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Chandran Rekha Jetty
MSRIT, architect.solution@gmail.com

Venkata subramani
VLB Janakiammbal College of Engg. and Tech, venkatasubramani@gmail.com

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Strategic Management of AECI Challenges

(Factors that affect Productivity and Efficiency)

Chandran Rekha Jetty & Venkatasubramani

[1]School of Architecture, MSRIT, Bangalore, India
[2]Dept. & Director Research, VLB Janakiammbal College of Engg. and Tech., Coimbatore, India
E-mail: architect.solution@gmail.com

Abstract **-** Nature of AECI is a complex array of interdependent activities-best organized chaos introducing challenges not encountered in other industries. The work is often seasonal; Each project is unique; Often involves remote sites with various access problems; The process is not as predictable; There is difficulty in applying automation; There is high potential for encountering unforeseen conditions; Costs can vary according to conditions; There is difficult to manage and supply utilities and other resources; Technical innovations are adopted at slower pace; Success is dependent upon the quality of its people; AECI is very custom-oriented; Products can be of mind-boggling size, cost, and complexity; The work is not performed in controlled conditions, therefore highly impacted by weather and other environmental conditions.

Over 100 Surveys, case studies and literature studies were done and it is found that the AECI faces several increasing & complicated construction and non-construction challenges, of all these few are new and rest centuries old. This extensive exploratory research was carried out to explore all the AECI challenges that affect AECI PDLC processes and this research suggests the remedial measures specifically to housing sector, addresses AECI challenges that help to improve productivity and efficiencies in the AECI processes.

Keywords*-AECI: Architectural, Engineering & Construction Industry, ICT: Information & Communication Management, PDLC: Product Development Life-Cycle*

I. INTRODUCTION

Today, AECI faces numerous challenges few new and few centuries old, few direct result of AECI operations and few result of peripheral activities. AECI projects are defined by unique set of activities that produce unique customized product. Project success is achieved when project meets the criteria of cost, time, scope, safety requirements, resource allocation, and quality that are determined by the owner in association with the Project/Construction Manager. Goals & Objectives of Architecture, Construction Project Management is to control, deflect or mitigate the effects of any occurrence/situation that could affect project success.

AECI is characterized by adversarial practices, disjointed transient relationships between stakeholders than long term partnerships. This results in mistrust between stakeholders of the project resulting in lack of integration, work as a disparate collection of separate organizations as un-unified team, with total unwillingness to share knowledge between the Knowledge chain and supply chain partners leading to poor knowledge flow along the PDLC. The purpose of Project Management is to achieve goals and objectives through the planned expenditure of resources that meet the project's quality, cost, time, scope, and safety requirements.

Survey was conducted and it is found that the AECI faces several increasing & complicated construction and non-construction challenges some of them are direct results of AECI Operations and others are results of indirect, peripheral activities stemming from and Information Technology Network & Building Information Management Service; Innovation Management; Knowledge Chain Supply Chain Management; ICT; Information And Geo Communication Technology; Architectural and Construction Management; Operations and facility management; Data, Design and Development Management; Project Management demanding realities in Planning & Control of AECI operations and high risk implications; of these few are new and rest centuries old.

This exploratory research broadly categorizes the challenges into construction issues, peripheral pressures and other-challenges, and explores all the AECI challenges that affect AECI PDLC processes resulting in

inefficiency and 1productivity loss, and suggests the remedial measures to address these AECI challenges to improve productivity and efficiencies in the AECI processes specifically to housing sector.

II. SCENARIO STUDY - INDIAN AEC INDUSTRY

AECI-India has recorded a consistent strong year-on-year growth during 2006-2010, and is expected to continue to grow during 2011-2015. Supported by robust economic growth and government spending, Emerging Market Intelligence expects a broad base growth in building construction across all key sectors – residential, commercial, industrial, and institutional. Major factors are: 1) Worth USD 50 billion p.a. and more, 2) Accounts for 6% to 8% of India's GDP. 3) AECI is granted Industry status recently. 3) 100% foreign investment permitted since 2005. 4) USD 4 billion per annum and more set to flow into this sector. 5) Focused on Infrastructure and housing. 6) Employs 40 million people and more. 7) Internationalization and increasing pressure to consolidate helps the industrial growth.

III. CHARACTERISTICS OF AECI

AECI is characterized by 1) Unorganized & low-skilled workforce. 2) Highly fragmented and inefficient supply chain and ICT usage characterized by adversarial practices and disjointed relationships. 3) At lower sectors, disorganized, ad-hoc, disintegrated. 4) A multitude of standards, technical specifications, labels and diversity in regulations. 5) A low adoption & integration of relevant ICT in most business processes, especially by SMEs. 6) High-sensitivity: Society/Market/Economic Changes. 7) Companies are either organizers of projects & project flows or suppliers to project-managing companies. 8) Industrialization based on new-concepts, (pre-fabricated houses). 9) De-Linked Material Supply chain, Knowledge chain, Value Chain, Information and Communication Chain, Administrative and Business Chain. 10) Non-value adding activities like 'waste in time, materials', contribute to islands of information & ineffective communication between Supply Chain partners causing poor communication among members of an AEC project leading to transient relationships between Supply Chain members than long term partnerships. 11) AEC Supply Chain works as disparate collection of separate non-unified organizations and lacks integration leading to distrust between construction clients, designers, and main & subcontractors. These characteristics of AEC Supply Chain cause low efficiency and productivity in project delivery.

IV. INDIAN AECI – DRIVERS OF GROWTH

Indian economy has been continuously blooming since last three decades. Government in its eleventh five-year plan (2007-12) has laid its trust on infrastructure development, Government projects, infrastructure outlay like: Airport modernization projects, railway projects, bridges, water works (dams). The need for housing is ever increasing due to increasing population, thus public demands on housing and commercial spaces like malls, multiplex requirements are growing. Many projects are outsourced or are part of exchange programs to India in the field of Architecture, Engineering and Construction Designs. Large numbers of material organizations are engaged in manufacture of building products, machinery and equipment for construction, operation, and maintenance & facility disposal. Handling Present AECI projects require professionalism.

V. MAJOR PLAYERS IN AECI - INDIA

The major players are Client Community, Design Community, Supply Chain, Facilitators/Providers, Economic Drivers, and Complementary Goods/Services Providers. L & T, GMR Infrastructure, HCC, Tata Projects, Gammon, ECCI, Nagarjuna, Shapoorji Pallonji & Co, Punj Lloyd: large projects. Shobha Developers, IVRCL, DLF, UniTech, Omaxe: flyovers, pipelines, apartments and housing/ office spaces. Large number of SME's, Architecture, Construction & Material manufacturing Industries, companies and Enterprises.

VI. PROJECT STAKEHOLDERS

AECI-projects generally have large number of stakeholders. The list of stakeholders include individuals, project owner, functional units, operations team, Architectural & Engineering design team, construction team, vendors, suppliers, and organizations directly/indirectly involved in the project from the client to ultimate user team. That is, all those external parties involved in commercial, residential, civil infrastructure, industrial, housing, and real estate development.

VII.FUTURE PROJECTION – AN ANALYSIS

Innovations have revolutionized the ways of working/living the built environment. Future projection Indicates: 1) Designed/invented & visualization of design excellence 2) Smart building modeling 3) integrated project delivery 4) sustainable design & construction 5) Green supply chain, & others.

Factors to be governed are 1) Global Scenario: Collaborative: Integrated Project Delivery 2) Social:

[1] *Challenges facing today's construction manager*, supplemental reading for CIEG 486-010 *Construction methods and management*, University of Deleware, Bob Muir, PE Fall 2005

Social networking, Major shifts in management techniques, Generational change, Collision of cultures & values, Knowledge workers getting outsourced 3) Technological: Accelerated change, Dependence, Open architecture, Experiential, Change in communication 4) Political: Transparency=>"No secrets"=>Democracy, Terrorism on infrastructure, NGOs and Civil Society driving change 5) Environmental: Triple bottom line thinking=status quo, Immediacy of our needs to deal with issues, Zoomorphism/New Animal Architecture/Wave form water/fluid Architecture/Bio-mimicry, Net zero energy, Water as the new oil 6) Economic: Economics of energy, sharing of the wealth, Domino effect of connected economies, Virtual and grey market, Environmental economics

VIII. STRATEGIC MANAGEMENT IN AECI

AECI requires Strategic Management of: 1) Supply Chain: AECI with its dedicated Supply Chain are much larger than what is defined by traditional construction statistics. 2) System Approach: Requirement of sector-wide system approach to supply chain, material chain, knowledge chain, value chain, information and communication chain and administrative chain 3) Material Chain; Information chain; Knowledge chain 4) Value chain & Management: Traditional AECI is limited to value-added site-activities of general contractors & specialty trades. 5) Administrative Project Management Chain

IX. GENERIC AECI ISSUES REQUIRING CHALLENGIN SOLUTIONS

AECI faces lot of qualitative & quantitative challenges and lot of opportunities to overcome these challenges. Of the identified generic types of challenges some may be predominant in one country and some in other countries. This research has tried to identify all those generic challenges that affect the production and efficiency of AECI irrespective of geographic locations. Few are focused to Indian scenario. The survey indicated the following areas that have issues.

Finance And Cost Management: 1) uncontrolled and high Cost of construction 2) Meager revenue returns & low income 3) High Excise duty & varied taxes 4) Poor management of constraints on funding & Investment 5) unreliability on costing 6) Capital & labor ratio 7) Uneven flow of institutional credit 8) Inconsistent profitability 9) Meager Capital Investment (except in infrastructure projects) 10) Growing deficit in maintenance & replacement

Cost Control: The Construction Material Cost along with Wastes attribute to over 60%. The types of wastes that were identified to affect the costs are: 1) Correction: repair or rework 2) Motion: any wasted motion to pick up parts or stack parts that includes wasted walking 3) Waiting: any non-work time waiting for tools, supplies, parts, etc., 4) Processing: doing more work than is necessary 5) Inventory: Maintaining excess inventory of raw materials, parts in process or finished goods. 6) Conveyance: wasted effort to transport materials, parts, or finished goods into or out of storage, or between processes 7) Over production: Producing more than is needed before it is needed. For cost breakup in Indian Scenario 'See p.13 Table-1'

Human Resource Management: 1) Insufficient workforce consideration 2) lack of awareness and in-depth understanding of roles and responsibilities of construction manager, project manager, operations manager, owner(s), and other stakeholders. 3) In-sufficient team building efforts and understanding of need of team building 4) lack of appropriate trainings to labor force 5) often deviation from labor act 6) un-hygienic work environment, unhealthy work practices and dislodged Culture 7) lack of necessary Motivation 8) low Incentives, Bonus, Salaries & Wages, 9) lack of efficient implementation of Appreciation, Reward and Recognition Policy

Innovation Management: 1) lack of promotion of sufficient Product, service, business processes, and technologies innovations 2) Lack of wide acceptance of innovations and dissemination by stakeholders 3) Lack of in-depth adherence to regulatory, standards, legal, contractual, labor, safety, and environmental authorities 3) Lack of provision of smooth working innovation system without inadvertent barriers to innovation

Quality Of Resources & Construction (Human Resource, Building & Construction Materials): 1) Failure to adopt to ISO Standards in spirit (Environmental, QMS and others), and Performance improvement methodology (six sigma approach) 2) Increasing health risks like indoor health of aging population due to their pattern of spending more time indoors exacerbating the problem, and increase In population sensitivity. 3) Fragmented human resource structure 4) Scarcity of labor force, trade skills, aging workforce, immigrants that were traditional source of trades are now channeled to hi-tech sector, increasing pull of the hi-tech and services industries are exacerbating the skills shortage issue 6) Deteriorating product & service quality

Resource Management: 1) lack of efficient policies for Asset Management 2) Facility Management is not sufficiently identified as an important requirement in AECI 3) in-efficient Land & Infrastructure management 4) improper Waste Management implementation: In India construction wastes constitute at least 25% of total – in some areas representing over 40% of all waste – represents both environmental challenges and lost

opportunities 5) un-streamlined Waste disposal practices during construction & deconstruction.

Sustainability & Energy Efficiency: 1) The sector is a major energy user: 15–20% of the total national energy consumption. By consuming Primary Resources, Natural resources are being challenged. There is social pressure to reduce the environmental footprint of construction. Construction consumes over 50% of primary resources – large dimension lumber is becoming scarce. 2) Consumption of high energy in the constructed facilities and built environments. There is need to use Low Energy Alternative Appropriate Design, Construction Technology & Materials. Awareness drives are required to users, need of availability of energy efficient material easily. [2]In India the factors affecting AECI from adopting Sustainability are: a) Cost of implementation of Sustainability is 67%. b) Lack of awareness is 62%. c) Lack of education and Knowledge transfer is 41%. d) Lack of innovative technology is 36%. e) Lack of governmental regulations is 36%. Advantages of Sustainability are Energy saving of 30-40 % from day one; enhanced indoor air quality; higher productivity of occupants; Potable water saving of 20-30%; Enhanced day light and ventilation.

Information & Communication Technology, Management & Decision Making: Lack of efficient implementation of virtual & interactive environment, Information & communication handling & management mechanism across AECI; lack of wide dispersion and transfer of the existing silos & islands of information through networks, lacks in standards required and high cost of interoperability. There is need of interfacing between the different project applications and to improve information flow through seamless integration of electronic data for quick access, faster support and reliable decision making.

Collaboration, Coordination & Integration: 1) Inefficient Systems integration 2) inadequate collaborative working environment conditions & management 3) lack of Technological strategies for coordinated & interactive working 4) Out of focus multitude of agencies-associations at regional level 5) Non-representation at Government-senior levels.

Technical Strategies for Collaborative & Integrated Working & Operate Ability: Existing methods need to be more effective. Following methods are in use. 1) Face-to- face 2) Written word & Hand drawings 3) Telephone & Telegram 4) Telex & Fax 5) CAD 6) Email & Groupware (e.g.: Lotus Notes) 7) File transfer protocol (FTP) 8) Websites 9) Intranets, enterprise portals 10) Video-Tele-conferencing 11) Extranets 12) Web-conferencing applications 13) File-sharing (P2P) 14) Instant messaging 15) Discussion forums 16) Wikis 17) Blogs 18) RSS 19) Social networking 20) Social search, tagging, sharing 21) Mashups: Mapping, time-lines, others 22) Virtual worlds 23) Web 2.0, SaaS (software as a service), Building information & management systems, cloud computing.

Operations/Productivity Management: AECI is lagging behind other sectors in productivity improvements and is characterized by extensive use of craft employment, lack of rationalization & use of digital tools. ICT-based productivity improvements are mildly reflected. Need more adequate & efficient project management, process integration, and workflow improvements methodologies/equipment. Need to establish highly cost-efficient/effective Customer Relationship Management. Need of use of Productivity enhancing solutions and systems (production planning, ERP with financials, Inventory management, logistical planning & route optimization, customer relationship management) for customer care, coordinated sale & marketing.

Affected Project Management Processes: in various degrees along the length-breadth-depth of AEC industry are: 1) Project management: HR, time, communications, procurement, integration, quality, scope, cost, risk, 2) Processes & project management knowledge areas 3) Process groups 4) competences: technical, contextual, behavioral 5) Organizational & governance 6) Planning the strategy 7) Project management in context & entry 8) techniques 9) Businesses & commercial 10) Executing the strategy 11) People & the profession 12) Project, program, portfolio & "program & project" management framework & principles & areas.

Project-Program-Portfolio Management: lack of efficient quality & Consultancy for Policies, Processes & Product Project Management.

Time Management: 1) Schedule Constraints & Management 2) lack of Predictability of Quality/Durability/Time Management, Cost within Budget.

Technological Management: Lack of: 1) necessary/required Building Automation/ intelligent systems 2) Technological acceptance factors 3) High tech design & construction 4) Quality Prefabrication – Fabrication.

QMS Processes: 1) Lack of adaptation of quality management system in spirit; 2) Reduced management responsibilities 3) Lack of efficient resource management 4) Lack of product realization

[2] Source: GIA Interviews with 40 Indian construction industry players, Jan-Apr 2010. Read more: http://www.globalintelligence.com/insights-analysis/bulletins/knowledge-gap-hinders-india-construction-industry-#ixzz1VdbrT9nO

requirements 5) Measurement, analysis and improvement requirements are not carried out.

Demographic Changes: Aging population with increased demand for specialized facilities, automation, and lower personal mobility.

Management Responsibility: Failure to assess managerial factors, lack of workforce leadership and decision making.

Scope Development: issues within projects are: 1) Architectural & engineering design scope change 2) Project development & management consulting services & creativity 3) Streamlining design, document & data management along supply chain & value chains 4) Project & building types.

Others: Inefficient organizational processes stability, lack of adequate & relevant arbitration, lack of efficient dispute resolution mechanism, inadequate provision for quality infrastructure & inner-micro climate effect within organization.

Market, Revenue & Competition: Industrial globalization & market place creates international competition/expertise for projects internationally, consolidate across design, construction & supply chain thus requires applicable Business model/Orientation, and Appropriate Project export models.

Procurement Management (Building & Construction) Tool & Materials: Complications/ uncertainty issues relating to 1) Building Materials Manufacture, supply and Management 2) Supply Chain 3) Project Delivery 4) Pre-fabrication, Modularization, Industrialization, On-site Fabrication.

Workforce Capability & Labor Productivity: 1) Declining Production & Performance 2) Myths of productivity 4) Deficient Overall Productivity & efficiency. 5) Deficient in assessing Productivity as performance indicator 6) lack of fool proof method to identify all the practices requiring improvement 7) lack of relevant Productivity tools.

Integration & Productivity: 1) Low sector productivity 2) Lack of adequate integration of new materials, information & technologies to improve productivity 3) Inadequacies for meeting demands of Design & Construction Processes integration to improve productivity.

Non-Construction Issues: Impact of 1) Socio-political pressures 2) Customer relation 3) Natural factors; External & Internal-Environmental factors 4) Internal: Deeply fragmented Organization Structure Characterized by very small companies (95% have less than 10 employees).

Environmental Issues: Global climatic change leading to global warming, contaminated, cluttered with full of chaos/polluted urban Environment this also includes eexternal factor-beyond AECI control.

Engineering Services & Building Services (MEP): Self generated On-Site/Off-Site construction, operations and Project Management issues on day-today basis like labour problem, equipment failure etc.

Change: 1) Need for driving change in industry & technologies, 2) Substantial/systemic changes in the culture & structure of the sector 3) Need to adopt Changes & Faster Solutions.

Research & Development: 1) Inappropriate research methodology & focus, 2) Lack of preparedness and vision for future research & innovations; 3) lack of sufficient fund allocation for R&D and encouragement for research.

Visions & Goals For Sustainable AECI: unachievable, unrealistic, without any time-bound, unaccountable vision & goals.

X. RESEARCH METHODOLOGY ANALYSIS CHALLENGES

SWOT Analysis was carried out to analyze the threats, Opportunities, strengths, and weaknesses in AECI, and the strategic solutions are identified.

XI. ROLE OF ARCHITECTS

Must be in value addition and streamlining the entire process flow to ensure there is no waste in time and cost over-run, besides maintaining sustainability – built environment in planning, design and management, applying statutory, regulatory and implied needs of clients. Monitoring process flow streamlining of knowledge Chains by building value in design through innovations and creativity all along the following process chains, Information and communication chain, supply chain of materials, Value chain, Administrative control and Business chain

XII. CONSEQUENCES OF NOT APPLYING STRATEGIES

AECI-Challenges if tackled based on strategies can yield better results, process efficiency and labour productivity 1) Available Capital need to be allocated & controlled to avoid influences of government agencies that result in quality failure 2) Consolidate AEC industry through regulation to support governmental programs 3) Oversight of emergence of large industry giants that control/own specific industry sectors (Large fish eating away small fishes) 4) Lack of diverse & multi-disciplinary AEC workforce 5) Lack of alternative

funding mechanisms/resources 6) Limited Capital available to stakeholders 7) Government mandates industry & technology standards and pricing structures at the (central government) 8) High incidence of unethical business practices (bribes, kick-backs). 9) Highly regulated & controlled AECI environment

XIII. ADVANTAGES OF APPLYING STRATEGIES

Applying strategies can bring about: 1) Increased demand for integrated project delivery approaches. 2) New technologies increase focus on process design and collaboration. 3) Appropriate, Alternative vernacular-local conditions and restrictions. 4) Cross-disciplinary collaboration and up-front lead forecasting and detailed cost modeling. 5) Price and accessibility to resources are key competitive differentiators and client's selection. 6) Innovative AEC culture. 7) Sustainable business practices. 8) Emphasis local projects funding by government. 9) Limited capable and experienced AEC firms. 10) Tight relationships with government Critical.

XIV. RECOMMENDED STRATEGIES APPLICABLE TO AECI

The following strategies if applied can result in AEC being more productive and efficient. 1) Incorporate government initiatives into corporate strategies 'Out-lobby' the competition. 2) Invest in R&D (in areas supported by government initiatives). 3) Business through acquisitions. 4) Vertical integration and offer broad service offerings. 5) Strong capabilities in detailed project documentation. 6) Strong relationship building across interdisciplinary teams–build confidence. 7) Develop and implement new technologies. 8) Collaborative culture with focus on cross-training, creativity and safety. 9) Investment-opportunities and relationships associated with government stakeholders (e.g., utilities, infrastructure, public-private partnerships, etc.). 10) Investment-sustainable business practices and expertise. 11) Strategic alliances with capital providers. 12) Excellent field productivity & project management capabilities. 13) Ability to drive efficient processes. 14) Strategic alliances with owners, suppliers and other service providers. 15) Specialize, Know your client completely. 16) Expertise, broad variety of experts. 17) Talent internally. 18) Capabilities in project control; attention to detail is critical. 19) Negotiating and assertive communication skills. 20) Deep knowledge of local influence

XV. RECOMMENDATIONS:

This research after series of surveys, case studies, interviews and references, concludes by making few recommendations to the Indian housing sector. 1) Clarify ownership rights of land titles, set-up specialized courts to handle land title disputes, simplify & modernize the current registration system for land titles (cumbersome land registration procedures), rescind the urban land ceiling act, & minimize high stamp duty. 2) Increase collection from property tax and user charges, tenancy rights de-link property taxes from currently controlled rents, minimize evasion of property taxes, & privatize water, sewerage & the remaining electricity services loosen. 3) Introduce modern standards for construction material & strengthen enforcement, link public funding to the use of these new standards, introduce consumer protection laws & special courts. 4) Reduction of construction cost without using inferior construction materials, fund flow to be streamlined, estimation & budgeting must be done by competitive person taking into account all permissible incentives.

XVI. FUTURE

This research can be used as database for future researches in AEC industry for bringing about any improvement or proposing any change. Further, this will act as ready-reckoner for any challenges to be met.

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