Using big data in smart cities transportation systems

Olga Bulatova

Abstract. This article examines the process of city digitalization and transport infrastructure in particular. Smart cities use a large amount of data to meet citizen’s needs, so Big data management is a priority in the “Smart City” concept implementation. The goal of this article is the transport infrastructure optimizing with the Big data usage. Various sectors of the economy use Big data to optimize the processes of production and services sale, track trends and directions of development, launch new products, expand the range of services provided, attract new consumers and make various strategic decisions. To build an optimizing model, for example, passenger transportation modes, a transport company will need to integrate a wide range of information about passengers, their place of residence/work and additional movements, transportation costs, etc. A transport company can combine real-time fare information, GPS and weather data, as well as employee productivity indicators to predict which routes will be most popular. This article presents the algorithm of making strategic decisions in transportation system based on Big data. This algorithm could make effective the data integration process, launch of pilot projects, creation of new tools for the clear vision of a specific goal. One of the key advantages of Big data and Data analytics is a detailed consideration of the various components of the project during its development and implementation.

1 Introduction

Nowadays new technologies are injected in resident’s lives. Smartphone became a source of city information: public transport routes, traffic jams, safety alerts and different news [1]. The researches show that the Smart city transformation starts not with technologies, but with people for making good quality of their life. If we are talking about Smart cities we mean that the city use citizen’s data for developing infrastructure that will meet their real needs. Smart cities are perspective, progressive and high life quality territories. Smart cities provide social and technical innovations. Therefore, for the transformation to the Smart city Big data management is in priority. Citizen’s data generated from different sources: smartphones, detectors, cameras and so on. The value of this data is very big. Big data analytics is the process, containing data collecting, data examine, and data organization for different relations and patterns definition for searching the most effective solutions.
Common analytic instruments are useless in the field of Big data because of its huge amount. First companies who started to use Big Data were Google, eBay and LinkedIn. They used Big data analytics for analytic model improvement.

The process when enterprises or the economic field use new business models, Internet of things, Big data, cloud storage and so on is the process of digitalization. Digitalization is the innovative technologies combination.

The digitalization allows providing physical indicators in digital form. This gave users the opportunity to track the process of service at any stage using a certain interface (for example, tracking a parcel). In addition, such tracking allows you to improve the quality of the provided services, create related services and new business models, which will increase the profit of companies.

City transformation influences every city services. New technologies development causes new services implementation which can meet actual user’s needs.

Big data is a term for large or complex datasets and analysis of such data to research some useful trends and logic. Big data gives new opportunities to transport infrastructure.

Big data gives users information about the movement of vehicles in real time, simplifies the process of paying for services using various devices and applications. Vehicles, in turn, provide information to operators to improve transportation efficiency, safety and speed.

New technologies are able to reduce traffic jams in peak hours, for example, by giving information, to increase public transport attraction, to create new services such as mobility as a service.

Big data creates advantages for developing new transport services that meet user’s needs and forecasting the implementation of these new services.

The present paper aims to explore new transportation service creation process based on Big data usage.

2 Data layer of Smart cities

Data layer is the base of Smart cities. We have to get this layer right for new services development. Data layer includes the next components: telecommunication system, the network, identification and data exchange (figure 1, 2). All of these components are connected by the Internet of Things. This interconnection allows data exchange between different devices.

For working with data it’s necessary to solve the next problems:

- Data exchange standards;
- Data owner definition;
- Data security mechanism and rules;
- Data storage;
- Accuracy of data;
- Data pricing

This problem have to solve on different levels. Storage and ownership – it’s the city level; accuracy, security and pricing – the national level; standards – industry level.
Every day big amount of different data is generated. It is very hard to use this data in traditional way. So collecting, storage, analysis, data exchanges requires new approach. According to researches generation data value increased in 40 times in last ten years. Smartphone became the most popular device for data generation. For the last 20 years the mobile phone have transformed from phone to computer. Smartphone provides citizens lots of city services. Thankful to the smartphone usage it could be possible to realize the Smart city concept. Nowadays in the digitalization, many different programs support the enterprises. Transport companies, even small ones, are no exception. This programs are not in connection to each other but they offer the combination of information which impossible to get just using one program. Big Data systems should combine data obtained not only from different programs that serve to perform certain functions, but also from programs that record this data in a certain way (fig. 2).
Creating or collecting Big Data usually beyond the capabilities of a single company, even if it is a large enterprise. The task and key issue for Big Data systems is the combination of data obtained not only from various types of services, but also from different firms that use them. It is necessary to collect and analyze all the information that can help in improving the efficiency and achieving the company's goals.

The process of decision making to optimize the city transportation system using big data includes the next steps (fig. 3):

- **User’s interview** is the process of goal definition. Answers on the right questions can help the company.
- **Preparation** is the process of goals identification for the project development.
- **The process stage** includes storage and data safe. In addition, there is a data selection and database creation.
- **Analysis** is the process of the main factors definition. This stage is not depend on goals.
- **The report** is transferring data to leaders for the holistic approach for goals and developing direction.
- **Action** – making a decision based on the received data.

To create a model for transportation optimization it is necessary to get a lot of information about passengers, their workplace, home placing and other geography, their costs for transportation etc. Transportation company could to combine information about costs, data GPS, weather and so on for forecasting the most attractive routes.

Data collecting and analysis is expensive process and requires a lot of time for the research. In addition, this kind of data are limited useful. Risks of bad data quality requires quality control and data correction.
3 Developing transportation service process based on Big data usage

Fig. 4. Data analytics in public transport (Victor Chang, 2021).
Each plan should solve some problems. They need leader’s attention and combine the

... from us transition includes technical and technological changes, and second, this process considered

... clear vision of a specific goal. One of the key advantages of big data and analytics is a

... launching pilot projects, creating new tools and training personnel occur in the context of a

... area (or in a region) for further data analysis for the project's behavior in larger territories.

... is possible when the strategy is implemented in a small area (or in a region) for further

... The conducted research shows that there is often an outflow of users when implementing

... a lot of data sources. Collected and stored data can be useful in new services creation for

... efficient management, high quality living, resources management. Nowadays every city has

... Big data and smart cities are two main concepts fo

... Each plan should solve some problems. They need leader’s attention and combine the

... Fig. 5. ... 4 Conclusion

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In this article, Big data management presented as a priority area in the implementation of the “Smart City” concept. A number of successful researches in this field is rising up. Big Data can rise profit gains of enterprises to 6%. Big Data can give the vision of the real working operations; make more effective forecasting, and testing new services faster. However, using Big Data is a hard approach still.

Creation and implementation Smart city transport services and applications based on Big data usage requires the following problems solutions:

- Special project models;
- Highly qualified specialists;
- Project simulation models;
- Special local authorities management

Big data could help local authorities to plan and to develop services and resources for Smart city concept realization. To achieve Big data aims for Smart cities, it’s necessary to use special tools and methods for data analysis.

In this paper suggested an algorithm to create a good plan of new transport services implementation by just necessary Data selection. Such plan provides the general specific view of the project that could be understood by leaders, operators, Data users, managers making possible them to discuss the issue. Such plan shows the most important decisions and priorities that the company should select. Before the beginning to work with the project Big Data analytics should choose income and outcome Data for the integration, to make a list of possible analytic models and instruments, creation an organization structure of the work.

Smart city transformation requires transport services transformation. By using the suggested algorithm of transport services implementation plan the process of solving such questions as investing priorities, the balance between speed, cost and Data quality, creation a possibility to solve problems ASAP will be much easier and effective.

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