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Big Data Analytics in Residential Property Buying Decisions in India

Shiv Prasad Singh[1], Nitesh Rohilla[2] & Dr Amit Kumar[3]
1,2 & 3 Associate Professor, RICS School of Built Environment, Amity University Noida, Uttar Pradesh, India

As per estimate for majority households their most expensive purchase in lifetime is property, residential or otherwise, locking 15.8% of the world's wealth in real estate (Capgemini World Wealth Report 2017). Often first property purchase by an individual is residential. In current times, Indian real estate market, despite the digital revolution, property purchase decisions are not yet based on data analytics. At best they are supported by a formal market research or valuation exercises, rather than a data-based decision. In Indian real estate market, property purchase decisions are influenced by heard behaviour, family and relatives, promotional offers and gut feel (Piyush, Bhatt,2016). This approach in decision making for the most expensive purchase of lifetime often backfires as it is nothing more than leaving everything to fate and prayers.

Indian real estate market has been questioned for its transparency, raking 34, (Global Real Estate Transparency Index, 2020) on several parameters including transaction processes, investment performance, data and regulations. Even though there are several digital property information platforms, it does not really help in residential property buying decision making for a customer, since these portal shave focused on structured information delivery rather than accuracy, the only duplicate developer provided information although in a structured manner. In such circumstances Big Data and protect is not yet enabling real estate buyers in decision making as it is effectively doing in other domains i.e. e-commerce, e-governance, financial markets etc.

Implementation of Real Estate Regulatory Authority (RERA) Act in July 2017 has been a disruptor in several ways for Indian real estate market, availability reliable data for under construction and new projects is one of them. As per regulations of RERA, every under construction or new real estate projects have to mandatorily register with concerned RERA Authority of their state and project information to RERA in the prescribed format that would be publicly available. This regulatory requirement is resulting in a large amount of reliable data with every state RERA which is currently unexplored.

This paper attempts to explore the potential use public data of RERA Authority for development of a digital platform using Big Data and GIS Applications to help customers in taking purchase decisions.

Keywords: *Real Estate, Property, Big Data, Technology, RERA*

INTRODUCTION

Every emerging economy has reaped the benefit of real estate and construction sector since it continues to be large employer as well as wealth creator for every nation, and India is not an exception to this economic phenomenon. "Based on various reports the real estate sector looks fertile for future growth and the Indian real estate market may touch US$180 billion by 2020." (Neerav Merchant, 2016). Although past five years has not been very encouraging for Indian Real Estate Sector. Industry accepts that home buyer's confidence across the country is lowest in the past 10 years. Reasons for this discouraging scenario are many i.e. increasing interest on project finance, poor return on investments, grossly delayed delivery of houses, substandard quality of constructions and abysmal sector outlook.

Although a closer look would reveal little different story for residential real estate collapse in India i.e. erratic and irresponsible project planning as well as purchase behaviour of buyers which is never on sound backing of reliable research and data.

One of the core issues in all these aspects is the information gap that runs wide in this sector. Both builder and buyer are responsible for this situation since closely held real estate business has a very poor record of disclosures and customer is not very demanding. No third party is providing reliable data on real estate projects and the sector continues to be under pressure due to information

asymmetry.

Property purchase in India is always a challenge since often it is the most expensive purchase of a lifetime for an individual buyer. Property buying decisions rather than being a data-based, is marred by herd behaviour, family and relatives' influences, promotional offers and gut feel (Piyush, 2016). This approach in decision making for property the most expensive purchase of lifetime often backfires as it is nothing more than leaving everything to fate and prayers. Data based decision making is also difficult since property information is either missing, incomplete, duplicate, or fragmented. Typically, a property record consists of numerous information like property maps, layout and design, product specifications, legal documentation, multiple taxes, statutory approvals, compliance certificate etc. This data is maintained by different stakeholders who do not have a strong compliance system to maintain the property data which results in data redundancy, duplication or data gaps in real estate business that creates access barriers for a prospective buyer while conducting secondary research.

Although transparency, governance standards and digitisation is increasing in real estate sector, through availability of online web portals as well as web sites of projects, consumers can now access the data without being present at the site. Virtual visit of the property is now becoming popular in the market and many property transactions are being executed online for capital and rental transactions. All these digitisation efforts are focused on better customer experience, but final purchase decision behaviour is still not data based, but there is strong anticipation that this purchase behaviour in India shall change because of implementation of Real Estate (Regulation & Development) Act, 2016, as it is expected to bring about radical changes in real estate sector.

LITERATURE REVIEW

Since we are embarking to a relatively new research area it is imperative to understand what is the role of disruptive technology and what is 'Big Data' prior to exploring its application in data-based decision making in real estate residential property purchase, following is the role of disruptive technology and definition of Big Data by leading technology pioneers is a good starting point.

Within the real estate context, "technology" may be construed in a broad sense to include innovative software, hardware, materials, construction, and design (The Real Comm Conference Group LLC, 2015)

Technology has the potential to allow countries around the world to develop a comprehensive real-time database of the use and ownership of buildings. Countries such as Sweden, Ghana and Georgia are already conducting trials on these aspects. This could be transformational because transparency in real estate markets has a profound impact on both economic development and the quality of life of citizens.(Couse, 2016)

(The Economic Times, 2019) "McKinsey influential Report claimed that the range of data science will be the number one catalyst for economic growth. McKinney identified Big Data as one of the new opportunities that contributed to the launch of the Big Data era. A growing torrent of data, this approach indicates that data seems to be coming continuously and at a fast rate".The report also says that ''India is one of the largest and fastest growing markets for digital consumers, with 560 million internet subscribers in 2018, second only to China. India will see internet users rise by about 40 per cent and the number of smartphones to double by 2023".

India is contributing significantly in Big Data generation since in the past decade and a half,

several property portals have come into being and providing digital information to the prospective residential property buyer. These property portals do not verify information and prospective property buyers and Investors are expected to undertake their own due diligence of available data. Since before taking any investment decision investors /buyers are expected to collect information from multiple sources and analyse it themselves, investors often do not take rational decision and their decisions get influenced by emotional or non-relevant factors. Naturally it ends up in an dissatisfied customer.

Real estate purchases have now become commoditised even though it is an investment class asset. Like any other commodity customer satisfaction is an important dimension of this high value purchase for individuals. Quality of service, transparency, ethical dealings, and customer satisfaction have never been strength of real estate sector even though it at centre of discussions for other goods and service in public domain. It has affected reputation of real estate business as well as supply side stakeholders. Introduction of customer satisfaction survey, which can provide an opportunity to obtain information about the needs of customers and control the quality of services provided, is essential for the successful operation of the company in order to maintain one of the core values – customer service quality – at a high level (Putniņš, 2007). Research has established (Basil & Weber, 2006; Golob, Lah, & Jančič, 2008; Wang & Juslin, 2012) that customer satisfaction approach has global appeal in positive business performance.

Research also shows that property purchase behaviour in developed and developing economies are comparable since it is not entirely data-based rational decision but it dominated by perceived value by customers (Raghubir, P & Corfman, K, 1999; Monroe, K. B., 1990; Monroe, K. B., Krishnan, R. 1985). Although high value purchase such as residential property cannot be purchased with such sentiments. This situation presents us an opportunity to further delve into this aspect and explore if the technological solution may improve the decision-making behaviour of residential property purchase.

METHODOLOGY

This research paper is exploratory in nature. It can be summarized from the above review that how Big Data can play a significant role in consumers' buying decisions and how Real Estate (Regulation and Development) Act 2016 (RERA) can effectively support decision making through Big Data or availability of data. In India, data is available with various stakeholders whereas data freely available in public domain in unverified hence cannot be relied upon. The emphasis of this paper is on the effective use of information available with RERA authority in the consumer buying decision. Purpose of this study is to explore the potential use of Big Data analytics in residential property buying decision making since, in this process, decision influencers are several and it is difficult to analyse them adequately with the conventional approach.

The study is mainly based on secondary data that has been collected from published journals, media reports, web resources, industry reports and annual reports. Since topic specific research is not available in Indian context so far, literature review has been undertaken to broadly understand high value purchase behaviour of consumers and role of big data in such decision making process.

BIG DATA AND ITS ROLE IN REAL ESTATE

Importance of data is undisputable in present times. We could make a planned decision if data is accurate and authentic but all those muddled set of numbers must be analysed before one could extract a piece of valuable data from them or conclude on a decision. Since the analysis of large dataset is an impossible task for a human being, the computer

algorithm is a reliable alternative.

Big Data refers to the massive dataset which may be structured or unstructured. Big Data analytics is the process of examining the patterns of large data sets and underline insights.

Structured data: Any type of data which has a specified format and processed in a fixed structured. There are several tools and techniques working with such kind of data (Where the format is well known in advance).

Example of structured data: An employee table in a database is a good example of structured data where employee_id, employee name, gender and department is given.

Unstructured data: Any data which a specified format doesn't have, in addition to that size of such data is huge and which is very difficult to process for deriving value out of it.

Example of unstructured data: Heterogeneous data source containing simple text files, images, videos are the typical example of unstructured data. For example, the output returned by 'Google Search' or 'Amazon'.

These days Big Data analytics is being integrated and used by almost all the industry and the real estate sector is also not an exception to it. The term "Big Data" is now commonly used to refer to all digital data for a long time but now it is proving to be a positive contributor for the growth of businesses, governance and empowering citizens. Availability of large quantum of data with corporations can be utilized for logical analysis and development strategies that may lead to the betterment of citizens and society.

"Madden (2012) summarises Big Data as data that is too big, too fast, or too hard for existing tools to process since new technologies are required to analyse it." Older ways of analysing such large quantity of data may not be productive, situation becomes even more complex since often data is not static and continuously changing due to sensor and social media based sources. (Provost & Fawcett, 2013). "Clearly, only Big Data is not good news since until it is not coupled with relevant analytical tools (Ward & Barker, 2013), it would prove worthless causing meaningless effort and expenses of managing and storing it."

"Big Data and the associated computational techniques can be compared with system of mass production devised by Henry Ford(Boyd & Crawford, 2012). The information extracted from Big Data, they propose, has the potential to change the way we think about many different areas of research, from economics to the social sciences to medicine and disease."

Disruptive technology can play a crucial role in improving customer satisfaction and experience because recent developments in technologies and improved data gathering through Big Data and/or other techniques have brought many changes in the evolution of the Real Estate Industry. A comprehensive analysis using Big Data by superimposing spatial information, project and promoter information, regulatory information and information on the macro-economic environment would help property purchasers in taking rational decisions.

POSSIBILITIES OF DATA ANALYTICS

Because of rapid growth in emerging technologies, it is now easy to capture, analyse and communicate with data. It is being leveraged by businesses to create digital applications where machine learning applications analyse, multiple kinds of data which is now available from city administrators, infrastructure providers, public & private businesses and citizens.

Matrix below represents shows the list of active web portal and services offered by them in the real estate sector.

Table 1:Digital Platforms & Service Offered in Real Estate Sector

Service Offered \ Web Portal	Magicbricks	Liases Foras	Propstack	99 acers.com	Propequity	Housing.com	Proptiger	Quicker Homes	Makaan.com
B2B Operations	•	•	•	•	•	•	•	•	•
B2C Operations	•			•		•	•	•	•
Property listing, Buy, Rent, Sell	•			•		•	•	•	•
Map Search Option				•					
Project Search through RERA ID							•		
Property Feedback	•			•	•	•	•	•	•
Expert Opinion of legal/Vastu/Home Loan	•			•	•			•	•
Home Loan Calculators	•			•		•			
Public database	•			•		•	•	•	•
Subscription based operation		•	•		•				
Publishes sector trends report		•	•		•				
Proprietary data		•	•						
Professional analytics support		•	•		•		•		
Interactive 4D view of project							•		

Sources: Secondary research through web resources, 2019, such as (99acer.com, n.d.), (Magic Bricks, n.d.), (Liases Foras, n.d.)

Improved data quality, multi-faceted analytical tools and superior visualisation techniques are now making it possible to develop better insights on urban issues and real estate markets. Real time data and decision making based on that, for service delivery, its management and optimisation is now possible and can be correlated with real estate values. This kind of analysis "provides an unprecedented potential from enhancing real estate property buying decisions, better forecasts for building utilization, more accurate assessment of the purchasing power of users of real estate and by better risk assessment of real estate users" (Herman Donner, 2018)

"Physical things are now creating an enormous amount of Big Data through sensors across the urban environment, on building, roads, streetlights, infrastructure and various other places. Smartphones, tablets, social media platforms, and network connected vehicles are all part of what is known as the internet of things (IoT) that allows for collection and application of knowledge on the environment and increasingly using Big Data analysis to predict market trends"(S Gregory Yovanof, 2009).

IMPACT OF RERA IN DATA DIGITISATION

After successful implementation of regulators in different business sectors i.e. Capital Markets, Telecom and Insurance it was imperative that real estate sector also gets an effective regulator for obvious reasons of improving consumer protection, increasing transparency, imparting professionalism and fixing responsibility of real estate developers and property brokers. With these noble intentions model Real Estate (Regulation and

Development) Act 2016 (RERA) was passed by parliament. Since Land is part of state list for legislation, respective state governments of India had to adopt this model RERA through legislation and ensure implementation from May 01, 2017. Key provisions of RERA were primarily consumer-centric that also necessitated mandatory registration of all ongoing projects with RERA Authority (Regulator), therefore significant disclosures about promoter, project, statutory approvals as well as associated stakeholders came into public domain and project promoter was liable for its factual sanctity. This was the first breakthrough for Regulator, since prior to RERA real estate project developers always retained right for revision in published information even after the transaction between property buyer and project developer was concluded and agreements were signed.

Although in India, several private businesses have launched online property portals in the past one and half decades (Table 1: Digital Platforms & Service Offered in Real Estate Sector Sources: Secondary research through web resources, 2019, such as (99acer.com, n.d.), (Magic bricks), (Liases Foras) in public domain, but none of them take liability for accuracy of their data since most of them has been organised asan internet media business publishing classifieds for consumer consumption and some value-added service to increase consumer traffic. Such information is not reliable even though it is part of Big Data. RERA has changed this situation for good.

As per (Kimberly Winson-Geideman, 2016)real estate traditionally generates three types of data – 1. Financial, 2. Transactional and 3. Physical. Financial data represents capital market and listed securities data of real estate assets. Transactional data represents information on real estate transactions, mortgages, taxes, expenses, leases and financial returns. Physical data represents information about land, project, structure, its characteristics, typology and spatial information (location, geography, neighbourhood).

Mandatory registration of projects is generating limited Transactional Data and but significant Physical data in real estate sector. A representative table of these data sets for a project is presented in the table below which is being currently captured by RERA:

A typical residential property buyer while undertaking market research to arrive at a purchase decision in her/his identified neighborhoods/he is concerned with, is now available with Regulator. This availability of factual and reliable data is opening several interesting Big Data Analytics possibilities that would help all stakeholder in better decision making. This analysis can be undertaken at core, spatial and peripheral data level(Kimberly Winson-Geideman, 2016).

SPATIAL DATA ANALYSIS

In the Indian context, a typical residential property buyer often concludes neighborhood for purchase very quickly based on personal preferences and rational. Often this decision is influenced by return on investment, affordability, social group connect, peer and family reasons or purely on a speculative basis. In the National Capital Region (NCR), that includes constellation of seven cities around Delhi, primary market residential property purchase decision in terms of choice of city is the easiest for an aspiring buyer. So far, such decisions are influenced by two key factors i.e. personal bias about a city and affordability. Personal bias itself may be influenced by one or several factors which have a varying degree of importance for an individual such as proximity to work, better educational facilities for children, quality urban infrastructure, conducive social, safe urban environment etc. Clearly tangible aspects of property purchase such as investment rationale, return on investment, total stock in a micro-market, demand supply scenario, available social

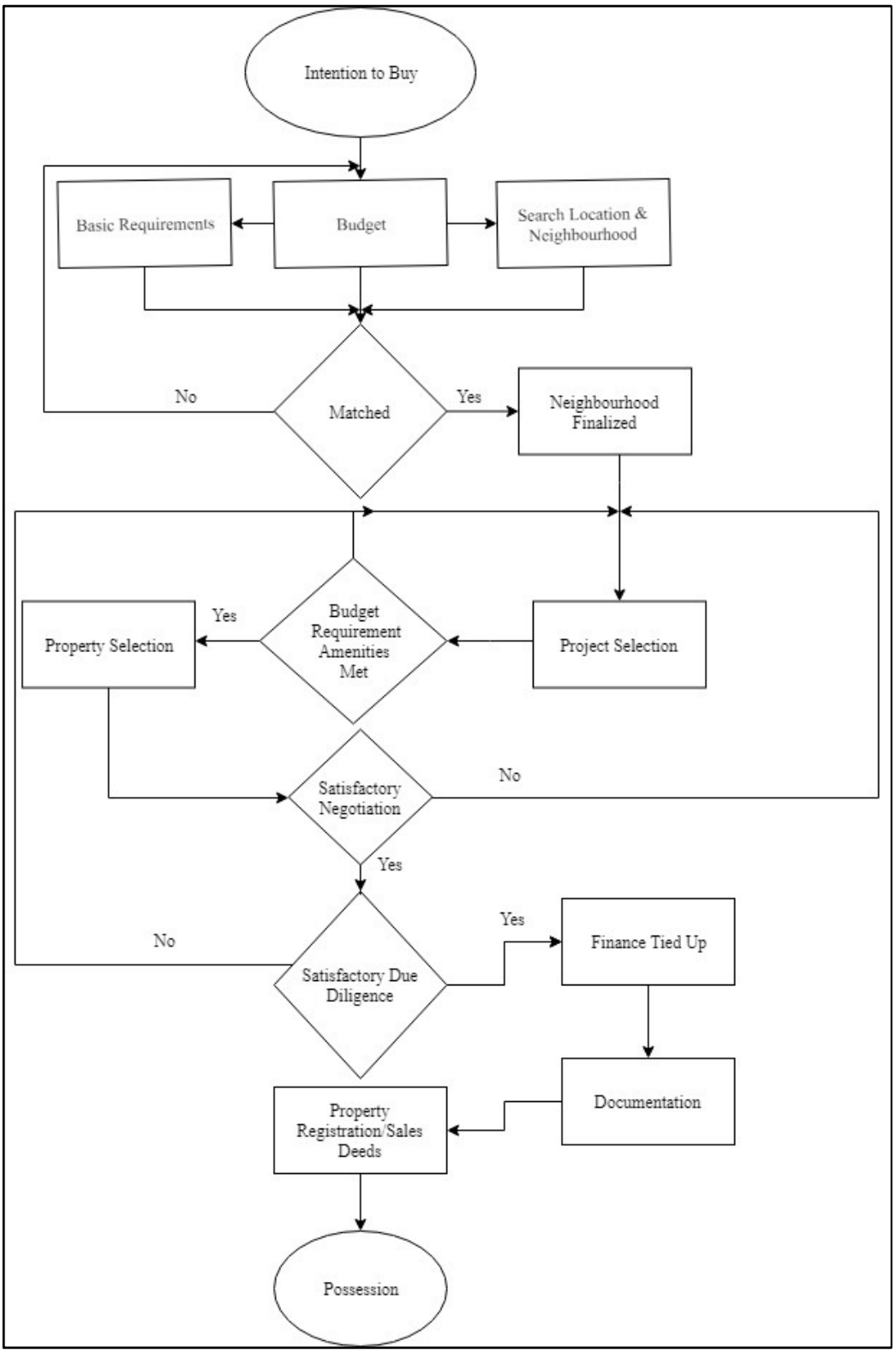
Table 2: Data to be submitted to RERA

Physical Data		Spatial Data
Project Details • Ongoing • New • Project Category • Project Name • Project Cost • Registry document • Sale Deed of Project Land • Lease Deed of Project Land • Extract of Land Record • Allotment Letter issued by Competent Authority	**Other Approvals** • CA Certificate • Waste Disposal Plan • Electricity Supply Plan • Electricity Clearance and Safety Certificate • Environment Clearance Certificate • NOC from Fire Fighting Department • Municipal Clearance for Serverage and other infrastructure • Commencement Certificate • Sanction Certificate of Bank Construction Finance • Height Clearance of Airport Authority of India	**Geographical Location** • Sanctioned Plan • Approved Map • Approved Layout
Sanctioned Plan • Type • Permit Date • Proposed Start Date • Proposed End Date • Sanction Letter • Project Specifications	**Development Works** • Water Supply • Sewer System • Design for Electric Supply • Energy Management System	**Neighbourhood Profile** • Geographic information • Physical and social amenities • Neighbourhood infrastructure • Landmarks • Transport terminals • Published secondary information • Planning norms

Source: (http://www.up-rera.in/pdf/Guidelines_for_Registration_of_Project_and_Updating.pdf, n.d.)

amenities etc., never form the basis for decision making since reliable information and analysis on the above parameters are available only through professional and paid engagement of consultants, which is often unaffordable for most of the households evaluating purchase options. Their best source of information is 'hearsay' with neighbourhood property brokers who advise on the basis of 'experience' rather than data-backed analysis.

Availability of reliable spatial data in the public domain about real estate projects in a neighborhood through RERA can effectively support decision making process of property purchase decisions. Big Data analytics and artificial intelligence over publicly available data of RERA can help in making a rational purchase decision in a neighborhood. If a prospective consumer can get bird's eye view of a real estate micro-market s/he can take a more informed decision about the time of purchase, type of property (under construction or ready to occupy), selection of builder, negotiation opportunity etc. Such decision making would also lead to a more balanced urban growth since buyers would avoid oversupplied markets because it would adversely impact asset valuation over a period of time and would have a higher probability of urban congestion.



Graph 1: A typical residential property purchase decision making process.

Spatial analysis of RERA data through Big Data analytics would also help project developers in taking a rational decision for new project planning. Through analytics developers would also have bird's eye view of entire micro-market so that they would be able take better business decision about product mix, target buyer group, project phasing and delivery period, project specifications, amenities to be offered in project, marketing and differentiation strategy etc. In post RERA scenario project developer's liability towards regulatory bodies, as well as customers, have increased significantly hence it is important that they carefully analyze the micro market before committing precious resources and launching a project.

PHYSICAL DATA ANALYSIS

Physical data (Kimberly Winson-Giedman & Andy Krause, 2016) constitutes property specifics such as land, structure, specification, amenities, type and size of units, project layout design, unit layout design and other quantitative and qualitative aspects of project, on which a prospective buyer spends most of his/her purchase evaluation time. In Indian context practice of involving a qualified architect or engineer, to advise on vital physical data prior to property purchase is non-existent, except for luxury property segment buyers. Reasons for this attitude are purely financial. Since usually property purchases are broker assisted who charge a fee, prospective buyers do not wish to further inflate their property purchase budget by engaging other consultants. Often this attitude backfires for buyers and they end up making a substandard purchase at market value. Buyer's entire focus during the purchase process is on price and mortgage conditions, more specifically interest rate and repayment period, as validated by Mahapatra, Mousumi Singha; De, Anupam (2017).

So far physical data was always transitional since real estate property developers retained the right for amendments in it and they kept it revising even after purchase decision was made. Although basic design and layout often do not change, project specifications and other physical data that did not impact individual properties were always in flux, e.g. changing the design of community club, position of entrance gates, internal circulation patterns, quality & make of finishes etc. In present circumstances as per RERA, all project specifications after project registrations would be fixed and project developers have lost all liberties for alteration is design or specifications. Therefore, data available with RERA can be taken as conclusive and can be effectively used for decision making analysis using Big Data Analytics. Through Big Data analytics now purchasers can effectively compare properties, its specifications, design and other tangible aspects to arrive at a rational purchase decision.

IMPACT OF BIG DATA ON VARIOUS STAKEHOLDERS

A Piece of information has a cost, sometimes monetary or non-monetary. So, it is important to understand the importance of a small piece of information. In past, it has been found that how poor-quality data can impact the outcome of the organization wherein if the quality of data is good results can be on a brighter side.Big Data in real estate is now a big term which is turning out to be a game changer for the industry as well as the community. With the availability and proper utilization of Big Data analytics all the stakeholders including, developers, agents, financial institutions as well as multiple regulatory bodies can use analytics for effective governance and consumer protection. This aspect has been detailed below for few stakeholders.

For consumer:

Earlier home buyers used to be completely dependent on traditional real estate broker to buy a property at a limited location with limited information. They did not have choice to explore

large number of locations and compare them, but now accessibility of all the information on a centralize platform would open up a much greater possibility of analysis and informed decision making. A Property buyer can understand demand and supply in the neighbourhood, types of property, it's pricing, target economic group and proposed facilities in various projects which are their prime concern. Consumers can also develop some understanding of how their property would fare as an investment over the medium and long term in case of a construction development project. Since information would be from RERA Web Portal hence it would be reliable and project developer would be legally bound to deliver promised product. Although actual transaction price information would not be available on RERA Web Portal, but authentic pricing information is available with few B2B property portals that can be easily amalgamated through Big Data analytics under commercial arrangements. Property buyer would benefit most if Big Data analytics is supported by RERA Data while making purchase decisions.

For developer:

Big data analytics would be very useful for project developers as well since it would help them in product mix planning, pricing strategy, specifications& design, understanding sales velocity, availability of unsold inventory of different types of product in a micro-market etc. Analytics around these parameters would help project developers in positioning their project and product to ensure success by gap analysis. Developers would understand the targeted customer behaviour and accordingly may work on an effective marketing strategy. This would also allow developers to achieve a better return on equity.

For financial institution:

Indian real estate sector is struggling today primarily for want of finance which has dried up due to disruption in the market cycle. Financial institutions also suffered along with developers and consumers, due to this disruption and initiating bankruptcy process for several developers. It would not be unfair to conclude that Big Data Analytics would have prevented this catastrophic situation. Had financial institution knew about total supply in a neighbourhood within a specified period, they might have taken an objective view while financing projects or would have effectively priced their risk. In absence of reliable public data on supply of housing units, project developers, as well as consultant, may present selective information creating an unrealistically positive picture of neighbourhood real estate market. Moreover, information about the solvency of developer in the public domain would have forced funding agencies not to go overboard while considering their funding proposals, saving them from non-performing assets.

For property agents:

Another significant improvement in service delivery would take place among property service providers particularly, property agents. This important stakeholder of real estate business who is the backbone of property sales that ensures project success,was completely out of any regulatory regime. Although property agents have attempted to regulate themselves by forming associations, however, it has rather resulted in cartelisation, further compromising interests of property buyers. Property agents have been one of the key stakeholders responsible for misrepresentation to customers as well as property developers. To an extent the entire marketing ecosystem is responsible for this situation since available information itself is questionable and cost of misrepresentation was practically zero for property agents. RERA has conclusively addressed the issue of misrepresentation of information since information is now universally available to all stakeholders. RERA has put real estate agents

under its ambit with punitive action hence property agents would also be more diligent with clients and Big Data analytics would make their jobs much more accurate, transparent and service oriented. They would not only share information with their customers but also be able to discuss several possible scenarios about prospects of their property, prior to purchase decision. Big Data Analytics can transform property agents into investment consultants.

For Regulatory Bodies:

With the implementation of Real Estate Regulation and Development Act (RERA, 2016), Every state authority is now custodian of a significant amount of reliable data in public domain just like Securities and Exchange Board of India (SEBI). At present RERA is taking the role of the reactionary regulator rather than a proactive regulator. RERA can easily superimpose its physical and spatial data for upcoming projects on Geographic Information System to create multi-layered analysis helping multiple stakeholders of built environment business to creatively use it. RERA can collaborate with private sector analytics firms having expertise in Big Data layered analytics that can have multiple application such as land record verification, resource planning and optimisation, traffic prediction and planning, infrastructure mapping and augmentation, supply demand analysis for reals estate sector, capital appreciation prospects in a neighbourhood etc.

Below table shows the possible analytics using RERA Big Data that has been mapped to various stakeholders which would concern them in various capacities either as buyer, builder, regulator, investor or service providers. This table is not exhaustive, and several combinations and permutation are possible using Big Data analytics that can handle millions of bytes of data.

CONCLUSION

Technology is changing several frontiers in business domains delivering efficiency and value. There is no reason why it will not be true for real estate sector as well. So far real estate sector has successfully developed digital platforms for property search that has become first point of information search for any prospective property buyer or seller followed by physical meeting or property inspection. This digitisation in real estate sector itself is generating large quantity of data that has potential for trend analysis in term of location and property preferences among customers. Although due to questionable reliability of data on these digital portals (refer Table 1), since it is never sorted or filtered by any human interface, except few subscriptions based portals, conclusive purchase decisions cannot be taken by customer using these digital classified platforms for real estate.

RERA Authority has now successfully bridged this gap of data reliability since project developer is bound by the information s/he has provided to regulator. Our analysis shows that the database of RERA can be effectively used for analytics if amalgamated with Big Data and that would be very helpful for a residential property buyer in taking informed decision. Such analytics shall not only be useful for residential property buyer but also for several stakeholders of real estate business.

Research conclusively indicates that RERA Authority can explore possibilities of partnering with private sector analytics organization to harness its data not only to improve governance of real estate sector but also work towards better resource planning and urban management. Layering of RERA data with GIS Spatial Data and Big Data at large, could open several businesses, governance and social application for a healthy real estate market.

This research is one of the early efforts in effectively using RERA data by amalgamating analytics for enhancing consumer buying experience as well as improving governance of real estate sector. Researchers will further build on

Table 3: Possible Big Data Analytics for stakeholders

Key stakeholders of Real Estate Sector / Possible Big Data Analytics	Property Buyer	Builder	Development Authority	RERA	Planning Department	Environment Management Bodies	Water Supply Boards	Transport Planning Bodies	Consultants	Property Brokers	Contractors	Capital Goods Suppliers
Neighbourhood Level												
Spatial demographic distribution	•	•	•	•	•	•	•	•	•	•	•	•
Neighbourhood physical infrastructure demand and supply (including planned supply)	•	•	•		•	•	•	•				•
Neighbourhood social infrastructure demand and supply (including planned supply)	•		•		•			•			•	
Neighbourhood planning restriction if any	•	•	•		•	•	•		•	•		
Neighbourhood and project densities	•	•	•		•	•	•	•	•			
Total housing stock supply in a neighbourhood	•	•	•	•	•	•	•	•		•	•	•
Total commercial property supply in a neighbourhood		•	•		•	•	•	•		•	•	•
Environment and sustainability issues in a neighbourhood if any	•	•	•		•	•						•
Natural disaster risk profile of neighbourhood	•	•	•	•	•	•	•	•	•	•	•	•
Project Level Analysis												
Land and Title Records verification including any lien on project land	•	•	•	•						•		
Profile of project promoters and their solvency	•	•		•					•	•	•	•
Sale information of properties for various projects in neighbourhood	•	•	•	•						•	•	•
Project progress status	•	•	•	•	•	•	•	•		•	•	•
Project development schedule and deviations	•	•	•	•	•		•	•		•	•	•
Status of various approvals and compliances	•	•	•	•					•	•	•	•
Project and property specification and deviations if any	•	•			•		•	•	•	•		
Financing requirements (both debt and equity) for projects in neighbourhood		•		•					•		•	•
Information on consultants associated with project.	•	•		•					•	•	•	•
Selling agents and brokers of project.	•	•		•						•		•
Project and Unit design analysis	•	•			•				•	•		
Infrastructure adequacy analysis at project level	•	•	•	•	•	•	•		•	•	•	

other aspects of technology in real estate sector for a consumer friendly, transparent, and professional approach towards buying decisions.

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