

Big Data and Predictive Analytics Drive Innovations in Construction Industry

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Abstract

Nowadays, business leverage Big Data (BD) & Predictive Analytics (PA) to remain relevant in competitive and dynamic markets by enhancing their offerings in data insight. Construction Industry (CI) has been steadily innovating to respond to changes like the skilled labor shortage, new sustainability regulations, & advancements in tools & software. The study aims to provide an information based on recent aspects of Predictive Analytics (PA), Big Data Analysts (BDA), new emerging construction trends, & some PA examples/opportunities to integrate, & implement in the Construction Technology (CT), & Civil Engineering (CE) for better productivity. Relevant database on these issues are described in the present article in the form of review with deliberation of the following objectives of this study; (i) How BDA & PA is implemented in construction Industry & Technology? (ii) How BDA help Architectural & civil engineering to run projects successfully? (iii) How tools, techniques, & trends are useful in the advancement of CT using models to forecast inventory & managing resources? What are other tools/techniques that are associated with PA & BDA for construction firms? & (iv) How to lead & share the data through advanced research on PA, BDA, & Construction Business (CB) as future insight? Yearly analysis of publications reveals that a rising trend is observed during 2010 to 2020. PA & BDA contribute almost an equal share of information. Integration of opportunities/examples such as risk management, CRM, direct marketing, health, fraud detection, cross-sell & up-sell, & underwriting is addressed in addition of PA & BDA. It is likely to predict that the implementation of these key issues in the CI may turn into a positive way & warrants more research in this direction. Thus it is a challenge for scholars, academicians, researchers & engineers of this current decade in this field.

Keywords: Predictive Analytics, Big Data Analytics, Construction Technology, Civil engineering, Data Analytics, Business intelligence

1. INTRODUCTION

Predictive analytics is the branch of advanced analytics that is used to make predictions about unknown future events. Predictive Analytics (PA) uses many techniques from data mining, statistics, modeling, Machine Learning (ML), & Artificial Intelligence (AI) to analyze data to make a prediction about the future. It has become a popular concept, with interest steadily rising over the years pass according to Google trends. Sriram [104] has well described & explained the definition, intelligence, working of PA & explained how it influences business outcomes. PA refers to using historical data, ML, & AI to predict what will happen in the future. This historical data is fed into a mathematical model that considers key trends & patterns in the data. The model

is then applied to current data to predict what will happen next. He tried to answer in his article on two questions (i) What benefits are companies making by combining their Business Intelligence (BI) drive with PA ? (ii) How does BI compare with PA? It is transforming all kinds of industries. It can catch fraud before it happens; turn a small-fry enterprise into a great strength & save files. Fig. 1a & Fig.1b depict models of working in PA & planning for construction project.

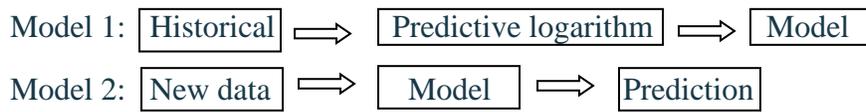


Fig.1a shows models of working in PA



Fig.1b Steps for predictive Analytics for project

Using the information from PA can help companies, & business applications, suggests & leads to a positive operational changes. Analysts can use PA to anticipate a change what would help them reduce risks, improve operations, & increase revenue. Predictive technology tools can be rigid to explain & almost strange to put in digital technologies such as drones, wearable technologies, & Virtual Reality (VR) are changing the approach of companies; address for safety, efficiency, & other industry challenges. PA can be used around the organization from predicting customer behavior & purchasing the pattern to identify trends in sales activities. They also help speculate requests for inputs from the supply chain, operations & inventory. PA is comparatively difficult to handle, & most enterprises do not use them in everyday of business. Larger companies are successfully using prescriptive analytics to enhance production management & inventory in the supply chain to ensure that the products are delivered on right time & consumer service is enhanced [59].

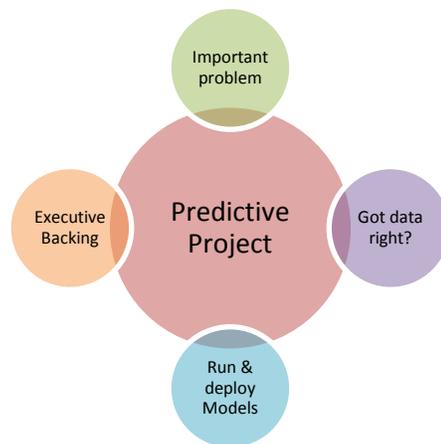


Fig.2 Building information about PA Models/Projects to the business [104]

Several authors have describe definition, database models, algorithms, applications, challenges, & benefits of PA in CT[59][64][79].Big Data solutions are emerging across the CI, driven by increased connectivity & Internet usage, the rapid proliferation of connected vehicles, & the continued investment in BDA innovations. However, the threat of data privacy & security continues to challenge potential adoption as businesses are still struggling to pinpoint how best to monetize these solutions. Several researchers have published many articles on Big data & Analytics pertaining to the present status, opportunities, future trends[12] transformation[16], adoption[91] ,changes & applications [72] for CT/CI/CE. On other hand, recently, Amit Dua [6] has commented on how CI is affected Big Data &Analytics. Advanced CT encompasses a broad variety of modern methods & practices that encompass the latest developments in material technology, design procedures, quantity surveying, facility management, services, structural analysis & design, & other management studies. The new emerging technologies mainly; BIM, AR/VR, modular construction, offsite manifesting, prefabrication, 3D printing, robotics, mobile technology, AI, wearable, architect design, construction software, sustainable construction, green technology, & GPS controlled equipment have been started to adopt in the CI & CE. Civil & architect engineers have analyzed data on technology & innovation transforming all parts of the construction & CE sectors[2][92].With the progress in technology, construction & engineering companies are generating & also capturing more data than ever before. Data collection techniques have also evolved very rapidly. Presently, smartphones, drones, wearable, job site sensors, telemetries, & GPS systems on heavy equipment & other mobile solutions are the preferred gadgets for data collection. Additionally, we incorporate studies on the integration of PA examples & opportunities such as risk management, CRM, direct marketing, health, fraud detection, cross-sell & up-sell, & underwriting along with PA & BDA in the present review.

2. BACKGROUND & RATIONALE OF THE STUDY

Construction technology (CT) is to create the design & erect structure, make & install their various components. This includes the art of building homes, skyscrapers, hospitals, & bridges. It is a field that changes constantly, as the industry comes with new design, new material, & new approaches. Commercial projects use more advanced methods to ensure the strength & life of the project. Recent decades have seen continuing change in the technology, including (i) increased use of prefabricated parts (ii) using a computer to design buildings (iii) green technology to create eco-friendly buildings. Analytics is the discovery, analysis & communication of meaningful patterns analytics. It also entails applying data patterns towards effective decision making. In other words, analytics can be understood as the connective tissue between data & effective decision making within an organization. Especially valuable in areas rich with recorded information, analytics relies on the simultaneous application of statistics, computer programming & operations research to qualify performance. The main theme of the present article is to follow & answer laid-down questions below:

1. How Predictive analytics can drive innovation for CT/CI/CE?
2. What are the common challenges of predictive analytics? How does it work?
3. How Big Data & Data Analytics (DA) are transforming construction?

4. What are possible applications of BDA examples, PA & PA opportunities for construction?

The aim & objective of this paper is to better understand the applications, role & implementation of the PA in the Construction Industry, Construction Management (CM), Construction Technology, & Construction Business (CB) in the current scenario. In India, the CI is an important indication of the state of the economy as it is one of the largest employment generators in the country. The sector serves as one of the strongest propellers of private sector involvement in the country's built environment. Between now & 2020, rapid social and economic changes will significantly increase India's population & the size of its cities, creating huge demand for CI. Recently Thomas Bengali [107] has very well explained various trends that are shaping construction. India will soon have one of the largest shares of the world's building stock, consisting mainly of new developments [42]. While writing this review, the work of Tim Gitter [110] & the report of Predictive Analytics Strategic Council (PASC) stimulated & created much interest to expand it.

3. LITERATURE REVIEW

We have collected references 2000 onwards on overtime, surprisingly, the evolution of digital transformation technologies more occurred after 2015. While writing this paper, notes are jotted down, gathered relevant information, & tried to place at appropriate sections. Care has been taken to acquaint information to update research pattern, applications, methods, suggestions, & tips described in books [26] [41], articles of [90] & [43]. Katerina et al. [61] has published a review article & given detail account on literature review, prescriptive analytics, and literature review & research challenges. We have also adopted the pattern of this article to synthesis the present review. We have outlined this review article considering new & emerging topic. "Big Data and Predictive Analytics drive innovations in Construction Industry". However, such title of the paper has not been appeared in either a comprehensive review or as a book chapter. Hence we thoroughly analyzed PA & BDA studies for construction for the last decade.

Today, construction contributes over 4% to the US GDP - \$826 billion in 2017. Industrial technologies are evolving, & in construction, there is no exception. A Dodge Outlook Report stated that the total construction growth is being continue, reflecting a mixed pattern by project type. The pattern construction starts with more specific segments include single-family houses, multiple housing, commercial building, & institutional building, manufacturing plant construction, public work construction, & eclectic utilities/gas plants [27]. The actual construction-count as CT involved planning & designing. At one level, thus includes specialists in skilled trades, such as carpenters, bricklayers, & plumbers. It also includes architects & designers & the many administrative tasks surrounding building projects, such as: (i) inspection (ii) cost estimation (iii) project management (iv) site supervision, & (v) construction [17] [28]. Self-Healing Concrete (SHC), transparent aluminum, aero gel insulation, robotic swarm construction, 3D-printed houses, smart roads bamboo cities, smart bricks, vertical cities, & pollution fighting buildings are some futuristic CT trends that are paving the way.

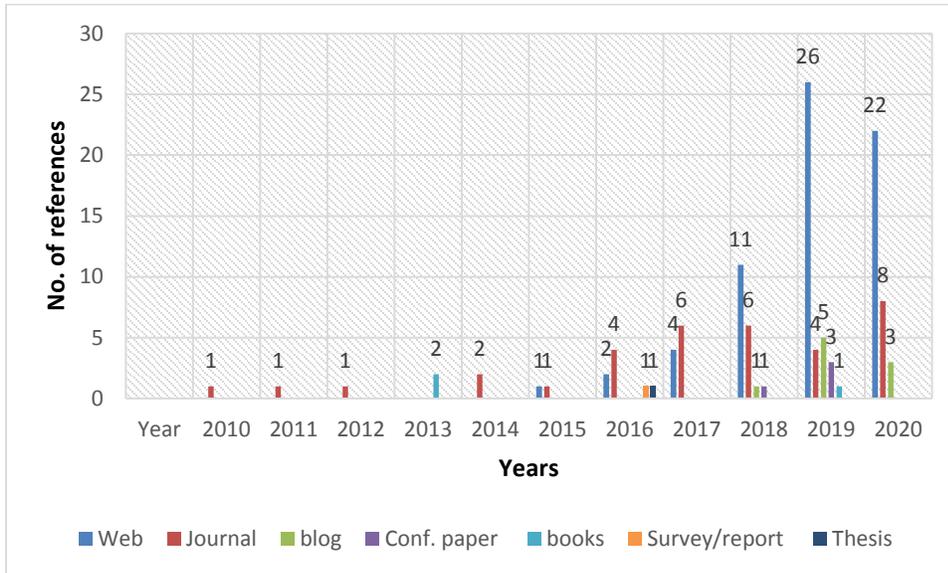


Fig.3a Yearly publications

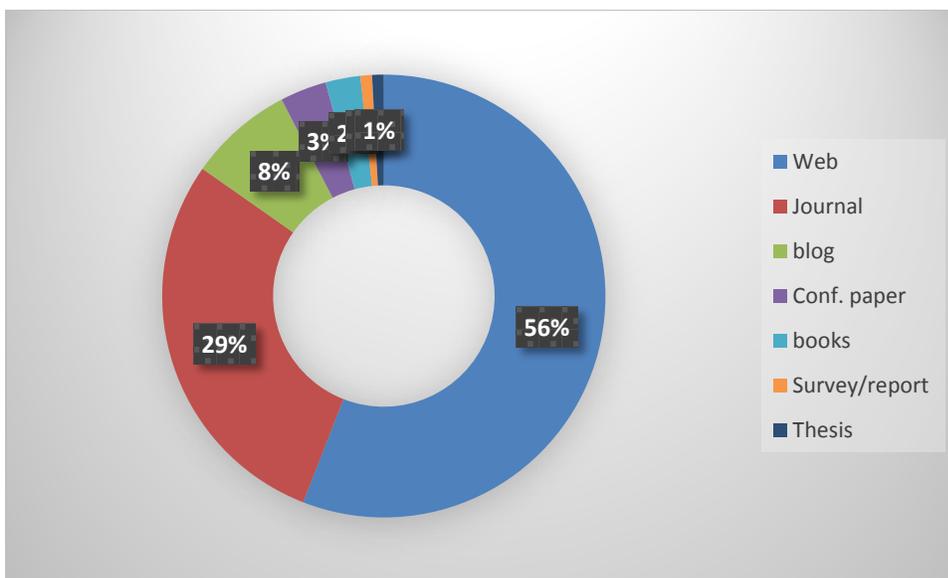


Fig. 3b Distribution of publications.

Fig.3a & Fig.3b shows year-wise publications & distribution of references (%) respectively. Webs contribute maximum share followed by journal articles, blogs, conference papers, books, report & thesis.

The CI has a vast potential & companies are planning & scheduling to implement digitization, innovative technologies, new construction techniques to improve productivity & efficiency. Asil & Rory [9] has analyzed both US Government service providers' internal estimate process & supplier's external estimate process & determined the best approach to use on future task orders.

They used three different classifier methods to perform the data analytic approach. Omran[84]in his dissertation work out on the application of data mining & BDA in the CI. He identified suitable & applicable data analytics techniques for specific construction /research in this direction. Aloysius[4] has highlighted extensively different applications & suggestions with challenges in his paper “ PA concepts in Big Data”. He described the analytics is the process of analysis to predict concealed pattern & associated among data along with definition, procedure, applications in health care, education, &hotel governance &consumer orientation. Mohsen et al.[77] have conducted a survey in the context of big IoT data analytics. They focused their study on (i) explored recent analytics solution (ii) discussed the relationship between BDA &IoT.(iii)proposed an architecture for IoT data analytics.(iv)presented BDA types, methods ,& technologies for big data mining(v) provided some credible use cases (vi) explored the domain & talk over various opportunities brought about by data analytics in the IoT paradigm &,(vii) elaborated open research challenges for future research directions. PA in general is used to detect the relationships & patterns in data in order to predict the future by analyzing the past & taking better preventive decisions. Swani &Tyagi [105] in their survey provided various trends, techniques &applications of data mining .It is becoming key to every organization. PA prevents the degradation through analysis of the fraudulent activities. Poornima & Pushaltha [87] have carried out a survey of PA using big data with data mining. This review paper gives idea to supply data mining techniques & PA on different medical data set to predict various businesses with accuracy level, pros & cons that concludes about the issues of those algorithms & futuristic approaches on big data. In the CI, cost estimates are the basis for which projects are awarded to suppliers. It includes features of accuracy, cost effectiveness & profitability for the supplier. Construction is an industry that impacts the lives of almost every person on the planet. Gayatri Patil [38] has accounted use of new emerging trends adopted in construction. These are: BIM, Augmented Reality(AR)& Virtual Reality(VR), Wearable Technology, GPS, Drones , IoT [32] ,AI[113] , ML, Robotics ,SHC, BDA, & PA[67].The use of these trends/tools/techniques for construction is also reinforce by many authors[15][24][30][39][40][66][107].

Table1: Types of Analytics, Process & Impact Analysis

Sr.No.	Analytics type	Definition &process	Lead to what direction?
1	Descriptive	Data aggression &mining to provide insight into the past	“What has happened into the past”
2	Predictive	Statistical methods &forecasting techniques to understand the henceforth process	“What could happen to understand in the future
3	Prescriptive	Optimization & stimulation algorithms to advise on the possible outcome	“Advice on possible outcomes. What should we do’?”

Source[54]

Companies use forecasts to predict deviations from their plans. Most of the forecasting processes rely on experience based human judgment. Table 1 describes meaning, types of PA & process. Kumar &Garg [64] have summarized PA process, PA opportunities, categorized of PA models, PA techniques & application of PA in detail. They explained various predictive models for scoring data & then forecasting .The accuracy of results by the model depends on the level of data analytics, & various applications of PA. They have also listed out following popular applications :(i) banking & financial services (ii) retail (iii) health &insurance (iv) oil gas &utilities (v) Government & public sector, & cyber security. Jose [58] has stated the value of smart energy management with IoT& PA for cyber security to avoid future cybercrimes. Dmitry [29] has quoted in his article that “AI can provide PA for any kind of business”. It can help us automate tasks. One can determine the right objectives for his business on deep examination. Big data analytics represent the challenges of data that are vast unstructured & fast moving to be managed by traditional methods. Singh et al. [100] dealt with analytics importance on big data, different aspects on big data such as storage techniques & tools used for big data analysis. Farraukh [33] has extensively elaborated on PA & comprise a variety of statistical techniques from predictive modeling ,ML& data mining .He analyzed current & historical facts to make predictions about future of digital technologies.

A large quantity of terabytes data is produced each day from present day information structures& automated advances. Mothe et al.[78] has explored the capability impact of large facts ,challenges, open research problems, & specific gadgets associated with big data analytics. The description given by authors also offers a stage to explore big data at various degrees. (i) maximize use of data (ii) digital modeling & (iii) advanced technology & impact on construction the future construction is built on digital transformation & the construction sector can lead the way to industry 4.0 now. Big data analytics also opens another skyline for experts to execute the arrangement in view of the demanding situations & open studies trouble. Reference [40] also of the same opinion & agreed with these statements. Planning, supply chain, risk management, budgets & cash flow, procurement, quality management, have been discussed in the report of [27]. Companies have started to embrace data-driven solutions while establishing a foundation for future initiatives [37].The PA produced wearable devices, combined with behavioral changes by employees &corrective measures by leadership, present new opportunities to significantly reduced construction workers injuries [74].

Construction firms are starting to move into arenas such as real-time, cloud-powered analytics of large & unstructured data sets. Bernard Marr [16] has stated that over next five years big data & analytics would be radically transform both the process of construction & the business of contracting. He further stressed future brightness for those companies which are able to embrace data analytics & new technology to innovate how we construct things. A comprehensive & exhaustive report is published[94]in 2020 ,entitled ,”Innovations in AIPA & BIM 2019”.In this report the total key topics are 31,& out of them 6 are based on recent applications of BIM & construction engineering. Sandra Durcevic[98] has mentioned top 10 Business Intelligence(BI). These are: AI, data quality management, data discovery, augmented analytics, collaborative business intelligence, data automation, mobile BI, embedded analytics, data driven culture, & predictive & prescriptive analytics tools. Michael (2019) [47] has suggested four uses of PA to reduce workplace injuries. (i) Predict an injury before it happens (ii) see insight unique to each site (iii) real-time processing, & (iv)open access. Reducing workplace injuries is a huge

benefit to manufacturing companies because fewer injuries mean less time spent away from work, no compensation to be paid, no productivity lost. It is reported [47] that innovations in CT poised to disrupt the industry. Lior [66] has mentioned 14 of the most innovative CT advancements. These are likely to see in the coming year. Some of the CT advancements are: LiDAR, humanoid labors, robot swarms, drones, connected hardhats, smart boots, smart infrastructure, AR/VR, wearable AR, AI, BIM software, material advancements, eco-friendly construction tech, PA & supply replacement. Major technology trends to watch 2019 are IoT, AI & ML, AR & VR, autonomous equipment & PA [73]. Jane [48] has addressed the importance of the fourth industrial revolution that become reality without a fully digitalized engineering procurement & in the construction sector. Edge computing IoT applications can transform the industry by now. Various stages have been laid down in a process of standardization in innovation in the CI. A wearable technology presents the opportunity to improve efficiencies, safety, reduce injuries, & enhances quality of life for construction workers. Adam Higgins [3] has proposed IoT, AI/ML, VR/AR, wearable technology, & PA as 5 major CT trends for construction. The predictive systems can anticipate problems as well as opportunities & give project managers insight into critical decisions.

Kenny Ingram [63] has proposed three predications for the future. Prediction 1: those industry challenges that embrace digital change will enjoy increased productivity through 2025, Prediction 2: offsite manufacturing will grow by 50% between 2023, & Prediction 3: the challenges are coming & existing market position will recognize, restructure and revolutionize. Reinventing construction is the key to improving productivity. This reinvention refers to not only inventing advanced materials & equipment but also developing new operating systems for construction projects. Recently, Sabet & Chang [96] revealed that a wide range of productivity fundamentals those are able to reinforce new advanced techniques through different pathways of their application. John, & Tracy [57] presented a case for one of the largest fund raising organizations who used analytics several years ago to mitigate the impact of a negative economic environment & continues to raise efficiently. Michelle Meisels [75] has described recent information on Midyear 2020 engineering & CI outlook & evaluated the key trends, challenges & opportunities that may affect construction business & influence industry strategy for the remainder of 2020. Very very recently, Tim Gattie [110] has published very informative article on “Applying of PA in CI” & proposed three models of PA (Fig. 4). The purpose of this paper is to investigate different & potential use of PA & Big Data with some emerging trends adopted for CT/CI/CE. A note of possible PA opportunities & BDA examples is appended as key issues presuming that they will contribute and integrate through PA for construction in near future.

4. THE MAJOR AREAS OF THE STUDY

The science of predictive analytics can generate future insights with a significant degree of precision. With the help of sophisticated PA tools & models, any organization can now use past & current data to reliably forecast trends & behaviors milliseconds, days, or years into the future

4.1. Implementation of PA in construction

Predictive analytics tools give users deep, real-time insights into an almost endless array of business activities. Tools can be used to predict various types of behavior & patterns, such as how to allocate resources at particular times, when to replenish stock or the best moment to launch a marketing campaign.

Virtually all PA adopters use tools provided by one or more external developers. Many such tools are tailored to meet the needs of specific enterprises & departments. Major PA software & service providers are listed. AUTOCAD for Drafting; STAAD PRO for Design & Analysis; PRIMAVERA for Construction Management; REVIT Structure for Building Information Modeling.; ETABS for Design & Analysis; SAP 2000. ARCGIS for Surveying. Autodesk BIM 360; Touchplan; Assemble; Synchro PRO; CMiC Platform ,Intra.; SmartPM.;& Apollo Platform[10]. For big data 10 tools are recommended. These are Hadoop, MapReduce, Spark, Hive, Storm, Samza, Flink, Heron, Kudu & Presto[22][45].

Construction business faces a major productivity challenges. We have consider four points to study the role of PA for CT/CI/CE .These are:(i) to understand the nature of the business problem in question to solve it, (ii) what data needs to be prepared for analysis, (iii) what model has to be built, & refined, & (iv) how to put prediction into action for positive outcomes to framework through PA favorably, accurately & effectively. Table 2 describes an account regarding name of the author, year of the publication, trend & impact on PA & lastly the reference number.

Table 2: Applications of PA for CT /CI/CE : 2010-2020

Sr. No.	Author/ Year	Title	Tool/ trend	Impact/application	Ref.
1	Samuell & kappius (2011)	“PA in information system research”	PA	PA could add theoretical & practical value in information system research. Six roles of PA explained..	97
2	Chen et al.(2012)	“BI: From BD to big impact”	BDA, P A	Proposed BI & A framework, suggested academic & industrial applications	20
3	Aloysis & Bhanumati(2017)	“Predictive analytics concepts in big data-A survey”	PA+B D	Highlighted may applications & challenges. Described the process of analysis of data	4

4	Fatimmetou & Mohumad (2017)	“The application of PA: benefits, challenge’s &how it can be improved”	PA	PA benefits & challenges, improvement in PA tool, Used as a solution to solve many problems in different industries.	34
5	Sriram (2017)	“What is PA?”	PA & BI	Definition of PA, different models explained, compared business intelligence with PA,	104
6	Asil& Rory (2018)	“A PA approach to determine construction cost estimates “	PA	PA approach to determine construction cost. Accuracy, cost effectiveness profitability for the supplier are included	9
7	Gayatri Patil (2018)	“Recent aspects of digitalization for CI”	PA+ others	Digital transformation for CT /CT: Described many tools, techniques & trends for construction.	38
8	Jose Tan (2018)	“Smart energy management with IoT& PA”	PA	Smart energy management with IoT& PA will help to improve production ,plan efficiency, & productivity	58
9	Kumar, &Garg (2018)	“PA:a review of trends & techniques”]	PA	PA in banking & financial services, health insurance, retailing, cyber securities etc. are given.	64
10	Rhumbix (2018)	“10 new CT trends to watch “	PA+ other Trends	Better collaboration discovery & analytics tools are driving the industry, reduce project cost &duration ,helped a construction firm with risk management.	95
11	Acitve vizards(2019)	“Top 8 Data Science Use cases in construction’	Data Science	PA: game- changing solution for the CI, applied to make estimation & avoid failures in the future.	1

12	John Edwards (2019)	“What is PA?, Transforming data into future insight”	PA	PA,PA models ,techniques, algorithms, examples are efficiently explained	54
13	Adam Higgins (2019)	5 major CT trends to watch in 2019	PA/BI M	Included PA along with other trends, highlighted innovative solutions.	3
14	Analytics Solution (2019)	“Predictive Analytics, What it is? Why it matters?”	PA	Defined a term PA, Examples, Benefits, various applications described.	7
15	Andy Patrizio (2019)	“Top PA Examples: Analytics for Business Success”	PA	PA changing business by using data mining, statistics, modeling, AI &ML to predict trends, with an eye toward gaining a competitive edge.”	5
16	Daniel Faggella (2018)	“PA for marketing- what’s possible &how it works?”	PA	PA modeling for customer behavior ,right approaches for market, customer real-time &content	23
17	Farrukh Mushtaq (2019)	“Predictive analytics”	PA	PA reviewed in detail & provided exhaustive information for construction planning, scheduling, designing trough PA.	33
18	Innovation &disruptions: (2019)	“CI innovation: DA & technology tools”	PA+ others 3 trends	Adopted emerging tools, t techniques for CT. Watch the standards on safety ,efficiency & challenges in CT/CI.	40
19	Jane Ren.(2019)	“Analytics, predictive jobsites can transform construction”	PA	Maximize use of data, digital modeling , advanced technology & impact on construction four pints elaborated.	48

20	Jenn Goodman (2019)	“Innovator of the year: PA strategic share PA strategic along with PASC members”	PA+ other trends	Considered labor shortage, Request for information(RFIs), to help combat jobsite safety incidents via tech-enabled tools .	55
21	Lior Zitsman(2019)	“14 CT advancements to watch in 2019”	PA+ other	PA & supply replacement is tool out of 14 CT advancement ,discussed trends to watch in 2019.	66
22	Madanayake & Egbu(2019)	“Critical analysis for big data studies in construction:significant gaps in knowledge”	BD,PA &others	Identified the gaps and proposed potential for future research avenues in big data and use of other tools in the CI	71
23	Metalcon.com (2019)	“Metal Construction Trades” Top ten-trends- in CT ”	Pa +others	Five trends in CT are listed & stated applications in CI.PA provide project managers insight into critical decisions.	73
24	Michael Dixon (2019)	“How to reduce workplace injuries with PA ”	PA	Predicting on injury before it happens, real-time processing, open access , reduce risk.	74
25	Muhamad Imbran (2019)	“Predictive examples in 2019”	PA+ others	Defined a term PA,PA examples, PA software, forge better relations with customer	79
26	Nick Ismail Marr(2019)	“Embracing PA in the forth industrial revolution.”	PA	The fourth industrial revolution is going to completely transform every single business & aspect of society.	81
27	Yvonne & Lisa (2019)	“Digital revolution will transform the steel industry”	PA, Big Data	Steel & metal companies could quickly capitalize new technologies with PA	114
28	Admin(2020)	27 emerging in civil engineering to watch in 2020	PA+or her trends	PA is about to make Risk management much easier. Possible to manage companies risk through the use of PA.	2

29	Huntley (2020)	“Construction Analytics”	PA	Construction &PA, mentioned cause of failure rates for large capital projects & it can be solved on applying data analytics	44
30	Jeff Rubenstone(2020)	“PA strategic council outlines benefits for construction,2020”	PA	PASC stated that PA can be incorporated into construction firms’ workflow to reduce safety incidents. Outlined many Benefits for CI/CT.	49
31	John&Trecy(2020)	“Successfully implementing Pain direct marketing”.	PA	A case study, PA direct marketing ,to mitigate the impact of a negative economic environment	57
32	Management:(2020)	“AI ,Predictive Modeling &Risk .management”	PA,AI	Applying PA in construction, basic models of PA, reduce risk	69
33	Research &Markets.com’s report:(2020)	“Innovations in AI, PA, & BIM”	PA,AI, BIM	Innovations in ICT have deeply permeated various applications and markets.	94
34	Tim Gattie(2020)	“Applying PA in construction”	PA	Provides guidelines on incorporation of PA output operational processes of construction firm. Collaborated with members of PASC.	110

PA=Predictive Analytics, BI=Business Intelligence, DA=Data Analytics ,BD=Big Data

4.1.1. Construction industry has been steadily innovating to respond to change like the skilled labor shortage, new sustainability regulations, & advancements in tools & software & the resulting tech is just as futuristic. Any successful predictive analytics project will involve following steps:

i. Identification & knowing about past data

Fig. 1a gives idea for Model 1 & Model 2 where we learn value of history, new data & prediction. Fig. 1b outlines the sequential steps for the process of implementation of PA. What are valuable business decisions one has to make with the insight? Knowing this is a crucial first step to applying predictive analysis (ii) Consideration of present data &: Is given operational system capturing the needed data? How clean is it? How far in the past do you have this data, & is that enough to learn any predictive patterns .Probable explanations and answers are described in [54][104].PA concept for industrial business is outlined in Fig.2.

ii. Working system & outcome prediction

When building our PA model, we have to start by training the system to learn from data. For example, this model might look at historical data like click action. By establishing the right controls & algorithms, we can train our system to look at how many people that clicked on a certain

link bought a particular product & correlate that data into predictions about future customer actions (Fig.2).The characteristic of the PA model should eventually be able to identify patterns &/or trends about the nature of customers & their behaviors. Trends & patterns will inevitably fluctuate based on the time of year, what activity of business has underway & other factors. Set a timeline maybe → once a month or once a → quarter to regularly retrain the PA learning module to update the information.

4.1.2. Innovator of the year: Predictive Analytics Strategic Council (PASC)

The PASC, founded in last year, encompasses some of the largest players in commercial construction. The council uses the available data to build AI-based predictive models for safety & risk [55]. Fig.4 illustrates three types of predictive models & their impact on business. We have already discussed definitions of the different types of business analytics: descriptive, predictive, & prescriptive. It illustrates the solution for analytics & business impact for three types of analytics[110]. PASC outlines incorporation of PA into construction firm workflows in many ways to reduce safety incidents by warning companies of similar situations that have led to previous accidents & disasters. This statement is supported by study of [49].

4.1.3. Predictive Analytics in information system

Prescriptive analytics makes use of ML to help businesses decide a course of action based on a computer program's predictions. Samuell&Koppius [97] has highlighted the need to integrate PA into information system research in their research essay. They described six roles of PA: new

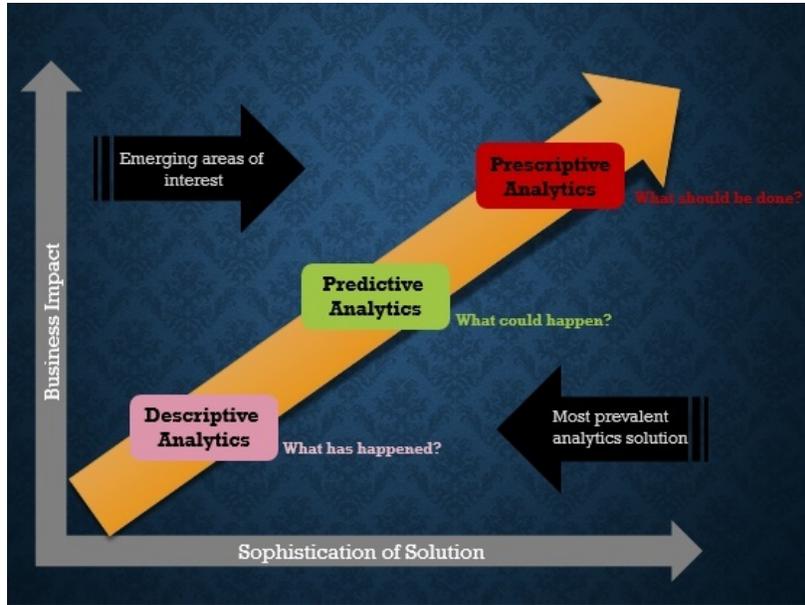


Fig. 4 The different types of models and their value [110]

theory generation, measurement development, comparison of competing theories, the involvement of existing models, relevance assessment, & assessment of the predictability of empirical phenomena. PA & explanatory statistical modeling are fundamentally disparate and they showed that they are different in each step of the modeling process. Ultimately they concluded that PA can add theoretical & practical value to information research. Most individuals in the industry understand & the importance of PA in construction, but the concepts behind tools & algorithms are daunting. These are hard to explain & not easy to apply. The company's approach for PA to construction is motivated to demonstrate emerging themes & approaches within the CE professions. PA is presently one of the most significant big data trend.

4.2. Execution of Big Data (BD) & Data Analytics for CT/CI/CE

PA is the subset of big data. It has few key characteristics such as volume, sources, velocity, variety & veracity. The use of predictive data analytics has been managing its many parties (engineers, construction subcontractors, construction managers, owners, employees, etc) & finding ways to heat the labor shortage, increase efficiency, & decrease safety related issues. The use of data analytics will play a large part in companies of the future. Data can enhance industry experience & expertise provide transparent & streamlined information, & drive more efficient work processes across a construction organization. Various reasons to study the implementation of BD in CI are: (i) need for BD in CI, business profitability & sustainability markets & customers, (ii) sustainability & resilience, (iii) & need for society & workforce. Big Data can transform the CI in two ways: (i) Modules of BDA in construction & (ii) Big Data can help track & manage projects. Some of the key challenges include a lack of reliable data sources, concerns about data security & individual privacy, & a lack of specific big data-related skills [11][101]. The challenges in big data includes, capture, curation, storage, search, sharing, transfer, analysis & visualization of the data. Table 3 gives detail of applications of BDA in PA for construction.

Table 3: Impact of Big Data Analytics (BDA) for PA in CT/CI/CE

Sr.No.	Author/Year/source	Title	Tool/trend	Impact/application	Ref.
1	Lu et al. (2014)	“Recent progress &trends in predictive visual analytics”	BD , PA	Data mining & ML developed, statistics applied, included model building, model validation &workflow..identifies the common framework.	68
2	Anette et al.2016	“Big Data in Construction Management Research”	BD	Identifies studies describing big data applications &research in CM.	8
3	Benjamin et al.(2016)	“BD &PA applied for supply chain ‘	BD ,PA,	Importance of supply chain for PA &Big data in CI explained effectively.	13
4	Bilal et al. (2016)	“Big data in the CI: a review of present status ,opportunities & future trends”	BD	Reviewed past present & future status of big data in CI in detail.	12
5	Bradlow et al. (2016)	“The role of big data of & PA in retailing”	PA;BD	PA & Big Data ,retailing, aided by newer source of data, application of statistical tool & domain knowledge emerge.	18
6	Omran(2016)	“Data mining &big data analytics in CI”.	BDA & data mining.	Identified a suitable& applicable data analytics techniques for specific construction, to provide potential research directions.	84
7	Gameil & Nithya (2017)	“Challenges &open research issues &tools on big data analytics “	BD	To explore the potential impact of big data challenges, open research issues, & various tools associated with it.	36
8	Mohsen Marjani (2017)	“Big IoT data analytics :Architecture, opportunities, & open research challenges”	BD , IoT	Given information & data on big data analytics & challenges, a relationship of BD with IoT& also provided valuable credible use cases..	77
9	Prarthana.& Jebah (2017)	“The challenges& opportunities with big data “	BD	Applications of big data analytics for CI/CT/CE are described in depth.	86

10	Sivrajah et al. (2017)	“Critical Analysis of Big Data Challenges & Analytical Methods”	BD	Contributed accrual of intellectual wealth to the BDA in technology & organizational resource management discipline.	102
11	Research & Market : (2018)	“Application of Big Data Analytics in CI :2018-2022”	BDA	Expected to transform growth in CI on applying big data for construction .	93
12	Singh et al. (2018)	“Tools used in big data analytics.”	BDA	Over looked aspects on big data such as analysis, storage techniques .Tools used in big data analysis.	100
13	Siti et al. (2018)	“An appraisal into the potential application of big data in the CI”	BD	Catalyst for creating an awareness to support the development of big data for the CI.	101
14	Ran Avers (2018)	“Five ways data is assisting the construction & civil engineering industry”	Five Ways+ Big Data	Engineers evaluated historical construction data to assess risks & avoided potential project setbacks. Highlighted 5 innovation ways to help engineers.	92
15	Tiffany Hosely (2018)	“Reinventing construction industry with big data analytics”	BDA	Real-time predictive data is a game changing solution to the longstanding ills plaguing the CI. Game changing data drive improved labor productivity.	109
16	Zafira, et al.(2018)	“Big data in the CI: potential opportunities & way forward.,	BD	CI can greatly benefit from BD, validate the potentiality opportunity of BD in CI.	116
17	BADAN (2019)	“How big data is transforming the construction industry”	Big Data	Explained various tools/techniques for transformation in the CI.	11
18	Burger Richel (2019)	“How the construction industry is using big data “	Big Data	Big Data is already being used by the CI ,considered design-build, operate lifecycle that increasingly defines construction projects today.	15
19	Garoet al. (2019)	“How analytics can drive smarter engineering & construction decisions”	Analytics	Infrastructure, construction decision, outlined major productivity challenges in construction business.	37

20	Mary Shacklett (2019)	“How analytics is helping build up the CI”	Analytics, BD	Analytics, big data, drones coming together advised for better project management.	70
21	Melissa Burns(2019)	“How big data changing CI”	BD	Role of big data in CI, positive effect ,BD is most trending tool for companies.	72
22	Mothe et al. (2019)	“Challenges open research issues &tools in big data analytics”	BD	Explored the capability impact of facts, challenges open research issues & particular appliance in concern with big data.	78
23	Nikolay& Venera (2019)	“Big data technology in construction”	BD	New trends such as BIM, IoT, cloud computing ,intelligent buildings & smart cities with great prospects for application .	83
24	Ram Jiwat et al. (2019)	“Adoption of big data analytics in construction: development of a conceptual model “.	BDA	Three factors: technological, organizational & environmental are described. Designed of a new model of BD adoption in construction.	91
25	Sandra Durevic (2019)	“Top 10 analytics & business intelligence trends for 2020”	Analytics+ other trends	Predictive & prescriptive collaborative business intelligence, explained the data driven culture.	98
26	Sonia Jobhson (2019)	“Using analytics to drive, smarter engineering, &construction decision”	Advanced analytics	Optimize existing projects, drive smarter engineering & construction decision.	103
27	Warton’s Lynn Wu(2019)	“How data analytics can drive innovation “	Data Analytics	Discussed on different organization structures that influences the use of data analytics to spur innovation.	111
28	The future of construction global 2030 (2019)	“The future of the world construction industry to 2030:”	BDA	Predictive job sites transform construction Revolutionary trends impacting the state of Construction Industry.	108
29	Amit Dua (2020)	“How CI is affected by big data & analytics”	BDA	Improved processes, conferred more benefits for construction projects.	6

30	Jha Deepak Kumar (2020)	“Future of big data analytics applications in India”	BDA	A huge impact in a wide of industries & continue to gain momentum diversified sectors:, telecom, BFSI, healthcare transportation &logistics.	60
31	Michaela Wong (2020)	“How BD and analytics are transforming the CI”	Big data, analytics	Explained many issues for transforming the CI Big data and analytics hold the key to the future and made valuable insights from big data ,essential for any modern business to succeed.	76
32	Sabet& Chang (2020)	“Pathways for the improvement of construction productivity”	BD ,BIM,AR/V R+ others	A perceptive on adoption of advanced technology, developing new operating systems for construction projects.	96
33	WS Alaloul et al. (2020)	“Industrial revolution 4.0 in the CI challenges, opportunities for stakeholders”	BD	Identified problems for delay implementation of Industrial Revolution(IR) 4.0 .discussed opportunities &challenges for long run.	112

Big Data Analytics =BDA, IoT=Internet of Things, BIM=Building information Model ,AR/VR=Augmented & Virtual Reality ,Construction Management(CM)

4.2.1. Impact of PA on big data & business intelligence

Business intelligence (BI) & analytics have emerged as an important area of study of both practitioners & researchers, reflecting the magnitude & impact of data-related problems to be solved in a contemporary business organization. Chen et al. [20] has defined a framework that identifies the evolution, applications, & emerging research areas with BI (Business Intelligence) &A(Analytics), BI &A.1.0., BI &A 2.0 , &BI &A 3.0. They also reported a bibliometric study of critical BA &A publications, researchers, & research topics based on related academic & industrial applications.

4.2.2. Big Data PA in retailing

Currently retail businesses across the world are facing many challenges. Bradlow et al.[18]has revealed the opportunities in &possibilities arising from bid data in retailing, particularly along five major data dimensions-data pertaining to customer’s products, time, geo-spatial location, & channel. They highlighted the ethical & privacy issues that may arise from the use of big data in retail. The role of big data & PA retailing is set to rise in importance, aided by newer sources of data & large-scale co- relational techniques. The output on data quality, application possibilities developed from mixing new data sources, a small application of the statistical tool & domain knowledge arise as continuous efforts of authors from three consecutive years 2014, 2015, &

2016.Reference [82] has worked out the retail pricing optimization. Retail data analytics is going to change the retail business scenario dramatically in 2020.

4.2.3. Critical analysis of big data challenges & analytical methods

Identification of knowledge gaps help keep academic research move forward for continuous improvement while learning[71]. Lu et al.[68] has surveyed recent progress & trends in predictive visual analytics systems operate data cleaning, feature selection, model building, model validation, & workflow. BDA is increasingly becoming a trending practice that many organizations are adopting with the purpose of constructing valuable information from big data. Sivarajah et al.[102] have extensively carried out a systematic review on the basis of information extracted from peer-review journals between 1996 &2015 from the Scopus database. Their studies have contributed both conceptually & empirically to the expansion & accrual of intellectual wealth to the BDA in technology & management.

4.2.4. Built environment project & asset management

Big Data (BD) is being increasingly used in a variety of industries including construction. Yet, little research exists that has examined the factors which drive BD adoption in construction .Ram et al. [91] has addressed this gap in their article, “Adoption of big data analytics in Construction Development of a conceptual model”. Madanayake & Egbu in the same year identified the gaps and potential future research avenues in the big data especially in the CI[71] & their findings are correlated with earlier authors. The design of a new model of Big Data (BD) adoption in construction is illustrated in Table 4.

Table 4: Design of a new model of Big Data (BD) adoption in Construction

Sr.No.	Aspect	Implementation
1	Technical	Augmented BD-BIM integration
2	organizational	Improved design &execution efficiencies &improvement capabilities
3	environmental	Augmented availability of BD-related technology for construction
Solution		Adoption of a new model of BD in construction

Ram et.al [91]

4.2.5. Healthcare Big Data Analytics & Fraud Detection

The era of big data has opened the door in the health care industry as a response to the digitization of healthcare data [4]. Data mining & ML techniques are mainly used for fraud detection in healthcare [105]. Recently, Raja et al. [89] has extensively elaborated & summarized the existing literature based on healthcare big data. It also helps the researchers with a foundation for future study in healthcare contexts. They also stated different trends, characteristics of big data, types of healthcare big data, challenges in healthcare, various issues in healthcare big data, applications of big data & healthcare benefits. In the same article, they further emphasized fraud detection & its prevention [35]. It is one of the major and important applications of data analytics in the healthcare sector. The present study will help the researchers with a useful base to understand the overall context of healthcare big data & its applications.

4.3. Encouraging to predict PA opportunities & BD examples as key issues for construction business.

Data is emerging as the world’s newest resource for competitive advantage among nations, organizations & business. PA is reflected in today Big Data Trends, and its tools are essentially Big Data Technologies. Each industry & sector puts PA to work in different ways. We break them down by industry and use case. Big data has changed the way we manage, analyze, and leverage data across industries. The following notable key issues have to be considered to include in PA opportunities and BD examples for making big changes in the construction industry.

Table 5: Sharing of PA opportunities/examples for CT/CE/CI

Sr.No	Author/Year	Title	Key factors /drivers	Impact/application	Ref.
1	Zavadskas, et al.(2010)	“Risk assessment of construction project”	risk	Decisions making as risk management results in construction projects .Five steps of process management are given.	117
2	Christopher et al. (2015)	“A review of CRM implications :benefits, challenges in construction organization”	CRM	Discussed benefits & challenges to CI at a strategic business & operational level.	21
3	Chamrima 2017)	“Cross-selling strategies & Data Driven Analytics”	Cross-sell, up-sell	Meaning, examples up sell documented, some the key to driving business growth in financial sector.	19

4	Dash, et al.(2019)	“Big data in healthcare: management, analysis & future” prospects.”	Big data+ healthcare	Explained the nature of big data in healthcare, &management analysis of big data in detail.	25
5	Eileen et al. (2019)	“Consideration of predictive modeling in insurance 2019”	PA+ health	PA application, Health maintenances, insurance .	31
6	Swati Sahai (2020)	“5 essential steps to find upsell &cross –sell opportunities with journey analytics”	PA	Provide new product recommendations efficiently execute &measure cross –sell & upsell complains in real-time.	106
7	Bergain Adiar(2020)	“The future of CRM in 2020 &beyond’	CRM	CRM, marketing ,sell organization, scope of it discussed .	14
8	Jim Davis(2020)	“PA in underwriting”	PA ,underwriting	Explored the use of big data analytics to streamline automated underwriting processes, in the mortgage industry.	52
9	Jennifer Xue (2020)	“How to use PA for better marketing performance”	PA in marketing	Various steps of PA process given,,8 use cases for PA marketing is accounted .	51
10	Jessika Kent 2020	“How big data analytics model can impact healthcare decision-making”	Big data, HealthCare	Big data analytics model helps improve care delivery, allocation of resources, &preventive health measures.	56
11	Kenny Ingram (2020)	“Predictions for engineering, construction infrastructure”	Predictions for CT/CI /CE	IoT, BIM, ERP software ,Ikea Increased productivity ,offsite manufacturing through 2015& revamp market position.	63
12	Michelle Meissels(2020)	“Midyear 2020 engineering &CI outlook”	Other trends	Explored engineering & CI trends & the impact of COVID-19 on construction is given..	75
13	Nabawy et al(2020)	A systematic review of quantitative risk of	risk manageme	In practice Worldwide mega projects, risk analysis as well as contractors	80

		construction of mega projects	nt	working of it.	
14	Quantzing: Healthcare provider Analytics: (2020)	“Pros & cons of predictive analytics in health care”	PA+ healthcare	Three benefits of PA analytics in healthcare are enumerated. A smarter approach to set out the difficulties in healthcare decision –making deployed.	88
15	Yaseen et al.(2020)	“Prediction of risk delay in construction projects using hybrid AI”	Risk ,sustainability, CT	Construction project management monitoring & sustainability, robust & reliable technique for project delay prediction	115

4.3.1. Customer Relationship Management

CRM implications, benefits and challenges are well documented [21] for construction organizations. It has become a vital skill for both providers & insurance companies looking to promote wellness & reduce long-term spending & predicting patient behaviors is a key component of developing effective communications & adherence techniques. Bergain Adiar. [5] has explained the future of CRM in 2020 & extended it with marketing strategies & planning in organization to execute. PA can support population health management, financial success, & better outcomes across the value-based process [50].

4.3.2. Collection Analytics

As collection development has become increasingly informed by data, a subset of the collection development role has emerged called collection analysis, sometimes also referred to as collection evaluation or assessment. It is necessary to plan analysis by deciding which data to be used [59].

4.3.3. Risk Management

PA improves firms’ efficiency & reduces risk. A financial institution, credit scores are used to assess a buyer’s likelihood of default for purchases of financial products & are well-known examples of applications [117]. These authors suggested & guided for decision making as risk management results in a construction project. It is seen from a report of Management [69] AI, PA modeling application reduce risk. Advanced analytics & predictive modeling are used in underwriting to help assess & score a customer’s risk (Table 5).

4.3.4. Direct Marketing:

It is well-known fact that computers are so much more accessible than they ever have been, & possible to know why predictive analytics is being used by businesses in industries of all kinds. Common uses include: (i) improve efficiency in production (ii) gain advantage over competitors (iii) reduce risk (iv) better marketing campaigns, (v) detect fraud, & (vi) meet

customers' expectations Organizations are turning to PA to help solve difficult problems & uncover new opportunities. Daniel Faggella [23] has proposed five major current applications for marketing. These are i) predictive modeling for customer behavior ii) quality & prioritize leads iii) bringing right product /services to market iv) targeting the right customer at right time with the right content iv) driving marketing strategies based on PA insights[51]. Jennifer Xue[51] precisely used PA for better marketing performance. She has given various steps of the PA process & also described 8 use cases for PA marketing. PA can be successfully implemented in direct marketing[57].

4.3.5. Fraud Detection

Fraud has become a trillion dollar business today. It is prevalent across almost all industries and has become more rampant and complicated. Enterprises are constantly struggling to implement effective and efficient fraud detection systems [35]. Businesses need new technologies, like PA to improve worker safety even more. Predictive data analytics is a technology that predicts future needs. Every enterprise knows the importance of adopting a comprehensive fraud detection system that is effective in detecting & preventing fraudulent activity [105]. The key forward is to convert domain knowledge regarding fraudulent behavior to real-time fraud rules use Markov modeling & ML to detect unknown behavior & use a scoring function to reduce the number of false alarms being raised. Patil et al. [85] have discussed a big data analytical framework to process a large volume of data & implemented various ML algorithms for fraud detection on a real-time basis resulting in low risk & high customer satisfaction.

4.3.6. Cross-sell & Upsell

PA helps customer for cross-sell opportunity & identify which customers are likely to buy additional products. In cross sell customer buys products in different categories other than already have [106] mentioned five steps (i) Take a journey based approach (ii) build multichannel retailing customer view (iii) create dynamic customer segments based on behavior (iv) use predictive analytics to provide new product recommendations (Hyatt Hotels uses PA to boost revenue), & (v) efficiently execute & measure cross-sell & upsell campaigns in real-time. She sums up her article with a conclusion that by taking a journey –based, data-driven approach, both B2B & B2C could find cross-sell & upsell opportunities. Chamria [19] has quoted that “Cross-selling strategies & data-driven analytics is the key to drive business growth in the financial sector”. These are Business models, big data revolution, engaging the customers, & customer-centric operations. Building effective cross-selling strategies, are providing the key challenges area for financial institutions.

4.3.7. Underwriting

PA streamlines the process to improve underwriting accuracy & efficiency. Jim [52] has stated the importance of predictive analytics with four keywords: Cognitive insight, loan-classification modeling, volume forecasting, & rules-based modeling without any statement on construction, building, or infrastructure. Underwriting has traditionally necessitated a fine balance between “art & science”, we know the equal value of both, and also technology cannot be completed without knowledge of both.

4.3.8. Healthcare Analytics

We have already discussed about healthcare big data analytics and fraud detection under 4.2.5. Here we consider it as PA example/opportunity. Kylie Watson [65] has summarized the significance of PA in healthcare along with benefits for PA in the health sector [31]. Dash et al. [25] have illustrated PA modeling in insurance in detail. Benefits of PA analytics in healthcare are : (i) improving the operational efficiency of business processes (ii) accuracy of diagnosis & treatment through personalized medicine & drug therapies & (ii) increase insights to enhance cohort treatment. They explained very well the nature of big data in healthcare along with planning & scheduling for the management & analysis of it for healthcare. The information has been the key to a better organization & new development in healthcare management. [62] [118]. BDA models can help policymakers make more informed healthcare decisions contributing to better public & population health. Researchers, providers, & policymakers are turning to big data analytics models to help improve care delivery, allocation of resources, & preventive health measures. The current COVID10 pandemic is perhaps the most notable example of organizations leveraging BDA models to inform decision-making [56]. Very, recently, Singh [99] stated in her research article “The health & wellbeing benefits of green buildings” that as India is fighting the Corona virus pandemic, green-certified buildings & facilities will provide tremendous health & well-being benefits apart from resource conservation.

CONCLUSIONS

The future of construction is built on digital transformation & the construction sector can lead the way to industry 4.0 now. The engineers & CI trends overall market growth despite cost pressure, labor shortage, & trends towards fix-bid projects, which are likely to persist in the future. Many Indian firms have put advanced platforms & applications augmented by AI/ML; the analytical tools have now become more user-centric. The present study is initiated with PA key terms, working, & models, type of models algorithms, & applications & benefits of its in construction. Further, it is extended with BDA, new emerging trends for CI/CT/CE. At the end, we have a focus on applications of CI research through PA & shared the data /information as future insight. On the basis of recent data given previously in the text, we would like to put the following observations & inferences for the future of the construction. It is our belief that this study would precisely fill the gaps in understanding various issues discussed here for construction.

(i) The present paper comprises different literature sources. It includes studies pertaining to current aspects based on literature sources, & major contribution is from the web, followed by journal papers & so on.

(ii) A significant rise in construction big data & predictive analytics is identified with an increasing trend in number of yearly publications. The contribution & sharing of literature for PA is close to BDA for CI.

(iii) The prime focus of this paper is the implementation of PA in CI/CT/CE, principally includes 34 publications, some of them represents examples of PA (Table 5). This study is extended with the role of big data analytics for these firms. PA is the key to successful marketing campaigns.

(iv) Big Data has become common as a business term in most businesses. Execution of big data analytics in construction reveals that BDA is much needed for carrying a survey. It is a successive component of this study. Big data will continue to have a positive effect on the whole CI, & it will become more readily available. However, companies will need to learn how to adopt this technology, & to relish these vast benefits. Businesses worldwide are leading the way for a paradigm shift with the evolution of big data. In India, big data analytics technology is creating a vast impact on a wide number of industries & continues to gain power.

(v) We focused to attract the attention of readers to incorporate advanced technologies described in tables 2, 3 & 5 for the curriculum of universities, academic institutions seeking to understand & the value of these technologies in construction.

(vi) The potential of PA for CI is expected to integrate some PA examples (key opportunities) to drive innovations in CI. These will result to orient them towards efficient practices, better productivity, & more benefits, reduce risks, & adoption of methods for managing workflows in construction companies.

(vii) Out of 8, PA opportunities/examples, CRM, risk management, healthcare, marketing for CI are available in the literature, however, for cross-sell & up-sell, fraud detection, underwriting is yet not fully materialized in the science & engineering for integration in construction. Much data is expected to come out in the future to realize their integration in emerging trends for appreciable results with high productivity in construction organizations.

(viii) The construction is a part of the country's overall economic industries & is a long-standing industry. The CI is under a significant paradigm shift. The experts believe we can expect to see the most noticeable trends in CI next year. Experts initially quoted, that "2020 is expected to be a breakthrough year for the CI". Now it is very difficult to say firmly that it could persist since Pandemic COVID19 at the beginning of 2020. It is still continued. It is observed that during the period of pandemic COVID19, more use of prefabrication & modularization adopted by construction companies. Eventually beginning 2021 year will emerge new idea, direction, and data & hope it will build new avenues in the growth & productivity with high efficiency of E & C firms, nationally as well as globally.

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