: EV MOBILITY: OPORTUNITIES AND TRHEATS.

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ABSTRACT

The field research of this paper was developed at the end of 2018 to survey EV mobility. Qualitative trends were based on indicators developed by consulting firm research reports, quantitative figures were developed using fuel cost values of 4,5 R\$/liter. The analysis was divided in three steps: a) evidence of public planning, b) evidence of industry and industry 4.0 systems, and c) evidence of market. Main results of the research are: a) no electric mobility planning was found form institutional evidences. No planning for Smart City initiative in Brasilia, b) no evidence of electric systems and innovation are developed or planned (i.e Industry 4.0 automated drive systems). c) opportunities in market found are: main metropolitan area is worth some three million inhabitants, almost seven including surrounding metropolitan areas with millions vehicles to be converted to ev, public transportation and urban delivery most interesting niches of market; threats: no fiscal incentives and infrastructure of electric posts able to sustain car supply, no offer for electric/hybrid cars and conversion kits. This part of an external strategic analysis give the orientation to develop urban transportation vehicles and buses (public transportation) taxi, buses, vans, light trucks and motorcycles ,used for delivery, offers. These are interesting segments mostly because of increasing operational cost mainly due to gasoline costs.

Keywords: *Industry 4.0, Smart City, Mobility, Electric Vehicles - EV*

1. INTRODUCTION

Although electric car market is rising in Europe, USA and China, Brazil still stands one step beyond and still need to improve some sustainable mobility matrix in the metropolitan regions. Brazil don't follow the climate change governance global trend for cities and motor vehicle changes and control. The number of electric car and vehicles in Brazil is numbered in a few thousands, been several millions car driving into Brazil Cities.

Policy and political economics in Brazil today doesn't reduce bottom necks for this business or incentive the business, meanwhile the cost of fuels and recent strikes that paralyzed all Brazilian logistic system alerted about great impact on mobility if such events will be replied.

Moreover the claimed best option of a flexible matrix gasoline-alcohol in Brazil depends on greatest distribution company. The price of alcohol in the network is rarely competitive.

Giving this context, are there opportunities to invest in smart cities initiative and innovation industry 4.0 (i.e. fully automated car) especially for electric vehicles EV market in Brasília Metropolitan Region (BMR) ?

Main objective of the research is to explore EV market strategic external factors in BMR. This research justifies itself because the BMR has a great number of qualified human resources to work with innovations and develop new firms in new markets. It's important to show new market opportunities like EV and mobility market for industry 4.0. It is relevant because actually Brazil depends on foreign technology, but it's possible to raise locally new products and technologies to work with the actual e future demand even to export solutions.

2. THEORETICAL DISCUSSION: INDUSTRY 4.0 AND SMART CITIES MOBILITY

Metropolitan cities development in Brazil increased dramatically during the last decades, but the increasing challenges of fast growing urban areas has been underestimated. The mobility laws and plans date 2012 claimed develop all stands and integrations between urban planning and mobility, but, in that period of time, almost fifteen years, Brazil government didn't integrate the global smart cities initiative global movement.

However the lack of public investments doesn't means lack of opportunity for private groups to develop ventures and offer to the executive market solutions. One of these was explored by UBER transforming the Brazilian taxi system, from monopoly to concurrency market.

We believe that innovation (i.e. Industry 4.0) and Smart cities strategic mobility project must start with a public strategy rather than private in Brazil, but is needed investments and strategies. To develop a strategy J. Schlick et al. (2014) focus the importance of be aware of, in industry 4.0 environment, at least of these scenarios: 1) Interoperability or to connect and communicate with each other via Internet of Things and Internet of Services. 2) Virtualization or monitor with sensor data physical processes. 3) Decentralization or enable factories to make decisions on their own, 4) Real-Time Capability: or react to the failure of a machine and reroute products to another machine, 5) Service Orientation or use the services of companies, CPS, and humans offered both internally and across company borders, 6) Modularity or flexible adaptation of changing requirements

Recently the World Economic Forum (WEF 2016) recommended 10 deep drives to develop and plan future nobility of cities: improve physical integration and connectivity between transport modes, establish industry standards on data/digital infrastructure across device types, enhance day-to-day transport management through data-based approach, promote demand-responsive shared transport, streamline regulation and management of demand-responsive solutions, introduce policies to accelerate adoption of alternative fuel vehicles, introduce policies to accelerate adoption of alternative fuel vehicles, consider possible technological and business model (r)evolutions when making, leverage corporate/institutional environments to test and showcase business, apply smart and competitive public-private financing models to fund new mobility ecosystems .

One of innovations for mobility is the phenomenon of Industry 4.0. This was first mentioned in 2011 in Germany as a proposal for the development of a new concept of German economic policy based on high-tech strategies (Mosconi, 2015). According to a Vasja et al. (2016) research, the fourth technological revolution is based on the concepts and technologies that include cyber-physical systems, the Internet of things (IoT), and the Internet of services (Ios), as well as Internet of Energy (IoE), the trend is leading toward the establishment of a communication channel for the continuous exchange of information about needs and individual situations in real time, provide value added for organizations and customers.

A PWC survey (2014) explains that, by 2020, European Industrial companies will invest 140 billion euros annually in industrial internet applications. At the same date almost 80% of these companies will have digitized their value chain with a 18% increase efficiency. Digitization of products and services portfolio is the key to sustainable corporate success.

In the report: “The industry of future”, KPMG (2106) shows that industry 4.0 is an evolution of industrial revolution that converge to a new model based on information technology strengths. The evolution from mechanization followed by electrification and digitalization now is turning to cyber – physical system that embedded networked ICT and interacts with physical processes. For KPMG the automotive industry leads the way using all disciplines encompass all interdisciplinary fields.

McKinsey & Company Industry 4.0 model factories, stressed that the industry 4.0 key of success is based on a complex management of services and after sales, resources process, asset utilization, new form of labor, inventories, quality match supply-demand and time to market.

Between other technologies the autonomous car vehicle (ACV) is one that can modify deeply mobility in cities. But in the industry 4.0 there are more opportunities to improve mobile. The challenge is understand how to link the industry 4.0 to the smart cities concept to develop innovative mobility. Smart cities and industry 4.0 one example is encouraging openness and co-creation to generate opportunities in the IoT. Other trends are: intelligent retail, intelligent logistic, intelligent healthcare, intelligent transportation, clean energy, reduce environment impact.

Smart cities are improving electric train to increase safety and reduce freight and transportation in urban areas. Metro are the more efficient and sustainable train to be developed today. Others intelligent systems are: traffic controls, automatic toll, traffic incident detection, vehicle plate recognition, intelligent bus systems. All these new technologies must be developed switching the cost and impact of fossil energy production to electric energy. Use of electric vehicles encompass goals of reduce cost, increase efficiency and reduce environmental impacts.

Use of intelligent systems in urban mobility allows the use of a graph database to calculate “optimal” transportation routes with respect to the contextual necessities of a urban personal trip or a transportation of a production asset. This is done by integrating contextual data by exploiting an affordance-based routing approach.

According to Deloitte (2015) projects to be developed in a Smart City are: user –centered mobility, integrated and intelligent transport, pricing and payments, automation and safety, public and private innovation. So we can summarize that Smart City Planning involve this view of mobility in the age of industry 4.0:

- Integrated development & spatial planning
- Transportation & traffic strategy
- Environment & public safety

Arthur D. Little and the UITP study (ARTHUR D. LITTLE 2014) conducted in 84 cities around the globe stressed again strategic directions for cities and have identified four key dimensions to be considered by mobility actors in cities seeking to put in place sustainable urban mobility systems:

- Visionary Strategy and Ecosystem

- Mobility Supply (solutions and lifestyles)
- Mobility Demand Management
- Public Transport Financing

A successful urban mobility strategy needs to consider the interests of both public and private transport, passenger mobility and goods mobility, motorized and non-motorized transport and vehicles that are parked as well as those on the move. The development of a master plan with a long-term horizon, which lays out responsibilities and allocates resources, together with the introduction of clear governance mechanisms for monitoring and updating is also a must. Meanwhile, a budget plan will ensure that the investment undertaken synchronizes with existing funding streams (ARTHUR D. LITTLE 2014)

3. METHODOLOGY

The paper developed for BMR is an exploratory research to understand which opportunities and threats for this market and suggestions for entrepreneurs of EV market. The research method has three step defined, using the report method seen in great consulting firms above in the theoretical reference section as:

- a) evidence of planning,
- b) evidence of the system, (both based on bibliography and assessments) and
- c) evidence of market opportunities for smart cities mobility with industry 4.0 features.

This last step was developed with a field research to understand electric vehicle - EV market opportunity. This third and final steps was developed with open interview, collect of pictures and information, open questions to some users.

4. RESULTS AND DISCUSSION

4.1 Step 1 – Smart City. Evidence in BMR urban planning

There are three administrative levels in Brazil (federal, states and municipalities) and the Federal District that is an entity with a rank of state level and with special rules for Federal District administrative divisions. However, there is a fourth form of territorial organization for which it was not yet given proper constitutional treatment: the metropolitan areas (CAFFÉ ALVES , 2001).

The metropolitan municipalities have an autonomy eventually constrained, but a conditional independence from the origin, the possible establishment of metropolitan areas, under the constitutional provision, when there are objective conditions that justify the measure (CAFFÉ ALVES, 2001). In addition, municipalities lack of funds and especially funds for developing metropolitan services, because it is the Union, and secondary the State, that provide the financial support of municipality budget. In other words there is low autonomy for the municipality to provide its own financial needs.

The metropolitan area of Brasilia fits by the supplementary law n. 94 of 19/02/1998 establishing the RIDE / DF, constituted by the Federal District and 21 municipalities of Minas Gerais and Goiás States. Another spatial area, defined only by some research institutions - Metropolitan Area of Brasilia or AMB - includes the Federal District and the municipalities in the immediate surroundings that are only 10 among the 21 municipalities. In 1999, the AMB definition was adopted in the study by IPEA / IBGE / UNICAMP " Characterization and Trends of Urban Network in Brazil ." Law 13.089/2015 called Metropolitan Statute finally defined metropolitan areas boundaries in Brazil.

So recently the RIDE-DF suffered various modifications. First was expanded to 33 municipalities and finally with the project of law of 4th of December 2018 was created the Federal District Metropolitan Area which includes all municipalities on the border of Federal District. State government of Goiás, DF and Minas Gerais must approve the creation of the area. The objectives of these changes are to grant new funds to new created spatial entities.

The Smart City movement wasn't included in that institutional discussion so no evidence of institutional programs or development for that was found till today. About the relation Smart Cities – Mobility also there is no evidence of policies.

The Law 12.587/2012, or *Política Nacional de Mobilidade Urbana* (Urban Mobility National Policy) it is now mandatory to be developed within three years urban mobility plans for human settlement of more than 20.000 inhabitants. Brasilia metropolitan area, have already a transportation plan (*Plano Diretor de Transportes Urbanos - PDTU*) that decided in 2009 the future plan implied because of the new policy. The PDTU plan must be upgraded in 2014 and must be organized as well as Mobility Transportation Plan because of the law 12.587 / 2012 above mentioned.

Theoretically main goal of Brazilian urban mobility policy is to reduce transport matrix dependence on cars and trucks. Walking and cycling too are considered form of transport to

be strengthened planning strategy and sustainable environment safe. Railroad transport and new public transport systems as Bus rapid transit (BRT) are planned all over metropolitan areas for the next years as sustainable solution. So recently Urban policies in Brazil are moving from a focus on transportation and developed, instead, focused plans on the human right to “equitable access to opportunities”.

4.2 Step 2 : EV mobility and Innovation system. Industry 4.0

Due to political articulation, financial resources will not always be reworded or redistributed in terms of their formal or textual configuration. Often carried out a territorial financial redistribution only the change in the next four years will embodying new plans.

Thus no relation between planning smart cities and industry 4.0 is still working in BMR especially EV mobility and systems developing. The case of Uber and Uber-like services introduction is one that explain how innovation could benefit costumers. Uber works with smart phone applications from 2014 in Brazil. Lei nº 5.691/2016 allow Uber to work in Brasilia legally in spite of opposition of taxi drivers that owned monopoly of public passengers transport and lost it since 2014. The number of Uber registered in Brasilia claimed are ten times the total 7 thousand registered. The entering of Uber is interesting because of innovation policy of this company that works with apps, automated vehicles and EV all over the world today and could innovate more in the Brazilian market and in BMR.

Another opportunity is the cost and distribution of energy in Brasilia. This is not so bad and not very expansive. The actual cost of 0,60 R\$/kWh or, at the actual change, 0,15 \$/kWh that is above 0,13 \$/kWh as average residential in USA and 0,107 \$/kWh average of all sectors. That means that at the actual cost of gasoline 4,2 R\$/L or more or less 1,03 \$/L the use of electricity inside of gasoline will be save 4/5 of total transportation cost if total transportation could have been switched into electrical.

Threats could be a short offer of electric posts and to establish a electric network for vehicles. There were three posts in shopping centers (Iguatemi, Brasilia Shopping, Gilberto Salamon) and one in Hotel district (Brasilia 21). One in University of Brasilia (Campus Darcy Ribeiro) and one that will be installed in 2019 in University of Brasilia (Campus Gama). Few more (three) are distributed among public agencies (CAESB, CORREIOS and Ministry of “Minas e Energia”) mainly with assistance of Itaipu project. Only in University of Brasilia there is a rapid charging electro charger.

4.3 Step 3: Market analysis

There are no statistics every year from the public agency traffic department of Brasilia - Detran, about electric cars in Brasilia. It was estimated that no more that few hundred drive the city, most are private and some public most of them, like public authorities, doesn't drive at all. In the other hand, Detran points out that at the end of July 2018 there are 1,7 million vehicles only in Federal District and a raise of 3,3% in the last year for a population of more than 2,7 million people. IBGE, the central agency of Brazil statistics claims that the RIDE/DF population count more than 4,5 million people.

So no statistics for total vehicles in BMR, and then it's difficult to estimate the total vehicles because de conurbation is very strong and part of mobility between Federal District and part of Goiás Estate is developed with vehicles registered both in Federal District and Goiás. Thus, considering 1,8 million people de difference between Federal district and RIDE/DF and Federal District we have some 0,5 rate of cars in the Federal District. This rate gives 0,9 million cars for people living outside Federal District . So BMR total vehicles sum roughly 2,2 million cars of what 1,3 million cars in Brasilia and 0,9 million cars outside.

We consider that the medium trip in Brasilia is more than a trip in compact cities, like Europe, because Brasilia is fragmented with several urban nucleus far one to other some 20 km average. It means that a medium electric battery charge of 120 km. is a little poor. A medium trip of more than 150 km is more realistic. The solution could be hybridization of the entire fleet. A hybrid vehicle can use electric and gas power and never became out of energy.

We estimate, some evidence in the press claimed the same, that an electric car must drive more than 60.000 km to return the extra investment in one year at the actual prices in Brazil. If the strategy chosen is to convert fuel cars there is some difference between electric and hybrid conversion. This is because there is a rate of efficiency between gasoline to electric, for us an average of 1/5, and between gasoline and hybridization, we calculate an average of 1/3. This average was developed research internet sites and articles that gives information and calculate how affordable and interest is to use electricity.

The field research included some people survey to understand how interesting the opportunity to switch electric mobility matrix. The survey includes two dozen people: academics, students, taxi drivers and ordinary people between September 2018 and November 2018. The survey was developed without questionnaires only to discuss pros and cons of EV.

This field enquiry reports poor interest on electric mobility and alternative mobility. This could be explicated by lack of information and governmental no incentives and no offers. There is more interest in reduce gasoline costs and switch into GLP, but the cost of electric car and no electric post are the main reason to lack of interest to electric cars.

Related to Industry 4.0, the field research point out that there now developed in Brasilia new mobility systems of sharing bicycle and other light electric vehicles. Two initiatives are ongoing: from the company named Yellow and Green. The model of sharing is free into a space. Uber too is claimed to develop another offer in 2019.

If these systems will develop others and other companies or partnership will follow, is possible a great development of sharing vehicles, new form of applications and software to be used with Smartphone. This could happens also for cars. This will develop increasing interest in Industry 4.0 in BMR.

4.4 Analysis of overall results – Threats and opportunities

We can summarize threat as following for BMR:

- No governmental strategy in Smart Cities and Industry 4.0 ongoing
- No innovation ecosystem for EV and electrical mobility
- No mobility supply of electric posts.
- No public transport financing.
- No incentive to sell EV vehicles. Interest to move to EV is calculated for use starting from some 60.000 km.

In the other side opportunities are the following:

- Public transport based on gasoil and gasoline matrix (no electric buses and trains). Very limited metro and BRT electric network.
- Great number of possible customers (uber, uber-like, taxi and logistic operators) starting from productive segment.
- No concurrency (automotive, conversion kits, mechanics) relative easy to enter into market and develop startups in BMR.
- High cost of fuels (increasingly every year) that imply increasing

logistics costs for all and need to seek solutions.

- Is possible great reduction of environmental impacts with EV. It could be considered as overall CO2 reduction

We can also underline the following geographical factors too: a) BMR was planned for car, Brasilia sprawl is well documented b) Lack of public transportation offer, c) Brazilians culture developed to use private vehicles in urban mobility, d) increasing number of inhabitants and high rate of translate from suburbs.

So this part of a SWOT matrix points out good chances for smart cities initiative and industry 4.0, but depending of public strategies. The analysis also underlines opportunities in these markets: low emission buses and develop metro network (both underground and BRT), individual public transport (taxi and scholar vans) and urban goods transportation (light charge EV). These markets could be easily linked to Smart Cities initiatives and Industry 4.0 development in BMR.

5. CONCLUSION

This first exploratory research was based on three steps: evidence of planning, evidence of system and evidence of market. Smart Cities Mobility and his link with Industry 4.0 aren't present in real planning and haven't evidence to have a system in place.

The field research underlines market opportunity for public and urban transportation following the Uber increase as innovation paradigm and best practice. In spite of lack of fiscal and public incentives EV could be an interesting market in the next future. The research pointed also many threats like no infrastructure of electric posts able to sustain car supply, no offer of cars and conversion kits, little offer of EV for public transportation.

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