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Business models to involve Stakeholders in Smart City Projects

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Abstract*: *The Smart City projects are visionary projects implemented by the Governments of respective countries. These projects are capital intensive and requires the stakeholders- the Government, the project promoter and the user or the citizen using the facility. Capital intense projects recover the money involved from the user, that makes him the sole spender for the entire project. This paper suggests the idea to make the user an involver than simple spender. Ideas like smart credit points trading among other users, smart credit points transfer earned by sharing individual resources with the community and utilities or facilities for need sharing or trading with the community can bring down the expenses of a single user and help the community as a whole.

Keywords: **Energy-as-a-service, Peer-to-peer electricity, Pay-as-you-go, *data sharing***

I. INTRODUCTION

The Smart City Project is the dream project of many nations that utilizes the resources available effectively and efficiently. Projects these days comes with sustainable ideas that uses the captions-Reduce, Reuse, Recycle. Resources are becoming scare every day and sustainable measures play important role in acquiring them.

The lack of stakeholder alignment or involvement always affects the ability to build or operate or even manage a successful business case or project, especially if the business/project depends on the ability to support multiple use cases and depends on the readiness of wider ecosystem of solution providers and consumers.

The user or the citizen living in the smart city project bears all the running, maintenance cost of the project in addition to the capital for purchasing the place to live in the facility. These overhead costs create a panic or hesitation for anyone to buy or purchase a property in the smart city. Projects fail due to these buyer moods in a long run and fail to establish the objectives of a successful plan of action.

The users can be motivated to be a potential investor with simple ideas and lesser investment from their homes with technology such as Data Science, Data Analytics and Blockchain technology.

II. TECHNOLOGY

A. Data Science

Data Science is a comprehensive science that uses scientific methodologies, procedures, computational calculation and systems to gain insights, extract relevant information from available irrelevant or crude data to a readable and understandable report that brings out the various factors deciding the course or action of an event or happening with proper advocacy, interpretation and inference.

Smart city projects use Data Science methodologies for collecting bulk volume of data from users, that includes the personal info and property or assets that are registered in the name of the user.

B. Data Analytics

Data Analytics is the process of examining or inspecting the data and involves in investigating the relational database of the user.

Techniques to inquire into a particular set of data with research methodologies is dictated by the various proven analytical methods.

Smart City Asset management helps the user to know more about real time happenings around him to take smart decisions that can land him in a better deal in case of trading.

C. Blockchain Technology

Blockchain technology is a digital record register technology that stores growing amount of data in blocks, securely linked to each other, encrypted and well established with time stamp that is persistent, tamper proof and a Digital Twin of one such can be used for various identification of various assets and users available in the city without ambiguity.

Here Blockchain is used only for identification purpose of the asset and the individuals, or the user id is masked with a virtual id incase there is a breach or tampering of any of the data by external agents or agencies with the motive of thieving individual data for the purpose of personal use.

The devices such as IoT's digital id is also masked with virtual id to avoid tracking by organizations.

D. Business models

- Peer-to-peer electricity trading: Is an energy management system that benefits the proactive

consumers(prosumers) in transacting their generated electricity in an open model online marketplace from an already available service provider with lesser economic benefits.

- Energy-as-a-service: EaaS is a business model that focuses on supplying electricity to the consumer along with power management without any new capital cost/investment from a new energy provider, thereby utilizing existing service line.
- Pay-as-you-go model: Is a business model that allows customer to pay as per the usage. Here the customer doesn't have to go for a subscription/regular charge as the energy service charges are calculated without rent or subscription charges.
- Community-ownership model: This model empowers the users of the community to own local energy assets and share with the community with like-minded residents and asset holders. This model empowers the owners with de-centralized management and encourages responsibility with accountability of the environment they manage and live-in.

III. METHODOLOGY

The user id like national id or Aadhar card issued by government agencies are received by the smart city operators with the masked or virtual id from the issuer itself. This lessens the risk of any individual's personal or financial data associated with a particular id document is protected by the issuer itself. The smart city promoter or the smart city operations team has only the access of the users virtual id. The devices used by the user such as mobiles, electricity charging points for EV, the electricity meter associated with the user, parking lot, any other IoT device used by the device for the use of personal, but with the intent of sharing with the community are all shared with masked ids.

Data Science is used to collect the relevant required data of the stakeholder. The user's data that was already masked by the government and the smart city operator are made structured with providing only necessary part of the data required for the purposes, not displaying all the available but only the required and relevant data without sending double the times of data for a single purpose to avoid double billing or calculation. Customizable features that comply with project internal policies and external regulations from government and regulating agencies regarding data privacy, restricting various levels of access to the dataset based on priority and authority.

Blockchain methodology is used to document all the relevant data using Digital Ledgering Technology with individual blocks that are securely linked together using cryptographic techniques available for maximum security.

A digital twin of this data is given to the smart city operator than copying the data. Digital twins are the same as the blockchain data which can be verified with the original data in case of any suspicion of tampering of the available data.

Data analytics is used to calculate the credit operation of the user, thereby make him involve in the trading, with mutual benefit among the community and the user.

User/customer segmentation is an important part in the smart city project that enables a producer or maker of the services with the consumer utilizing the resources. These data along with reginal/demographic information are used for predicting customer preferences/behaviors over available services in a competitive market. Account history is maintained for customer view over insights.

All these technologies are made in an easy-to use platform that connects to all data across the project server, wherever they are stored. "Even-driven approach" methodology is a real time, sequence of related events-based approach that can be used for the project business to connect interactively with the customer/user. The sequence of related event is usually called a "stream". These streams and events are the building blocks of a data platform, that may come from an IoT device, and user mobile.

IV. RESOURCE UTILIZATION-1

The user can export the power he generated using his household solar, wind or any other renewable energy that is in excess to him to the grid. A bi-directional energy meter records all the power flow in both the direction. This power exported to the grid is a renewable one that has carbon credits, that can be traded for either money or services anywhere inside the city.

Data Analytics is used here for the calculation of carbon credit electricity. The carbon credit calculation or data value guidance is available on the internet by various agencies/governments in accordance with the standards followed by the native country and can be used for the energy exported by the user in KwH multiplied with the conversion factor for solar/wind (renewable energy).

Data science is used to create a wallet that stores the smart credit points of the user by his contribution or export of energy to the grid.

Blockchain verifies the export of energy is from the authenticated devices registered by the user. This technology can also create a QR code for credits (For e.g., If the user has 20 credits and want to trade with other user, he can convert these 20 credits to a QR code, and the buyer can use it as he likes and can use this credit for buying power for his machine from electricity supplier without any penalty or fine for using power (without carbon footprint). QR code gives the data of from where the energy was purchased.

The user capable of generating power without carbon footprint can even trade with industries that requires carbon credit to avoid penalty from environment agencies in Carbon Trading platform. This process involves smart credit points

trading and smart credit points transfer.

The business model used here is a blend of peer-to -peer electricity trading and Energy-as-a-service.

V. RESOURCE UTILIZATION-2

If the user has a solar car and when he can park it under the sun, it gets charged fully and becomes an electricity generator. The electricity generated can be exported to the grid if the parking lot is for electric vehicle and can manage bi-directional power flow. The machine/car id is captured using the IoT device available in the charging station and the corresponding wallet is credited by the power flow the car has exported to the grid.

The details of power exported, and the credits are all debited in the wallet. Here Data Analytics does the additional job of calculating the power including the time, as there are some incentives offered by the electricity boards to supply the grid with power in the peak hour demand period. This data is also verified by the algorithms in the analytical science.

The business model implemented here is Energy-as-a-service.

VI. RESOURCE UTILIZATION-3

If the user/parking lot owner has a parking lot with him (he could be a shop owner, and if has got some space for parking his own/employees/customer car) can rent the space to external user for a specific time he is not using the space. The parking lot will be equipped with IoT to identify the exact location of space in the city and capable of scanning the car/vehicle's IoT using the space for rent with a digital parking meter. The space available for the specified time can be made an advertisement ready to be posted for anyone looking for space for the time.

The rent is automatically debited in the owner's wallet credited from the user's wallet. IoT's identify the user, data science calculates the credit and transfers the same.

Pre-booking option is also made available, that indicates the space is booked and warns on unauthorized parking by other vehicles so that the parking lot owner can either collect rent or initiate action on the violators. This process involves facilities for need transfer and data sharing.

The above-mentioned idea is based on business models of Community-ownership and Pay-as-you-go model.

VII. RESOURCE UTILIZATION-4

Public transportation services are always recommended by the government than the individual transportation. Public transportation reduces the energy consumption, emissions per commuter.

Public transports charge the individual based on the number of stages the user travels. Here there is a slab system. For e.g. The user is charged some basic fare up to 3 stages then the hiked charge is constant from 4 to 7 stages. The user boards the transport and is charged based on the slab than the stage he is off boarding. The public transport then finishes the trip to the destination but with an empty run, wasting the resources of fuel.

Here Data Science and Analytics algorithms asks the user in the mobile portal about the exact stage the user wants to travel and charge money accordingly than the slab used now (For e.g., the user off-boarding in stage-5 is charged an amount in-between slab-1 and slab-2, as there is no change problem with the ticket collector, and he pays the exact amount mentioned using the wallet.

Data from all users is collected about the boarding and leaving point along with the trip start, end time for a period to look for any major change in patterns of travel and the number of passengers in every single vehicle at any time. Optimization is aimed based on the loading of the vehicle up to 80% all time. Accordingly, timing for a particular stage and the route is altered based on traffic and the requirement of the majority of user. Destination points of the vehicles are altered in the trips based on requests from the user's wallet.

Guidance and suggestions to use the best possible vehicle in public transportation is given to users, so they can choose wisely and alter their travel time to avoid traffic, rush and use the public vehicle than their personal, which is not so convenient and cost effective.

Here the users are encouraged to use wallet pay and are allowed to book tickets in advance and the quantity of passengers can be determined in advance along with their destinations, so that vehicle operation is planned accordingly with less complications and streamlines operations. This process involves data sharing.

Business model utilized here is Pay-as-you-go.

VIII. CONCLUSION

Embedding business models in stakeholder aims in active participation of the stakeholder or the customer. This involvement creates a bond between the place and personnel and motivates him to a responsible citizen than a simple user who relocates the place or residence as and when there is a block or obstruction faced.

Smart city projects are visionary projects created by a nation, but the expenses incurred to the people living in them, reconsider their options of choosing another place.

For e.g., some of the cities are experiencing down trend in population growth as they are getting expensive compared to other cities or even nearby towns. People working in smart cities relocate their homes outside the city and choose to commute. This pattern of people moving outside the city for the sake of high cost of living can be balanced by attracting capital from the residents than for going a loan by the developer/operator or even the government as the loan interest will surely increase the municipal tax indirectly or the cost of commodities directly, thereby giving an impact in monthly expenses of the resident.

The immediate problem now faced by many of the

countries now is Inflation. People worldwide are experiencing this spiraling cost of living and without additional income, are now reducing their expenses and even have brought big cuts in their staple food and preferred food menus.

Any country can manage setbacks due to environment such as COVID, economical such as recession, emergency situations such as war in a neighboring nation, that supplies essential commodities, provided it has a working self-reliant, sustainable plan that can manage the situation without much outside help.

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