Gayatri Mahajan, 2022, 10:1
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

Exploration of New Emerging Trends during Midyear 2020, For Building Construction & Civil Engineering: An Overview

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Abstract- The change is constant but evolving to future demand & is the need of construction. Advanced construction technology (CT) covers a wide range of modern techniques & practices that encompass the latest developments in material technology, design procedures, quantity surveying, facility management, services, & structural analysis & design, & other management studies. In this paper, we have incorporated & adopted technologies mainly; BIM, Augmented Reality/Virtual Reality, modular construction, offsite manifesting, prefabrication, 3D printing, Robotics, Mobile technology, AI, wearable, architect design ,construction software, sustainable construction, green technology, &GPS controlled equipment for better understanding and their utilities in the construction industry(CI)& civil engineering (CE) also. This study also extends & cover objectives based on (i) to set a revolution in CI/CT trends (ii) How technology is changing the CI/CT (iii) Advanced BIM application in CI (iv) the new age of CE& CT (v) looking to the future advances in CI. It also reveals that practicing these technologies, in CT/CI/CE increases levels of quality, efficiency, safety, sustainability, & economics. The data & information comprise of recent sources such as websites (68%), journals (15%), blogs (8%), survey & report (42%), books (2%), Conference & proceeding papers(3%), & thesis(1%) analyzed in-depth useful for academicians, engineers & students also. The results reveal that construction trends vary from 5 to 10; however it reaches 27 in case of CE. The perspective of the most recent innovation, trends, tools, challenges, & solutions adopted in the field of building construction & civil engineering is emerged for near future.

Keywords- Construction Technology, BIM, GPS, Civil Engineering, 3D Printing robotics, Modular construction.

I. INTRODUCTION

Construction starts with planning, design, & finance. It continues until the project is complete & ready for use. The C I trends are changing the business & global landscapes. By adopting new practices, technologies, & investment in new projects, builders & developers can induce profit. The CI is a part of the country's overall economic indicators & is a longstanding industry.

Buyer (2017) analyzed various problems related to CI of India & quoted in his article "Construction in India, key trends & opportunities to 2020". In the year Hudson has predicted innovative aspects concerning to digital future for infrastructure & the statements are supported by Kaplinski (2018).

Technological advancement will lead to innovation in construction (Kendall Jones, 2018, Lim et al, 2019). In the year 2020, contractors will leverage the most recent technologies & business models to create vital strides in potency & stay competitive against

the scenery of recent market entrant. As construction firms all over the world push to find new ways to complete in 2019, innovations in CT are proving to be one of the most important ways to do it. The leading edge seems to move at light speed & it can be hard to keep a track of innovations as the next big thing over shades the impact of tools, we have only just begun to explore. As we look forward to the 2020 year of development & CT innovation, we have complied current list of most exciting trends in this fast moving field.

For firms that actively embrace technology in the quest for improved safety, efficiency, & quality, these are trends to watch IoT, AI & ML, PA (Predictive Analytics), VR/AR, Autonomous equipment, & wearable in CT. In the year 2020 an increase will be seen with the use of technologies such as 3D printing, drones, Cloud Computing, modular building, wearable safety devices, & BIM changing the construction project are managed & implemented (Hamid, 2016, Cearly, 2017, Hudson, 2017, Michael Tobias, 2019, Genie Belt,2018, Mills, 2019, Anurag, 2020, Zang et al., 2020). Technologies such as AI, VR/AR are remarkable tools in our hands that serve to improve worker performance & efficacy. (Rumbix 2019).

Far from replacing the human workforce, they are bound to enhance onsite safety (Mills et al, 2019). 3D printing is by far the biggest disruption that CI has experienced so far. It allows for more design flexibility (Arlinda, 2020 & Lior 2020). In the coming decade, there is disruption on the way. Modular construction will increase by 50% by 2023. (Kenny Ingram, 2020).

The majority of technological advancements fueled by AI are replacing workflows rather than people. AI will create more jobs than it eliminates this year (2020) (John Kelly, 2020).

A book was written by Babu et al. (2020) on Emerging Trends in Civil Engineering based on proceedings of the International Conference on Emerging Trends in Civil Engineering (ICETCE 2018) gives an insight to emerging topics such as smart materials & structures, green building technologies, & intelligent transportation system is beneficial for students, academicians, industrialists & researchers working in the field of civil engineering & architectural engineering. This review paper aims toward facilitating aspiring students.

II. BACKGROUND & RATIONALE OF THE STUDY

In our previous communication we reported implementation of digital technology reformation techniques, tools, & trends adopted for the construction industry. These include AI, ML, BCT, CC, Automation, & disruption in the CI. (Gayatri Patil, 2018) Several Web posting, journals, blogs, reports/surveys, & thesis are continuously appearing in the literature & this trend is found 2015.

Therefore, we thought to accommodate & focus & write an article based on new emerging trends at glimpse, most likely to be useful for academicians, budding research scholars, architects, engineers & professionals. This study extends our previous work & encompasses objectives based on the current trends /tools /techniques adopted for building construction & construction technology/construction Industry. This overview primarily focuses some unanswered & mind boggling questions on construction individual.

- How to set revolution in the CI/CT trends?
- How technology is changing the CI/CT?
- What are advanced BIM applications for the CI/CT?
- What is the new age of CI& CE tools?

III. LITERATURE REVIEW

The construction segment is established to the third world's largest industry, with a size of $ 1 trillion by 2025. The CI is a part of the country's overall economic indicators & is a longstanding industry. The trends in CT are changing the business & global landscape as it is consistently evolving with new innovations. Construction has elements & tools to break out as the next productivity revolution.

Synthesis of this article is done on the basis of literature regarding information collected from Web, internet, journals, conference papers, theses, books, blogs, & reports/surveys mostly during the year 2016-2020. The pattern & format are referred from the books (Ray, & Laurence (2016) & combine this article on the basic information is laid down (Ramdhani, 2016). Previously, Gayatri Patil (2018)

reported recent aspects of digital technology transformation for CI, considered most of the tools, techniques, & trends available during 2014-2018. Further, she extended her studies specifically tools like CC, AI, BC, & ML implementation in detail for the construction Industry. Now here she focused this study on new emerging trends for CI to watch in 2020 in the form of review article.

Blanco et al (2017) in their article title "The new age of engineering & construction technology' stated that the new technologies are transforming all stages of the engineering & construction process & 10 points are included. In the same year, Brett Long (2017) announced 6 types of CT technologies impacting the industry. Kendall Jones, (2018) mentioned 8 technological trends for the US commercial construction industry documented in the literature.

Paul Wallest (2019) introduced a cloud-based collaboration to robotics & AI an incredible array of developments in improving the building & infrastructure development happening in India. Technology top 5 trends that are shaping the future of construction. (WEF, 2016, Michael Wright, 2020).

Home byes & technology, sector role in adopting international best practices, prefabricated construction, green construction, micro-apartments, 3 D printing, & BIM are seven trends prescribe to adopt a new CT in India. (Mammen, 2019). In the coming year suggestions & implementation of new trends appeared in the literature.

Lets Build (2019) has given 9 main construction technology/trends. Further, Jack Ball (2019) mentioned the top 10 CT trends adopted in the construction industry with some additional trends like automation, & AI/VR etc. Michaela Wang (2019) compiled a list of the top 10 trends in 2019 & she believes that these are key advancements in the CI through 2020.

Gaurav (2019) predicted India's CI is set to emerge as the third-largest market in the world by 2075. Admin (2020) pointed out 27 top emerging trends in civil engineering. The list is too long. Figure1 illustrates that the highest number of resources are in the current year, & the least numb in2015 year. It shows pattern of distribution of references year wise.

Joe Beeton (2019) suggested 5 ways for construction that will evolve in 2020. Kasey Panetta (2020) extensively described Gartner's top 10 strategic technology trends for 2020.

These are hyper automation, multi experience, democratization, human augmentation, Transparency & traceability, The empowered edge, The distributed cloud, Autonomous things, practical block chain, & AI security. Table 5 summarizes in detail the name of the author, the title of paper, tools, trends, & techniques applied in construction & civil engineering.

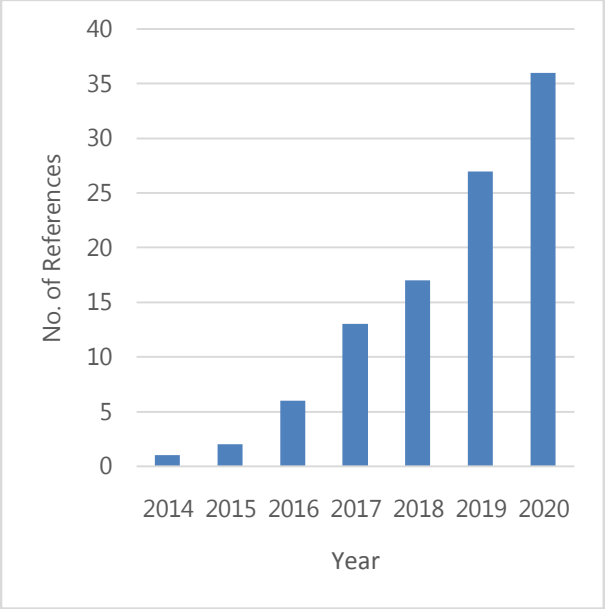

Fig 1. Year-wise progression of references undertaken for review.

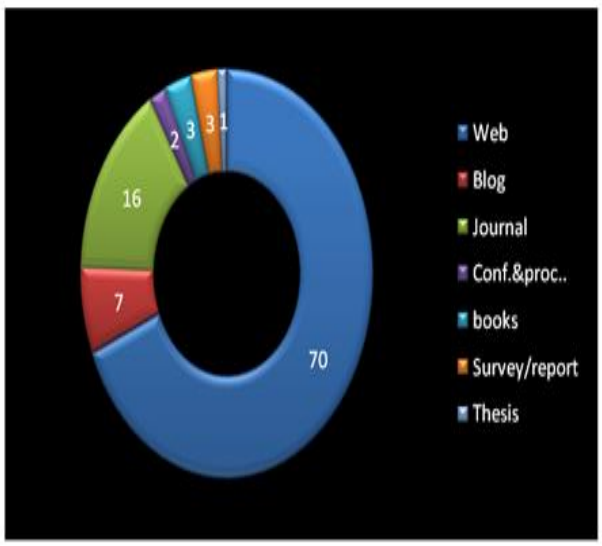

Fig 2. Distribution of reference sources undertaken for preparation of current review.

This table shows how new emerging trends of construction are evolved. Table 1 & Figure1 describe the year-wise progression of references & distribution of sources of references undertaken for the synthesis of this review respectively. However, the year 2020 is halfway therefore we expect total references will be more than 30, it will reach 60 &/or more than 60, assuming that COVID 19 pandemic does not affect much.

It is clearly seen from Figure 2 that the web is the best source of information, followed by journal, blog, conference paper, report/surveys, & thesis. This observation is very close to our earlier communication. (Gayatri Patil, 2018, 2019a & 2019b).

IV. MAJOR AREAS/ISSUES UNDERTAKEN FOR THE STUDY

CT in India, despite its large-scale rollout, remained rather sluggish in adopting new techniques & tools. However; it is the second largest industry in India & has shown promising growth in the past year with a re-energized output of around 8%. CI has been steadily innovative to respond to changes like skilled labor shortage, new sustainability regulations & advancements in tools & software & resulting tech is just futuristic.

It is likely that Engineering & construction companies plan to invest 5% of annual revenue in digital operation solutions over the next five years. This study is to provide recent trends adopted to use in Construction.

Construction Industry (CI), Construction Project (CP), Construction Technology (CT), Construction Business (CB), & Civil Engineering (CE).

1. How high technology revolutionizes architectural design?

Architecture revolution follows technological changes. IEEE defines architectural design as "the process of defining a collection of hardware & software components & their interfaces to establish the framework for the development of a computer system."

The software that is built for computer-based systems can exhibit one of these many architectural styles (Hodge, 2018, & Archistar Academy, 2020, Cagaff et al, 2020, Thomas & Charles,2020). Table 1 gives an idea about the architect's software's for future architecture design & routine use also.

Table 1. Architect software's for future Architectural Design.

Sr. No.	Author	keywords	Significance
1	Sebastein Lucas (2016)	5 major technological shifts that made the future of architecture.	• BIM rise • Parametric architecture –is a new way to design a shape, which eventually ends up building. Architecture robots & 3-D printers Smart device –a sensor & internet software, & Collaboration, crowd sourcing, co-design.
2	Ricardo Alverez (2017)	Thrilling technologies	Generative design Additive design, 3-D printing & robotics Architecture apps & cloud services – BIM, & Virtual, augmented & mixed realities.
3	Lucie Gaget(2017)	Top 16 of the best 3-D modeling software for architects in 2020.	ArchiCAD, Revit, Cedreo, AutoCAD architecture ,AutoCAD Civil3 D, Chief Architect, All Plan, Vector work Architect ,Microstation, Bricscad BIM, Rhino 3D ,CATIA, SketchUp,3DStudio Max ,CorelCAd & Solidwork .
4	Greg Geilman (2018)	Revolution points of the architecture world	• 3-D printing machine make building better Digital sketchbooks make saving &

			displaying renderings easy Smart technology affects home designs & building designs Climate change predictive software VR make models more realistic than ever • Photorealistic rendering create a colorful picture of finished product ,& • Architecture continues to advance with technology
5	Mark & turner (2019).	8 best architecture software's of 2020 & other four softwares	Easy to make digital design & model for buildings. 3DS Max, Civil 3D,auto CAD, CATIA, Chief Architect ,Revit, Rhino 6 , SkechUP, TurboCAD Deluxe, Free CAD, Solid works & Corel CAD .
6	Maria & Santos,(2018)	Project management software to manage business	Software's for: project estimation, to improve accuracy, process standardization & automation, improve technologies efficiency ,migration to industry focused software & other technologies like drone, robotic, automation equipments,AR,3D ,cloud mobile & BIM Software.

2. Advanced BIM technology applications:

BIM is currently considered the most innovative methodology across the construction sector. BIM is widely seen as a catalyst for innovation & productivity in Computational Intelligence in Biometrics & Identity Management (CIBIM) & can be adopted in developing countries. Table 2 summarizes advanced BIM technology & its adoption& significance in CI/CT & CE.

Table 2 Advanced BIM technology adoption 2016-2020.

Sr. No.	Author	Aspect	Significance
1	Rosali 2018	" Applications of BIM overbuilding life cycle	Implementation of BIM overbuilding life cycle with a view of addressing the challenges & future research proposals
2	Mostafa et al(2018)	Consideration of Key performance indicators(KPIs)	They identified & prioritized the BIM applications towards KPIs in the light of the construction stage of the projects life cycle
3	Hamid &Dossic (2016)	BIM curriculum design in architecture engineering, & construction education.	To support & activates throughout the life cycle of projects, bringing about a wide range of benefits for various aspects of the delivery process.
4	Lee et al,2019	BIM adoption	BIM technology applications in a number of ways.
5	Tatajan et al,2019	BIM technology integration	With Web, AR, fabrication to speed up overall productivity
6	Donald Berry	Real estate	Important for

	et al (2019)		commercial real estate (CRE) business & real estate industry of tomorrow.
7	Koseoghu et al (2029)	A case study	BIM-enabled digital transformation in megaproject & gave detailed account on the Istanbul new airport as a case study.
8	Ganbat et al (2020)	uses of mapping BIM	Mapping BIM risk mitigation international construction projects.
9	Moreno & Raja (2019)	CE education facility projects	Use of BIM for architect-engineer & construction AEC industry in education facility projects
10	Arlinda Sipila (2020)	New upcoming trends	Pointed out nine new & upcoming CI trends resulting from BIM adoption
12	Zen et al (2020)	Megaproject delivery	On benefits prioritization analysis on adopting BIM systems with regard to effectively dealing with major challenges in megaproject delivery.

3. Technology set to revolutionize CI trends in 2020:

The year 2020 will see the use of technologies such as 3D printing, drones, cloud computing, modular building, wearable safety devices, & building information modeling (BIM) changing the way construction projects are managed & implemented. Mahashreveta, (2019) has stressed some points to revolutionize CI trends in 2020 & these are supported by Gaurav, (2019).

3.1 Large scale government investment: The government devised major plans for infrastructure development in the country with an aim to strengthen India's housing, ports, railway network, roadways, & water supply. It has also given a serious boost to CI by arising up with a single-window clearance facility for all construction projects within the country. (Future of construction,2019)

3.2 Towards a brighter tomorrow: Private players are able to bring in some of the best technological innovations from around the world to India in recent years; Fueled by an excellent movement of population on towards urban shores, the demand of residential construction is estimated to extend by leaps & bounds. To crater this demand private players are embracing new-age construction technologies for faster progression, achieving shorter project deadlines, & better quality of construction. With private players rushing in to fill the gaps & take the leading edge innovation will bring in some of the most exciting trends in the field of CT.(Ellis,2019)

3.3 Technology as disruption & not a threat to human resource: The year 2020 will see the use of technologies such as BIM, AR/VR, 3-D P, WE, MT, AI, CC, MC, RB&CT changing the construction project are managed & implemented. (Arlind Sipila,2019).

Table 3 reveals analyzed data for emerging trend & frequency & Table4 summaries detail of new emerging trends adopted for 2015 -2020.

Table 3. Analysis of emerging trends adopted for CI/CT/CE for 2015-2020.

Sr. No.	Trend/tool/ technique	Abbreviation	Adoption frequency*
1	Building Information Modeling	BIM	20
2	Augmented Reality/Virtual Reality	AR/VR	19
3	Robotics	RB	15
4	Prefabrication	PF	14
5	3-D-Printing	3-DP	13
6	Mobile	MT	12

	Technology		
7	Artificial Intelligence	AI	12
8	Wearable	WE	11
9	Green Building /technology	GB/GT	10
10	Drone	DE	09
11	Internet of Things	IoT	09
12	Modular Construction	MC	09
13	Automation	AM	08
14	Cloud Computing	CC	08
15	Sustainable Construction	SC	O6
16	Self Healing Concrete	SC	05
17	Blockchain	BC	04
18	Machine Learning	ML	04
19	Construction Software	CS	04
20	Predictive Analytics	PA	02
21	Exoskeleton suits	ES	02
22	Advanced Building Material	ABM	02
23	Global Positioning system	GPS	02
24	Digital Tween	DT	02
25	Autonomous Equipment	AHE	01
26	Sustainable Design	SD	01
27	Autonomous vehicle	AV	01
28	The Environmental Built	TEB	01

• Other terms(trends) are described in text.

4. New emerging trends for CT & civil Engineering:

The construction industry is constantly evolving. The years 2020 is predicted to be a breakthrough year for the CI. The construction industry is under a big paradigm shift. The experts believe we can expect to see the most noteworthy trends in the CI next year/future.(Cas,2020). Table 5 is the extension study of table 4 for CE for 2017-2020. Table 6a & 6b gives evidence for total number trends adopted for CI/CT/CE.

Table 4. Summary for CT/CI new trends studied during 2017-2020.

Sr. No	Author / Year	Title	Trend No.	Abbreviation	Impact/ response/role
1	Brett Long 2017) .blog.devicemagic.com	6 types of CT to be used in future	6	MT,DE,BIM,VR/WE,3-DP,AI	Sustenance growth, competitive & better workflows
2	The Rumbix blog www.rhumbix.com/2018	10 new construction trends to watch 2018	10	PF,3DP,GT,WE,AR/VR,RB,CC, BCI,PA,ABM+mobility	Better collaboration, discovery, analytics tools driving the industry
3	Michael Floyd(2018)	5 trends to watch for green CT	5	Construction: industrialized,& circular, BIM, Cost saving & energy	Play in managing scarce resources.
4	Igor Bebriakov 2018/medium.com/activ wizards)	"The top 10 technology trends of 2018	10	AI,BC,ML,IoT,+other-5	New approaches evolving

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10	9	8	7	6	5
Kasey Panetta (2019).	Lets Build (2019) letsbuld.com	Jack Ball (2019). onstructionweekonline.	Render3DQuick.blog[20 19. ww.render3dquick.cor	CT nnovations:(2019)biblus.accas ftware.com	Technology (2019)news:ww w.construction weekonline.com
"Gartner top 10 strategic technology trends for 2020	'Top 10 CT trends for 2020	" The world's top 10 CT trends to watch in 2019	3 technology trends fo he use in commercial C	"10 trends for 2019 that will evolutionize the AEC industry	he world's top 10 CT trenc to watch2019
10	10	10	8	10	10
BIM,AM,WE,AI,ML,IoT,CC,RB, C&sensors	R,BIM,PF,SHC,DE,RB,CC,MT GPS,CS	MT,DE,AM,AR/VR,CC,AI MB,WE,SHC,SC	BIM,3DP,PF/MC,MT,WE RB,AR/VR,AI	MT, DE, BIM, PF, RB,,AI, IoT, WE,AR/VR,3-DP	AI,AM,DE,AR/VR,MB,BIM,W SHC,GB,3DP
Growth,drive significant disruption ,idea for"people-centric smart spaces"	Emphasis on collaboration higher productivity & fewe painful project delivery	Boost efficiencies &quality,improve site health & safety as well	Applying revolutionary echnology for busines development	Leveraging technology to improve CI	Tools are lowering barriers to productivity

16	15	14	13	12	11
Mills,2019). https://www.the 1m.com/	Michaeliawang (2o19) esub.com	Cristopher Mc Fadden (2019) .www.interestingeng neering.com	Michaela Wang 2019) https://esub. om/	Pant Wallest (2019) cioeconomictimes.indiat mes.com	Kim Slowey(2019). constructiondive.com.
9 construction trends to watch in 2010	'Top 10 CT trends to look ou for in 2020"	7 CI trends to watch 202 "	10 CI trends to look for 2020	top construction trend to watch out for 2020	7 trends that will shape commercial construction in2019
8	10	7	10	5	7
RB,DE,3DP,AR/VR, E S, AV,ABM, ,TEB, jobsite	MT,DE,BIM,PF,MC,GB,AR/VR CS, SC +other	VR/AR,3DP,RB,SC,PF/MC,EX BIM	CS,RB,GT,MC, /PF,,SC,BIM,AR/VR +other	BIM ,AM ,AI, IoT,RB	MC, RB,+ others
shapes how every human being on Earth is able to live their lives.	Project management solution key advancements in the CI through2020	Motivate to replace tradition method & aspirat to move advance trends	Advancement ,trend to stay competitive	Collaboration ,infrastructure development	Technology supplements not replacing human workers

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21	20	19	18	17
Arlinda Silpa (2020) cioeconomictimes.indiatimes.cor .www.megicad.com	LiorZitzman (2020) https://www.bigrentz.com/	LP Building Solutions.https://lpcorp.com/b og/2020	Construct & connect:bim36 esources.autodesk.com Fel 15 2019	Mahashreveta Choudhary 2019
" 9 upcoming CT trends resulting from BIM applications"	" CI trends you must know"	Top 5 construction trends mpacting the industry in 202	5 major CT trends to watch in 2019	Blog technology trends that revolutionized A E C industry in 201
9	10	5	5	8
AI,BIM.RB,3DP.SC,AR/VR,PF, WE +digital twins & model	B,DE,3DP,AN,MT,AR,BIM,CS,M ,PF +others	DE,3DP,MC,PF,BIM	IOT,AI/ML,PA,VR/AR,AE	oT,AI,VR/AR,WE,CC,BC,BIM,digitaltw n,real-real-time data
BIM adoption, modeling	outlook for CI is positive, Companies moving away from megaproject	operate a construction / remodeling business,	Next generation of digital natives	Revolution in AEC industry

26	25	24	23	22
Michael Georgiou (2020.imaginovation.net	Biblus.com 2020)www.biblus.accasoftware.c m	Joe Beeton(2020) constructiondive.com	UK Connect:(2020)www.ukconn ct.cSom	Anny Hottmann (2020) cioeconomictimes.indiatimes.com
digital technology trends fo the CI	10 CI trends in 2020 to watch in 2020	Top trends 5 ways construction will evolve in 2020	10 CT Trends impacting the industry in 2020	"5 CT to watch 2020"
7	10	5	10	5
MT,,BIM,PF,WE,AR/VR.3DP,AI	MT,DE,3DP,PF,RB,AN,WE,GB.,SHC CA+scanner	MB,AM + others	IM,DE,AN,AI,IOT,AR/VRMC, PS,3DP,SC	BIM,3DP,AI,MB,SC
Provoke use of digital technologies trend for CI	Revolutionize the CI in 2020	Shape the way contractors do business & build structures	Better collaboration ,projec evolution resulting in real-time	*Major role in all facets of constructio industry growth*

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29	28	27
Nikita Duggad 2020 17Julyhttps://www.simplilearn	construction technology (,2020)pbctoday.co.uk	John Kelly www.contractormag.co m
Top 8 technology trends for 2020	5 CI trends to watch in 2020	Major growth expected for PF &MC
8	5	4
RB,AI,VR/AR/ML,IOT BC, edge computing, cyber security	RB,GC,CS,EX,BIM	GB BIM,PF,MC
These trends suffering from shortage of skilled workers.	Making life easier	More Productivity

Table 5. Guideline for CE New trends studied during 2015-2020.

Sr.No.	1	2	3	4	5	6	7	8
Author	ackson,F(2015).www.ra conteur.net	Flatword olutions:www.flatworsso lutions.com(2018)	Outsource2india:www.outsour ce2india.com (2018)	WorthView: www.worthview.com. 10 dec.2019	Admin(2020). https://www.const ructionplacements.com	Benthany (2020)	*Building radar.com. 2020,jan14*	Liam Stannard (2020). www.bigrentz.co
Title	Top 10 building innovations for civil engineers	6 latest trends in CE for 2018	Top 8 upcoming trends in CE for 2018	7 key construction ndustry trends in CE to watch 2020	Top 27 emerging trends in civil engineering to watch in 2020	5 trends in sustainable building for 2020	20 construction industry trends to watch 2020	CT to watch for 2020
Trend No	10	6	8	7	27	5	20	16
Trend	SHC,CS,3DP,MC,CC,+ot hers	BIM,MC,BIG DATA +others	AR/VR/AR,BIM,SD,DE,ABM,IoT, 3DP,RB	AR/VR,BIM,SD,ABM,IoT, 3DP,RB	Almost all are included given in Table 3	Green energy, water conservation, better building design, energy efficiency,	S,AI,BM,AR/VR,3 DP ,BC RB, MC, PF, SC +other	Refer text*
Impact	Create a wave of innovation within CI	Visualization to mainstream information –reach building tool	Civil engenderers placing more emphasis on computer vision, smart cities	echnology can become obsolete really fast	higher productivity rates, reduce painful project delivery	Conserve environment, eco-friendly approach, save the planet.	Discover the most important trends & developments in the CI	Growth, Eco-friendly construction tech

5. Technology is changing the CI /CE:

In India, the CI is an important indicator of the state of the economy as it is one of the largest employment generators in the with strong linkages to industries such as cement, chemicals, paints, tiles, etc., the sectors which are of the strongest propellers of private sector involvement in the country's built environment. Between now &, 2050 rapid social & economic changes will significantly increase India's population & the size of its cities, & rapid growth of civilization leading a huge demand for the CI.

India will soon have one of the largest shares of the world's building stock, consisting mainly of new development. Shobha (2019) has started new edge technologies for CI. She focused on the use of aluminum shuttering, prefabricated construction, & drywall systems. Bhatiya (2020) stated in his article "How technology is transforming the CI". He comments that the CI has a vast potential, & companies are focusing on implementing digitalization, innovative technologies, & new construction techniques to improve productivity & efficiency.

Table 6. Year-wise No. of trends for CI/CT/CE for 2017-2020

Sr. No.	year	Frequency							Total
		10	9	8	7	6	5	4	
1	2017					1			1
2	2018	2					1		3
3	2019	6		2	2		2		12
4	2020	3	1	1	2		5	1	13
Total		11	1	3	4	1	8	1	9

Some of the trends that anticipates pivotal role are as follows: (i) Real-time information through software & mobile apps (ii) Transforming product development through offsite construction (iii) Use of construction technologies to bring down. (iv) Disruptive & exponential technologies to accelerate innovation.

Use of drones & site sensors for fast-track surveying & construction cost. Currently, the industry is leaning toward factors influencing like skillful labor shortage, new sustainability rules, & advancements in information technology & software, & the resulting tech is just futuristic. Things like robot workers to 3 D printing homes have become a reality, actually there are numerous advancements happening so quickly that sometimes it's just a blink eye. Liam Standard (2020) summarized 16 trends in his article " CT to watch 2020".

This list includes: (i) LIDAR ,(ii) Humanoid Labor (iii) Robot Swarms ,(iv)Drones ,(v)Connected Hardhats, (vi) Smart boots ,(vii)smart infrastructures, (viii) VR/AR,(ix) Wearable AR ,(x) A,I (xi) BIM, (xii) PA .Supply replacement , (xiii) software, (xiv) Material advancement,(xv) Eco-friendly construction Tech,(xv) Electric trucks & Delivery vans, (xvi) Modular & prefabricated construction, (xii) 3-D-printing, (www.bigventz.com).

Major advancements are construction trends to keep everybody's eye on in 2020. BIM, robotics, VR, Wearable Tech, & green technology in construction (Jessica Tabinor, 2020) www.marson.com. A few aspects of advances in 2020(i) efficiency (ii) safety, & (iii) communication, are described (AZ BIG MEDIA, 2020). The construction sector is undergoing a radical change in recent years, looking back a few years ago, the progress made is evident. More recently, new10 CT trend to watch in 2020 according to construction expertare available. (biblus.accosoftware.com).

6. What is the new age of civil engineering & CI?

Civil & architect engineers analyzed data on technology & innovation transforming all parts of the construction & civil engineering sectors. New materials & energy, design approaches, as well as advances in digital technology & big data, are creating a wave of innovation within the construction industry. With the introduction of smart roads & more energy-efficient housing, the need is there for construction to get smarter & more efficient too.

Table 7. Year-wise new trends for CE (2015-2020).

Sr. No	Year	Trend No. (Individual)	Frequency /year
1	2015	10	1
2	2018	6,8	2
3	2019	7	1
4	2020	5,16,20,27	4
Total		8	8

With more innovative tools & techniques appearing all the time, the significant t industry-changing examples (Jackson, 2015) of the new technology

used in CE today are; i). Self- healing concrete, ii). Thermal bridging, iii) Photovoltaic glazes, iv). Kinetic Footfall, v). Kinetic Roads, vi) Predictive Software ,vii). 3DModeling, viii) Modular Construction, ix) Cloud Collaboration, x).Asset mapping.

6.1 Coming as technology startups & upcoming trends: By providing advanced software, construction-focused hardware, & analytics capabilities, these innovative start-ups are eliminating many of the problems that have dogged the E&C sector for decades, including difficulties compiling & sharing project information. To help E&C companies navigate the l & scape & develop more effective deployment strategies, Blanco et al (2018) have analyzed more than 1,000 construction-software start-ups & their products. They identified common use cases for which software tools are being developed across all project phases (design, preconstruction, construction, & operations & management). Authors have also reviewed data from McKinsey Global Institute's Construction Productivity Survey, which received responses from more than 200 senior E&C executives & mentioned most of the techniques as stated earlier in tables. (www.worthview.com (2019), www.render3quick.com, 2018; www.google.co.in 2019; www.constructionworld.in, 2020).

More recently, Michael Georgiou (2020) has given 7 digital technology trends for the CI & CT in 2020. She expressed her view as these are futuristic technology trends for construction with additional statements for Trends likeAI, BIM, Robotics, prefabrication modularization, & eco-friendliness, SHC, cloud, & mobile tech & drones. Big Data, Cloud Computing, Augmented Reality & Virtual Reality, RPA (Robotic Process Automation), IoT (Internet of Things), Civil engineering technology new Photovoltaic glaze are recommended. One of the most exciting new technologies used in CE is building integrated photovoltaic (BIPV) glazing, which can help buildings generate their own electricity, by turning the whole building envelope into a solar panel.

A web source that is out source2india.com mentioned: "top 8 upcoming developments & trends in civil engineering for 2018 & beyond" (www.outsource2india.com) VR/AR, BIM, sustainable design, drone, advanced building material, IoT,3 D-printing & robotics that are parallel gaining prominence. This article provides a mash-up of the latest developments in civil engineering that are becoming the latest trends. Table 7 summarizes the top 10 predictions for digital future for the infrastructure industry (Biblus.com, 2020).

Table 8. A digital future for the infrastructure industry: Top 10 predictions.

Sr.No	Particular aspect	Result	Response/Impact
1	Risk cover	Become increasingly focused on innovation & both contractors & customers	Become less risk-averse
2	Shape of infrastructure	Will change significantly	Products & services new business model
3	Infrastructure	Use of new material, Concrete, & steel	Adopt & Respond surrounding
4	New jobs in the industry	Create/disappear	Low or zero skill roles
5	Thinking only design & construction	Become outdated concept	As infrastructure becomes multifunctional
6	Robotics	Able to run more efficiently, quickly.	Reducing costs & overages per project.
7	3 D & 4-D printing	Construction will get faster	Self-transforming object, self - assemble
8	Disruptive ideas	Emerge for Making transit faster	Safer & less damaging the environment
9	Wearables technology	Increase productivity	Accessible to the industry, customer friendliness ,easy access
10	Direct neural control	Over devices & vehicle	Easy to approach

6.2 Sustainable construction: Sustainable construction brings along the principles of green building strategies & eco-friendly values in a bid to lighten the environmental impact of residential & commercial structures. The concept encompasses using resource-efficient construction methods for the design, construction, maintenance, renovation &

deconstruction buildings (Smartsheet.com, 2018, Building Solutions, 2020).

Neill Gatley (2020) described the reasons for the importance of sustainable construction. Sustainable buildings are designed to help reduce the overall impact on the environment & human health during & after construction. This is accomplished by preservation & protecting natural resources that surround the project site. Eleni Tsangouri (2018) studied self –healing concrete for scaling feasibility & contribute it as a base for future studies dealing with concrete optimization.

The author has critically discussed on the Self-Healing Concrete (SHC) technology on the concrete material response, durability & long term response to damage, general information, innovation environmental impact, & viability of self-healing concrete is discussed.(baflourbeauty.com,2020&Jieah et al,,(2020). Today due to increase in dem & of durable building materials, there is a requirement of efficient techniques to augment the physic mechanical properties of cementitious materials (Charpe & Latkar, 2020) The potential is seen in self – healing concrete to reduce fracture production of cement concrete is the most used material for construction work due to its cohesive properties & durability (Jirah & Hendrik, 2020).

Recently, Stanaszek (2020) reviewed bacterial concrete as a substitute building material. It can improve durability; however, it is not currently used on an industrial scale. Biocement , is a self-healing material to enhance the durability of the building structure. It is also used to conserve cultural heritage. Numerous methodologies for the assessment of self –healing capabilities of polymers, fiber-reinforced composite, coating, concrete, ceramic, ceramic coating, & polyurethanes foam coating of such class material along with damage mechanism & healing is extensively studied & reported in the literature. (Mohamed, 2017, Arthi & Dhaarani, 2018).

The production process, feasibility, benefits, & concerns are currently the main research subjects of biocement. Compared with synthetic topical sealers, biological surface sealers provide a more effective & safer way to combat the material deterioration of concrete pavements.(Jaiuo et al 2020). Tech trends reshaping the industry for the better & helping to further-proof the built environment. (Michael Floyd, 2020). The Green revolution has some effect on CI/CT. The global movement of saving the natural environment has emerged the latest concept. Green energy, water conservation, better building design, energy efficiency, & refurbishing instead of rebuilding are 5 trends describe by Benthany (2020) for sustainable building in the current year. Such trends will have the largest impact on green construction.(www.getgreenbadber.com,2020).

V. CONCLUSIONS & RECOMMENDATION

CT in India, despite its large-scale rollouts, remained rather sluggish in adopting new techniques & tools. However; it is the second largest industry in India & has shown promising growth in the past year with a re-energized output of around 8%. There are real, practical applications & benefits to modernizing the current processes.

On the basis of recent information & data given in the text, we would like to put the following observations & inferences for construction. (i)The present paper comprises different literature sources. It includes studies pertaining to recent aspects based on literature sources, like Webs, journals, blogs, conferences, reports/surveys &thesis in descending order. (ii) We have noted recent trends are more in CI /CT than CE. In the former case, they are about 27& later 10 (iii) Actually appearance of relevant references on the emerging trends in CI/CT & CE are cited significantly in 2017 & even an exponential growth till date. It is noted that year-wise increase in resources is recorded during the last 6 years & we expect that this will magnify intensively in the coming year or future.

The surprisingly year 2020 being the peak for literature as it is seen at midyear of 2020, ironically due to pandemic COVID 19, it may have an impact on the construction business & literature will have a deviation from original data. Let us hope this critical situation will create new data.

However, what shall be the pros & cons of this effect, Almighty knows! (World Wide Construction outlook to 2014), (iv) BIM overall is highly adopted & priority has been given for both business architecture & civil for designing, planning, &modeling, This is followed by AR/VR,RB,PF/MC,3-DPAI,MT,&WE which are daily use in construction. (v)A list of Architect software's

for future Architectural Design consist of maximum number(16) of software, out of the 10 are very common & routine use, (vi) On the basis of tabulation data, it may be stated that the emerging trends for CI/CT vary from 5-to 10, while for CT/CE they are from 5 –twenty-seven. This data is available in the literature, (vii)The top 10 predictions for a digital future for the infrastructure industry are well summarized.

The CI is experiencing a new & revitalized era with the help of technology through new applications & tools. These applications from tech start-up companies are designing, planning, & executing their projects, (viii) Construction Company wants to remain competitive, therefore, it always finds a way to integrate new approaches into current strategy & workflows. These cutting –edge technologies are drastically changing the industry to operate & hence future projects can be completed easily, (ix) We focused to attract the attention of readers to incorporate advanced technologies described in tables 1, 2. 4 &5 for the curriculum of Universities, & academic institutions seeking to understand the importance of these technologies (x) The goals of sustainable construction are to reduce the industry's impact on the environment.

SC methods include using 3R's: renewable & recyclable resources, reducing energy consumption & waste, creating a healthy, eco–friendly environment, & protecting the natural environment. For conservation, natural material used for a green building must be eco-friendly. Thus it saves our planet, (xi)The potential is seen in SHC to reduce fracture production of cement concrete is the most used material for construction, it is used primarily because of its properties & durability, (xii) New emerging technologies, recent trends described in the text can drive innovations & thus orient towards efficient practices, better productivity, & adoption of methods for managing workflow in the CI/CM&CE. The construction is part of the country's overall economic indicators & is a long-standing industry.

In a nutshell, today, new technologies in construction are being developed; & what seemed like future tech 10-20 years ago –connected equipment & tools, telemetric & mobile apps, autonomous equipment, drones, robots, AR/VR, & 3D printed buildings –are here, being deployed & used on job sites across the world. It is also expected that there will be wider use of technology in construction & CM/CE in the future as companies realize the long-term efficiency & cost savings of such techniques.

Many of the tools & advances discussed until now are already in use in advance worksites, training facilities, & manufacturing plants. Adoption of modern techniques will motivate engineer for the most success in the CI/CT/C for future. It is learnt form first half 2020 that during COVID-19 an increase in the use of prefabrication & modularization is likely to be a way forward for many firms, The second half of year 2020 will emerge new data & hope to build a growth story for E&C firms.

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