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A Study of the Scientific and Logical Step By Step Process of Sourcing and Implementing New Technologies for Construction of Low Cost and Related Housing Initiatives in India

Through the Global Housing Technology Challenge (GHTC-India) Programme, Incorporating the Light House Projects & Also the Navaritih Training Programme of the BMTPC (Building Materials Technology Promotion Council)

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***Abstract*:- This paper attempts to highlight the methodology, efforts and success of a very important programme undertaken by the Government of India to introduce new technologies in construction in India. Traditionally India has been using time tested methods in housing construction, but resulting in usage of old methods and losing out the gains of using new technologies. The need for this was felt when India embarked on a huge mission to implement low cost housing. However the technologies selected can be used for many other high end / regular constructions. Similar exercises can be initiated for other construction technologies for other applications. The method in which the entire programme was launched and on its way to completion, can be an ideal example from which other developing countries can take guidance and implement their own programmes.**

The objective of this paper is not to discuss any particular technology that is being selected / examined by the Government, but is to study a very methodological process of obtaining relevant technology for the country, and to utilize and implement in the most effective manner.

Keywords:- GHTC, NAVARITIH, low cost housing, PMAY, mass housing, Light House projects (LHP)

INTRODUCTION:

Global Housing Technology Challenge-India (GHTC) intended to get the best globally available innovative construction technologies through a challenge process. It aimed to demonstrate and deliver ready to live-in houses in minimum time and minimum cost with high-quality of construction in a sustainable manner. This challenge sought to promote future potential technologies through Incubation support and accelerator workshops, in order to foster an environment of research and development in the country. It was also a very effective way of knowing and getting new technology in the housing sector in India.

Global Housing Technology Challenge-India has brought this issue into a sharp focus in the year 2019. Through GHTC-India, a large number of new materials and technologies being used in over 30 countries across the world have been identified and are used for constructing light house projects in six different states in India. Most of these are green, affordable, fast and easy to construct. These six major 'light house projects' would be live laboratories for evaluation, assessment, certification, standardization, skill development leading to adapting and mainstreaming these technologies in India. This disruption is soon going to herald a major housing' revolution in the country. The selection of the technologies, the companies offering the solution, the materials and project execution abilities, and overall the ability in qualifying on many technical and commercial conditions was a key to decide who qualified finally for the Light House Projects

Analysis of the requirement of India and the pressing housing needs

India is undergoing rapid urbanization. While 31% of India's population lived in urban areas as per Census 2011, this number is expected to grow to 40% by 2030 with a contribution of75% of India's Gross Domestic Product (GDP). Large sections of the society are migrating to urban areas for better job opportunities and quality of life from rural areas. These Cities need to provide a receptive, innovative and productive environment, which can promote faster and sustainable growth ensuring a better quality of living. Hence it is imperative to have a comprehensive strategy to fulfil the rising demand in the housing sector. The emphasis on urban housing will be in most cases high rise buildings and fast completion at low cost is a major consideration.

The need for a Challenge & competition

MoHUA (Ministry of Housing and Urban Affairs) initiated the Global Housing Technology Challenge- India (GHTC India) which aims to identify and mainstream a basket of innovative construction technologies from across the globe for housing

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construction sector that are sustainable, eco-friendly and disaster-resilient. They are to be cost effective and speedier while enabling the quality construction of houses, meeting diverse geoclimatic conditions and desired functional needs. Future technologies will also be supported to foster an environment of research and development in the country. GHTC- India aspires to develop an eco-system to deliver on the technological challenges of the housing construction sector in a holistic manner.

Administration of GHTC-India

i) GHTC-India is being administered by the MoHUA and Joint Secretary and Mission Director (Housing for All) as the nodal officer for conducting the challenge.

ii) An Empowered Committee (EC) under the Chairmanship of Secretary, MoHUA is empowered to take all relevant decisions for GHTC-India.

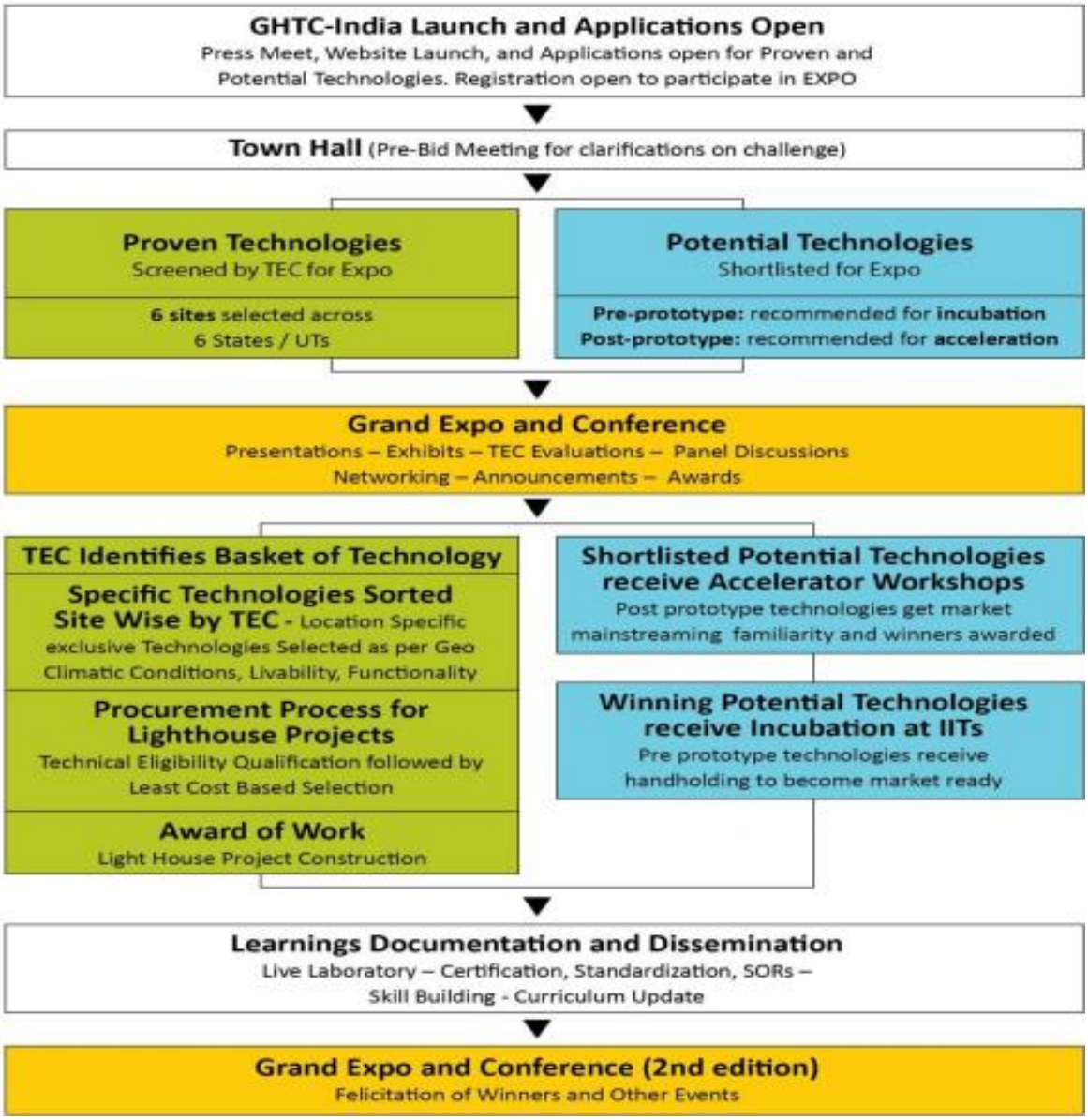
iii) A Technical Evaluation Committee (TEC) under the Chairmanship of the Director General, CPWD, is constituted for screening of applications and detailed evaluation of proven and potential technologies amongst others.

iv) World Resource Institute (WRI), India and NAREDCO are associated as the Knowledge Partners for GHTC-India.

v) Bloomberg Philanthropies (BP) is strategic partner. Other collaborators of national and international repute such as Indian Institute of Technologies (IITs), National Institute of Technologies (NITs), National Institute of Urban Affairs (NIUA), Massachusetts Institute of Technology (MIT), Confederation of India Industries (CII), International Finance Corporation-World Bank Group etc. have shown willingness to associate in GHTC- India and further were to be on-boarded as Associate Knowledge Partners (AKPs). All Associate Knowledge Partners are /will be on-boarded on no cost basis.

vi) Complete documentation of the GHTC-India is ensured for future reference and learning.

Graphical representation of the entire process from Launch till Training of Personnel



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The process adopted and implementation

Component-1: Grand Expo and Conference

- **i)** A **Grand Expo-cum-**Conference was organized to provide a platform to all stakeholders associated with housing construction for the exchange of knowledge and business.
- **ii)** Proven Demonstrable Technology providers from across the globe and domestic Potential Future Technologies were invited to the Expo through a simple online screening process and a Technical Evaluation Committee (TEC) constituted for GHTC-India evaluated and assessed the range of technologies available.
- **iii)** Other stakeholders such as Research and Development (R&D) Institutes, academia, students of technical institutes, technologists, engineers, architects, government agencies including State Public Works Departments (PWDs) and Housing Boards, developers, entrepreneurs etc. were also invited to participate as delegates. Developers and construction companies who may serve as Indian Partners to provide local logistic support in execution of the projects on ground (in partnership with global technology providers) were also invited through a simple registration process.
- **iv)** Various events such as seminars, panel discussions, MoU Exchange among the partners, exhibition of prototypes, posters, digital interfaces, awards ceremonies and the display of PMAY (U) projects were done and are envisaged for the future..
- **v)** Networking opportunities were explored at expo such as for Business to Business (B2B), Business to Government (B2G) and Government to Government (G2G).

As part of GHTC-India, an Expo-cum-Conference named Construction Technology India - 2019 (CTI-2019) was organized on 2 -3 March, 2019 at Vigyan Bhawan, New Delhi. The Expo was inaugurated by Hon'ble Prime Minister of India and brought together multiple stakeholders involved in innovative and alternative housing technologies, for exchange of knowledge and business opportunities through an exhibition, thematic sessions, panel discussions and master classes.

Overall CTI-2019 had participation of about 2500 delegates from 32 countries and more than 3500 visitors at the exhibition. 54 exhibitors with 32 innovative technologies from 25 countries were in display with 166 stalls. 54 Proven Technology Providers with 32 new technologies from 25 countries including technologies from USA, Finland, Australia, Spain, France, South Korea and Italy were evaluated by the Technical Evaluation Committee (TEC). A total of 78 Potential Technology Providers from across the country, with 55 post-prototype and 23 pre-prototype made their presentations to the expert jury during the event.

The two day Expo-cum-Conference consisted of 4 Plenary and 4 Parallel Sessions, 3 Masterclasses, 4 Panel Discussion and a World cafe. There were 8 different parallel interactive sessions between Proven Technology Providers, Technical Evaluation Committee and Expert Jury to shortlist the best technology

Component-2: Proven Demonstrable Technologies for the Construction of Lighthouse Projects

Stream 1: Proven Demonstrable Technologies

A) Proven Demonstrable Technologies were invited through an Expression of Interest (EoI) from across the world which are suitable for use in the Indian context. The applications were initially screened to participate in the GrandExpo-Conference, where the applicants interacted with the TEC.

B) Post the expo, the TEC through rigorous assessment shortlisted and empanelled a basket of technologies that could be considered for demonstration through actual on ground implementation of six lighthouse projects located in six sites across of the country. Criterion such as scalability, adaptability, sustainability and safety were used for evaluating the proven technologies.

C) Upon selection of six sites for the implementation of lighthouse projects the empanelled basket of technologies were sorted site wise by the TEC. This sorting ensured location specific exclusive technologies as per the respective site's geo climatic conditions. These selected technology providers were invited through a tender process to bid and construct a complete affordable housing project on approximately 1- 2 hectares of land, which is expected to accommodate about 1,000 houses at each selected location. The key challenge parameters for selection are the ability of the technology to deliver maximum number of dwelling units in minimum time and in optimum cost. Technology providers were encouraged to transfer technologies and shall provide technical support and capacity building.

D) Requests for Proposal (RFP) for construction of six lighthouse projects under GHTC-India were issued by MoHUA. Owing to the unique nature of the challenge and for effective coordination with States/UTs, evaluation of bids of all six regions were done centrally by a Bid Evaluation Committee (BEC) to be constituted after issuance of RFP which would include a member from the concerned State/UT. It was mandated that different sites had different and exclusive technologies. The period of construction was decided to be minimum 12 months from the date of handing over of sites after all approvals. Approvals were accorded through a fast-track process by the concerned State/UT Government.

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vi) Technology Providers successfully completing the construction of lighthouse projects within the stipulated 12 month period of the contract are to be rewarded with USD 20,000 each. A further incentive for early completion is being provided wherein technology providers that complete lighthouse projects in less than 12 months will receive an incrementally higher bonus of USD 2,000 for each less month than sanctioned 12months.

vii) These Lighthouse projects will serve as live laboratories for different aspects of transfer of technology to the field. This includes planning, design, production of components, construction practices and testing for both faculty and students of IITs/ NITs/ Engineering colleges/ Planning and Architecture colleges, builders, professionals of private and public sectors and other relevant stakeholders. For this purpose, periodic interactions, webcasting etc. are organized.

Stream 2: For States and Union Territories (UTs)

i. States / UTs participated in Component 2 through a Terms of Reference (ToR) and evaluated by TEC. Participating States/ UTs provided encumbrance free and adequately serviced land of preferably 1- 2 hectares while committing to comprehensive operational assistance for the construction of these light house projects. The State/UT facilitated relaxation of development control regulations, fast-track approvals and certifications for speedy construction, setting up of a new technology construction components factory , and ensure fund availability and finalize beneficiary identification

ii. For the subsequent allotment of constructed houses to the beneficiaries in States/ UTs, procedures of existing guidelines of PMAY (U) were followed as PMAY (U) guidelines.

Component-3: Potential Future Technologies for Incubation and Acceleration Support

i) For those upcoming Indian technologies in the housing sector that demonstrate potential, but need assistance to mainstream their product in the market or need more technical handholding/ improvements to reach a viable product, acceleration and incubation support is being provided.

ii) Shortlisted potential technologies that are market ready (post prototype applicants) as evaluated by the TEC received Accelerator Workshops. These workshops and masterclasses had sessions by Certification and Standards Agencies, Financial Institutions and Industry Leaders, and Marketing and Pitch Development Professionals and served as a fulcrum to connect various upcoming technology providers with the larger housing construction eco-system. The Accelerator workshops were organized by Building Material and Technology Promotion Council (BMTPC) and WRI, India. Winners in the post prototype category will receive a cash award of USD 5,000 each and certification.

iii) Shortlisted potential technologies that are not yet market ready (preprototype applicants) as evaluated by the TEC will receive Incubation Support. Through the Affordable Sustainable Housing Accelerators- India (ASHA-India) initiative, Incubation centres will be set up in 4 IITs (Bombay, Kharagpur, Madras and Roorkee). These IITs will provide mentoring, workshop and testing facilities, IPR support, financial advice, networking support and branding. These IITs will create further facilities, which may be essential for validation of technologies for structural safety, acoustic, thermal and other important parameters against the requirements given in the National Building Code of India/relevant Indian Standard as recommended by BMTPC and approved by Central Sanctioning and Monitoring Committee (CSMC). Incubation Grant to facilitate the conduct and structuring of incubation and accelerator programs were given by MoHUA after approval of CSMC.

Way forward – the outcome from LHPs will decide the commercial, business and also the tendering aspects of future technologies to be put into practice officially.

LHPs are model housing projects with houses built with shortlisted alternate technology suitable to the geo-climatic and hazard conditions of the region. These will demonstrate and deliver ready to live houses with speed, economy and with better quality of construction in a sustainable manner.

The period of construction initially allowed is maximum 12 months from the date of handing over of sites to the construction agency after all statutory approvals. Approvals were accorded through a fast track process by the concerned State Government.

These LHPs shall serve as LIVE Laboratories for different aspects of Transfer of technologies to field application, such as

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planning, design, production of components, construction practices, testing etc. for both faculty and students, builders, professionals of Private and Public sectors and other stakeholders involved in such construction.

Six Technology providers have been selected through rigorous online bidding process for construction of Light House Projects (LHPs) at six different locations in six states.
As a part of GHTC- India, six Light House Projects (LHP) consisting of about 1,000 houses each with physical & social infrastructure facilities is being constructed at six places across the country namely Indore; Rajkot; Chennai; Ranchi; Agartala and; Lucknow. These projects showcase the use of the six distinct shortlisted innovative technologies for field level application, learning and replication. LHPs will demonstrate and deliver ready to live mass housing at an expedited pace as compared to conventional brick and mortar construction and will be highly economical, sustainable, of high quality and durability. These projects shall serve as Live laboratories for all stakeholders including R & D leading to the successful transfer of technologies from the lab to the field.

Some unique features of the Light House Projects

- LHPs are model housing projects with approximate 1,000 houses built with shortlisted alternate technology suitable to the geo-climatic and hazard conditions of the region. This will demonstrate and deliver ready to live houses with speed, economy and with better quality of construction in a sustainable manner.
- The minimum size of houses constructed under LHP shall be in accordance with the prevailing guidelines of the Pradhan Mantri Awas Yojana (Urban).
- Constructed housing under LHP will include on site infrastructure development such as internal roads, pathways, common green area, boundary wall, water supply, sewerage, drainage, rain water harvesting, solar lighting, external electrification, etc.
- Houses under LHP will be designed keeping in view the dimensional requirements laid down in National Building Code (NBC) 2016 with good aesthetics, proper ventilation, orientation, as required to suit the climatic conditions of the location and adequate storage space, etc.
- Convergence with other existing centrally sponsored schemes and Missions such as Smart Cities, AMRUT, Swachh Bharat (U), National Urban Livelihood Mission (NULM), Ujjwalla, Ujala, Make in India shall be ensured during the designing of LHPs at each site.
- The structural details shall be designed to meet the durability and safety requirements of applicable loads including earthquakes and cyclone and flood as applicable in accordance with the applicable Indian/International standards.
- Cluster design may include innovative system of water supply, drainage and rain water harvesting, renewable energy sources with special focus on solar energy.
- The period of construction will be maximum 12 months from the date of handing over of sites to the successful bidder after all statutory approvals. Approvals will be accorded through a fast-track process by the concerned State/UT Government.

Live Status of the Light House Projects (Monitoring of the projects is crucial for timely completion):
The live status can be seen/ trackedon the internet of the various LHPs https://ghtc-india.gov.in/login/lhpstatus?LocationId=L6

LOCATION	TECHNOLOGY SELECTED	NUMBER OF HOUSES TO BE CONSTRUCTED
Indore Madhya Pradesh	**Prefabricated Sandwich Panel System**	1024
Rajkot Gujarat	**Monolithic Concrete Construction using Tunnel Formwork**	1144
Chennai Tamil Nadu	**Precast Concrete Construction System – Precast Components Assembled at Site**	1152
Ranchi Jharkhand	**Precast Concrete Construction System – 3D Volumetric**	1008
Agartala Tripura	**Light Gauge Steel Structural System & Pre-engineered Steel Structural System**	1000
Lucknow Uttar Pradesh	**PVC Stay In Place Formwork System**	1040

Expected Outcome of GHTC-India will be win-win for all the participating stakeholders due to the following envisaged outcomes: -

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1. For Central Government Agencies: -
i. Apart from achieving the goal of Housing For All (Urban), it were contribute towards fulfilling the vision of Hon'ble Prime Minister of India of "Make in India" and "Skill India".
ii. Contributing toward fulfilment of SDGs (Sustainable Development Goals) and other national and international commitments.
iii.Central Government Agencies to be benefited through latest housing technology knowhow, and mainstreaming of innovative and alternative technologies.

2. For States/UTs: -
i. Readily available empanelled basket of technologies that are suitable for implementation in Indian context.
ii. Prestige of winning the Global Challenge and implementing housing project that showcases innovative and alternative technologies, which will serve as lighthouse projects for future deployment.
iii. Additional TIG along with existing PMAY (U) contribution.

3. For Global Technology Providers: -
i. Benefit from innovative and alternative technologies being incorporated in Schedule of Rates (SoRs) and standards, receiving certifications and fast track approvals.
ii. Opportunity to implement the innovative technology on ground as a housing project approved by the government.
iii. Providing an impetus to set up large scale production units potentially resulting in adoption of innovative and alternative technologies in the Indian construction industry.

4. For Local Indian Partners and Developers: -
i. Opportunity to form consortiums with Global technology providers.
ii. Exposure to international construction practices and knowhow.
iii . Unleash tremendous business opportunities.
iv. Growth of ancillary industries and provide the required skill set in the innovative and alternative construction regime.
v. Transfer of technology from Government driven schemes to the private sector- contractors and builders so that fast and effective implementation of a number of approved technologies (at least some of them) is achieved. Government works are expected to be rule and regulation based, tender oriented and time consuming and slow. However the methodologies identified will be implemented much rapidly by the private sector.

5. For Emerging Technology Providers: -
i. Opportunity to showcase the emerging technologies at the Expo.
ii. Receive mentoring at premier technical institutes, networking with key certification and standardization agencies.

6. For Academic Institutions and Students: -
i. Incubation Grant to facilitate the conduct and structuring of incubation and accelerator programs. ii. Promotion of technological knowhow and skills as included in academic curriculum for research students and other relevant stakeholders.

7. Laborers and Beneficiaries: -
i. Laborers will gain from being trained and skill enabled for employment in modernized construction industry that is envisaged by MoHUA, thereby accessing higher paying jobs.
ii. Through GHTC-India beneficiaries (house owners) had access to improved living conditions and environment with a sense of dignity in line with the vision of our Hon'ble Prime Minister to provide Housing for All by 2022.

Training on new technologies- NAVARITIH – a very effective course from BMPTC (course that complements the developments under the MoHUA and GHTC initiative)
(NAVARITIH is New, Affordable, Validated, Research Innovation Technologies for Indian Housing)

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The housing problem in India is huge, with urban housing shortage pegged at 11.2 million dwelling units. In order to reduce the housing shortage, it is necessary that a speedy and affordable housing construction mechanism be devised. Therefore, there is an urgent need for us to look at alternate and innovative building materials and construction systems and proper training of engineers & architects in this area.

The Course on Innovative Construction Technologies has been launched as one of the activities under "Construction Technology Year (2019-20)" which was announced by the Hon'ble Prime Minister during Construction Technology India 2019 : Expo-cum-conference under Global Housing Technology Challenge – India on March 2, 2019 at New Delhi.

It is being offered jointly by the School of Planning & Architecture, New Delhi and Building Materials & Technology Promotion Council (BMTPC), Ministry of Housing & Urban Affairs, New Delhi.

The objectives of the NAVARITIH course are to:

a) Familiarise the professionals with the latest materials and technologies being used worldwide for housing.

b) Provide an awareness of the state of art of materials and technologies in terms of properties, specifications, performance, design and construction methodologies so that professionals can successfully employ these in their day to day practice.

c) Provide exposure to executed projects where such materials and technologies have been implemented.

Potential and expected problems

i. In almost all cases detailed training of engineers, staff and workers will be required. A course like NAVARITIH is excellent for an initial launch of the scheme. The training has to be scaled up in many ways

ii. The training of engineers and architects can be done online. However as you go down the hierarchy, the actual hands on implementers like site foremen and workers must know the method of erection and its significance. This is a major challenge. Since the success of any particular technology is going to be by word of mouth, the training at the ground level is of paramount significance. Large contracting companies will have to step forward to train not only their staff and workers, but also go beyond company borders.

iii. In many technologies that are suggested or selected, there is a large scale need of mechanical fixtures, consumables, hardware and tools for actual erection. Manufacturers of these within India and local supplies are essential, and the technology supplier may initially find it challenging to support.

Marketing of the technologies

i. Publicity of these new technologies despite having a well set our process and excellent induction, is severely lacking. The Govt may have to go all out to get these approved technologies publicized well and reward contractors and builders with monetary benefits for using these for projects for a initial few years. Once the Light House Projects are completed, BMPTC/ MoHUA should make every attempt to get this aspect of business

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going. The publicity material developed by the Government and the technology providers seem to be adequate for kick starting the process of change. The videos, literature and documents from within India and from international technology providers are excellent, and this is going to be a major factor in publishing without any serious time lag. The Government must consider appointing professional advertising and marketing agencies through DAVP (Bureau of Outreach & Communication- earlier the Department of Audio Visual Publicity) or in any other way.

ii. Tenders that will be floated with these technologies must attract bidders and relaxed bidding/ qualifying norms in terms of tender document and security fees/ bid bonds may attract many companies to get involved.

iii. Timely completion of the 6 Light House Projects is a key factor for an early success of this initiative. Publicity of these project and key take aways- technical and commercial should be transparent.

iv. Private sector business (contractors, builders, architects) will need the following information and will also ask for documented justification on the following :

a) Cost comparison of the new technology v/s using regular construction methods.
b) Whether speed in construction achieved by using the new technology is really justified and financially useful in a project as many projects get delayed in any case due to non-technical and compliance related reasons.
c) What will be the saving per sq.ft of the building compared to normal construction.
d) How much investment will be required by the contractor/ builder upfront that can be spread over multiple projects, and how many.
e) All details in a well-documented format will enable success. In the case of launch of ready -mix concrete (RMC) in India, it was only after extensive marketing and sales efforts that industry accepted the same. It is extremely popular now, and hence all the new technologies could be highly successful in a few years time, leading to a revolution in the industry.

CONCLUSION

This is by far one of the most ambitious and evolved programme being implemented by the Government with the initiative of BMPTC/ MoHUA /PWD and ably supported by a number of research and technological institutes like the IITs, and SPA (School of Planning and Architecture) . A great deal of credit goes to the private sector in contributing its abilities and sharing knowledge to other potential competing companies through NAVARITIH and other training programmes lined up. Highly technical & erudite staff and academicians of BMPTC and other organisations deserve a mention in this well drawn our plan.
The process and system adopted is highly professional and can be extrapolated to other areas of the country's development – specially in civil engineering, construction and architecture. Unless made mandatory by the government new technologies will not be absorbed by the private sector though they are highly competent and technologically savvy.

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- He has recently completed the course of BMPTC – NAVARITIH- New, Affordable, Validated, Research Innovation Technologies for Indian Housing. (November 2o21)
- Holds qualifications and MOOC certifications from American, British and Swiss universities in Smart City Planning, Management of Smart Urban infrastructure, Financing Major Engineering Projects, Construction & Project Management, and also in Governance, Risk and Scope management.
- Holds a Certificate in Engineering Leadership from Rice University, Houston
- Holds a certification in Contract Management from The World Bank and certifications in developmental studies from the Asian Development Bank.
- Has over 30+ years of working experience in Civil Engineering/ Engineering services /Consulting / Marketing & International business in large and medium sized private sector companies and has travelled to several countries on business development.
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