

TCE**xpression**

TATA CONSULTING ENGINEERS LIMITED

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Digital Engineering

The Phantom Unveiled



Editorial Team

Anindya Chatterji
Nookala Yajnavalkya
Kishore Chandu Salian

Kanchan Ghughe
Jyoti Prabha
Moanaro Ao

Priya V
Sandhya Singh
Shristi Pranjal

Sumit Mathew
Sutapa Mozumder
Sneha Powar

Design Agency

Trisys Communications Private Limited

Editor's Note

Technology is shaping the way we live, interact and transact in today's world. Technology is changing every aspect of life and the world of engineering is fast adapting these new technologies. In this issue of TCEExpression, we focus on the integration of digital engineering and its positive impact on business for us and our customers.

We look forward to your views. Do write to us at corpaffairs@tce.co.in

Mallika Sriraman

Reflections

Greetings to TCExpression readers!!

Marching into the new financial year, we look back at what we have accomplished so far and what we should aim at to be relevant to our clients. With volatility challenging most industries, in today's competitive market, how can we ensure we have a differentiator?

We took an in-depth look to ascertain what would be the key growth drivers in the engineering consulting industry. It became apparent that technological advances and digital engineering will be the key focus areas around which new business models will emerge. How to turn this around to create value for our customers? Certainly, not just by plugging in engineering and analysis tools but by combining these with what we do best – which is creative conceptualisation, iterative design, functional knowledge, industry operational best practices and detailed engineering analysis and simulations. Throw in a good measure of value- engineering, functional and operational knowhow, collaboration & partnerships, predictable outcomes based on strong project and program management, a bit of financial acumen and flexibility around customer's unique needs – a new lean, agile and customer centric delivery model evolves. Imagine the possibilities when we combine years of proven experience, knowledge and vibrancy of our young professionals born in the internet era with digital engineering! Digital that connects people, processes, machine, equipment, architecture, engineering, design, and sustainability with embedded intelligence, data reuse and analysis, with ability to manage interdependent trends, patterns and intelligence in a smart manner!

This edition of TCExpression recounts developments taking place in our industry and how tangible value can be created for our customers who are embracing new TOTEX (CAPEX+OPEX) business models. With an aim to optimise these new technologies that are able to value engineers, enhance and add predictability to their projects. TCE has taken a forward leap in this area and is ready with people, tools and proven knowledge as the future unfolds. Read on to find out more..

Sincerely yours,

Amit Sharma
Managing Director

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Technovation



TCEndavour



TCE Engage



Customer Connect



Digital Engineering



Corporate Communique



DIGITAL ENGINEERING

The Phantom Unveiled

Let's get digital

We live in an era where the word 'Digital' is ubiquitous and is relevant to nearly all walks of life. Picture this - a 'digital discussion' against a touch-screen table-top that is wifi-enabled. Insert a memory stick with a power plant design in 3D. Take your customers through a visual walkthrough across the table. Discuss the best construction scenario that will fast-track the project. Consider the pain points and focus on areas where innovation is required. Address the carbon foot print aspect and tweak engineering design. Evaluate the resource requirements and take decisions on the extent and timing of investments in resources. Call for a 3D print out of the prototype or use a mobile app to project the facility right on the table from the 3D simulation file stored in your smart phone- A very decisive meeting indeed, made possible with all things digital . . .

The above visualization is not an exercise in wishful thinking. Most of it is today's reality. The question is – Are we ready to embrace and see the value in all things digital? Hardware, software, core domain expertise and business strategy come together to create game-changing value, opening up the mind to new possibilities.





Into the world of virtual engineering

When every aspect of life is being driven by digital, inventing innovative ways of going digital is the key. New information technology tools and systems are increasingly being put to innovative use by marrying them with core expertise. Technology evolution has given rise to new needs, novel ways to exploit available tools and bring about new

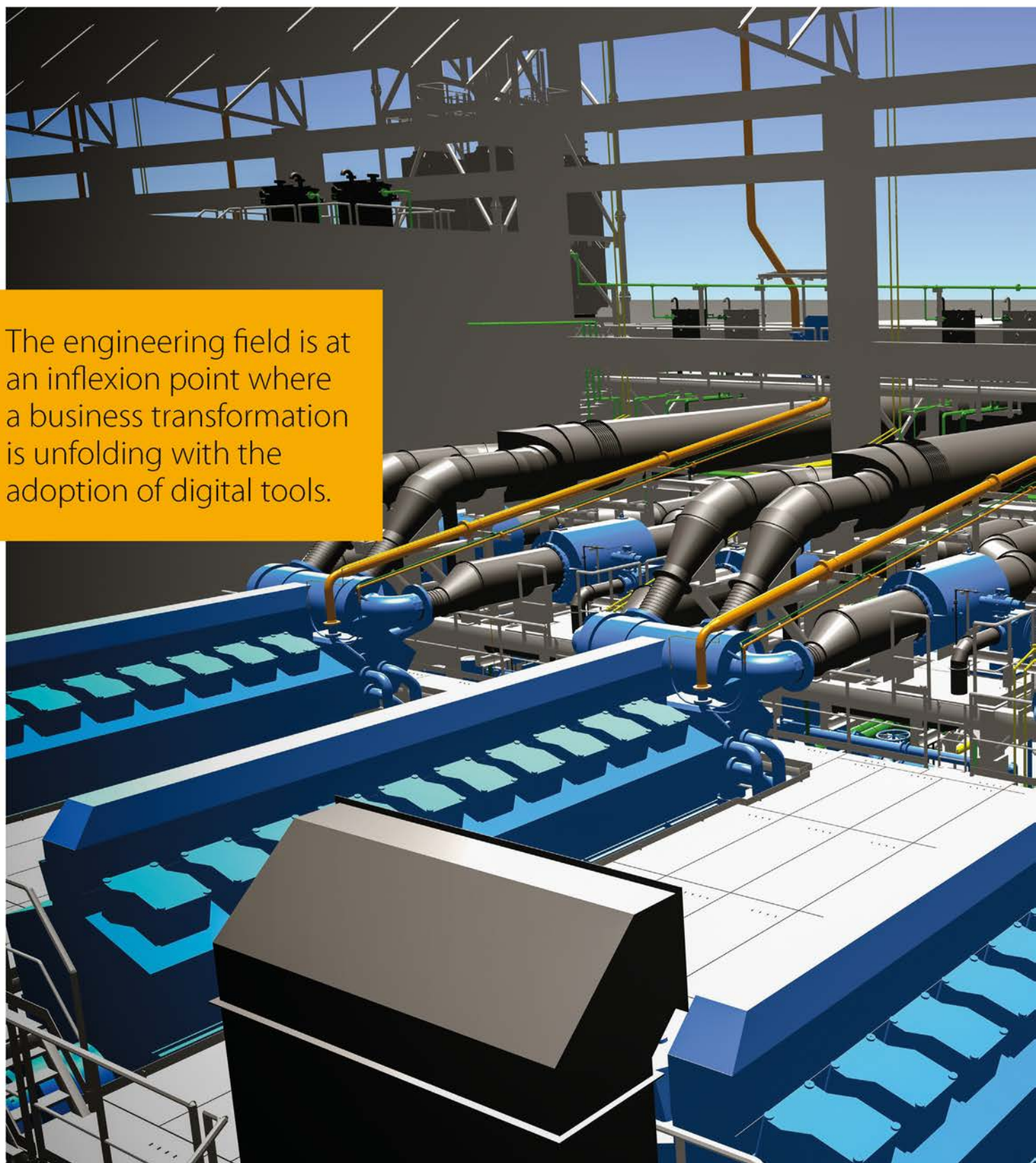
service lines that customers did not know they needed. Bringing digital to the field of architectural engineering consulting is already in practice. The extent these digital tools are used to reinvent service delivery is evolving. The engineering field is at an inflexion point where a business transformation is unfolding with the adoption of digital tools. Virtual engineering is here to stay and business models are surely and certainly being reinvented around it.

The concept of modularization has enabled segregation of standard processes and customized elements which result in quick turnaround time. For instance, standard plant engineering processes and elements of a power plant can be pre-designed and virtually simulated. Efforts on design can be relegated to solely customised elements and integrated into

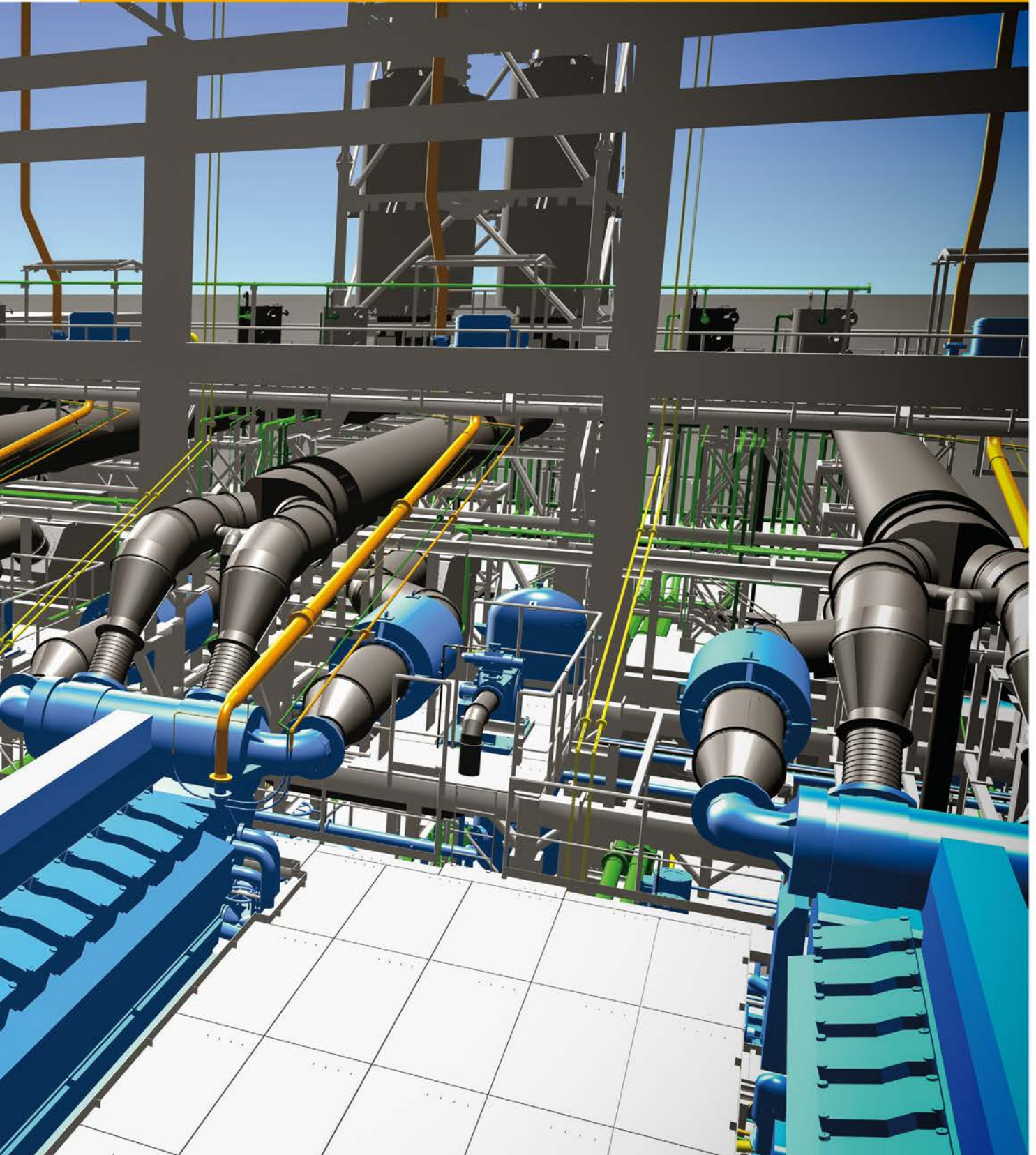
the main plant design. Using various levels of digital tools, construction and project planning can be done virtually, prior to the execution stage. Detailed engineering and simulated plans of assets in digital forms can be re-used anytime.

Project management sans clashes and totally predictable -
Welcome to the world of digital engineering.

The engineering field is at an inflexion point where a business transformation is unfolding with the adoption of digital tools.



A new era of service solutions is already unfolding. Hardware, software, core domain expertise and business strategy come together to create game-changing value, compelling the need to open up the mind to new possibilities.



The Evolving 'D's

Digital engineering is all about depth and dimensions. Earlier, engineering designs were on 2- Dimensional (2D) platforms, by manually drafting the design engineering plans on a drafting board. The same were moved to CAD or computer-aided drafting where 2-dimensional drawings were done using computer applications. 3D typically involves conceptualization, detail engineering, modelling & design, walkthrough and simulations. The 3D modelling and simulations are enhanced through additional dimensions that provide various experiences to the engineering design such as scenario mapping, scheduling, time and resource planning and more.

Digital Dimensions

Post commissioning



Pre-Commissioning

Digital Engineering

Multi-dimensional applications are used for integrated plant design, buildings, urban planning and complex infrastructure projects such as nuclear plants, power plants, chemical plants, water distribution systems, waste management systems, towns, hospitals, buildings and smart cities. 3D to 5D of Digital Engineering typically involves Conceptualization, Modelling, Design, Detail engineering, Clash and Interference Checks and Time and Resource Simulations:

Conceptualization involves overall conceptualization and layout planning using computer systems for power plants, nuclear plants, refineries, buildings, malls, smart cities, roads, bridges, etc

Design and analysis delves further into the design by visualizing aspects of stability, stress, strain, durability, serviceability, etc of the master design. Several iterations and reviews are possible at this stage. – Typical tools from Bentley, Ansys, Etab and Intergraph are some of the engineering applications used.

Detailed engineering - Enrichment of 3D models are done based on design validations using engineering tools from Tekala , Bentley, Aveva, Autodesk & Intergraph.

3D walkthrough - Engineered models are rendered to create virtual simulation of plant or Infrastructure projects as walkthrough. These walkthrough are used for visual



checks for clashes and interferences. The system also has the capability to detect clashes and interferences.

4D Simulation - The walkthrough are further used to validate project schedule, constructability, construction sequencing of plant or infrastructure facilities. Construction sequencing, scheduling, constructability check, safety checks, etc are visualized and planned. This is a critical stage as all iterations are done prior to construction which saves cost, effort and time. Projects can be pipe-lined, collaborative teams can work simultaneously on various aspects, reducing timelines drastically.

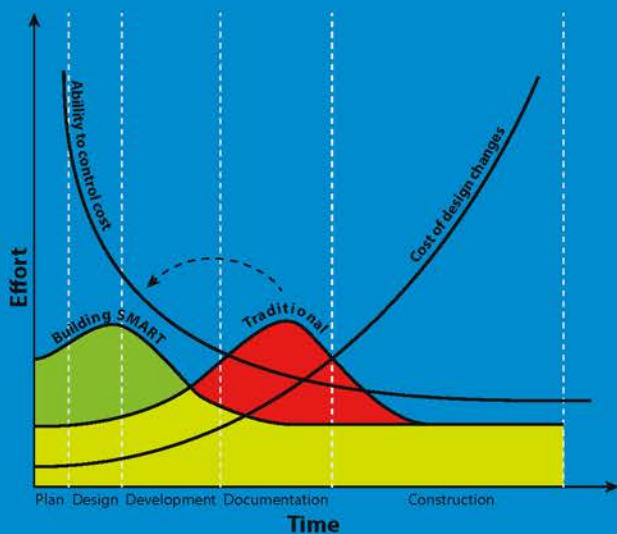
5D involves cost and resource scheduling. The detail modelling ensures project specific data is input in the engineering plan. The 5th Dimension inputs various project milestones, assesses the cost and resource needed at each milestone. This helps in predictability and planning of cash flows and the efficient deployment of resources at the right time.

Asset Life Cycle Management, Training, Outage management, Refurbishment and Demolition of Assets are the future aspects of Digital Engineering post commissioning of plant or Infrastructure facility

Digital Engineering - the Rationale

Cost equation is the simplest of all rationales. Digital solutions help

move the mountain of costs and effort to the design and planning stage such that construction costs escalation due to design clashes and need for iterations at this stage can be avoided. For large capex projects that are complex in nature, this is a smart way of project management. Iterations and reviews and adequate planning can be pushed to the conception stage. Data rich, simulated model can be recalled post commissioning for modernization and upgrades with minimal effort.



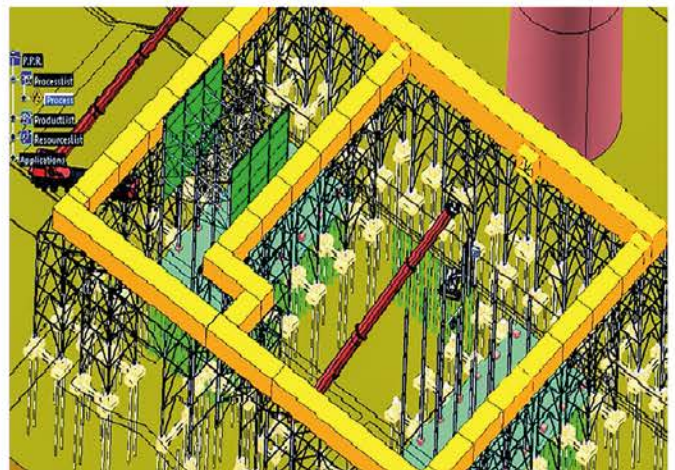
Patrick Macleamy curve indicates, the cost of design corrections is higher at the construction stage and the ability to control cost is lower at this stage. Smart way to manage this is to move documentation and effort to the concept and design stage through digital tools and simulations.

Bringing Value to Customers with Digital Engineering

Power Sector & Digital Engineering

When it comes to plant engineering for super critical power plants, reduction in time-to-market and

commissioning makes a huge difference to the cost. Delays during construction can throw several inter-linked processes and procurement management off-the-track resulting in huge cost escalation. In terms of construction of the plant, sequencing of construction activities is mission critical. Digital engineering in 4D helps to plan the order of tasks in the construction phase in a digitally simulated plant environment. Construction simulation also ensures safety at site, placement of cranes and building equipment optimally,



and maintain project schedule. Cost estimation, raw materials and manpower can be planned with cost analysis done on a daily basis. Several activities in plant engineering can be pipe-lined and executed simultaneously. This is critical when custom equipment need to be deployed at various stages. Procurement nightmares can be avoided and early project completion is possible.

Plants engineered using digital tools serve as a blue print which can be re-used when the plant has to be modernized at a later stage or in retiring asset management. Digitally simulated power plants and power transmission and distribution systems offer efficient solutions to outage management.

Addressing criticalities in the Oil & Gas sector

Oil & gas plants typically require about two years for project to be commissioned, depending on the capacity. Presently customers seek 16 to 18 months to commission and reductions in time to go on stream by at least 6 months. Early production is expected to bring about 20% cost reduction due to profit booking. Hence minimization of errors and delays in construction is very critical. The oil & gas plant engineering has several processes. Digital engineering using 4D & 5D tools helps manage processes efficiently through simulations and scenario planning. Several processes can also be pipelined. Safety is very critical to avoid future disasters as explosives and chemicals are part of the production process. Digital engineering tools provide a great deal of predictability as possible situations can be simulated; alarms and signals



to avoid disasters can be planned. Managing pressure and temperatures are yet another aspect that can be planned and visualized right at the design stage in order to optimize the control rooms, ascertain positioning and ensure disaster warnings at the most appropriate junctures.

Adding 4D (timing data) to 3D models makes it possible to plan and run multiple activities simultaneously with sequencing. Decision on pipelining activities, resource planning (manpower planning, cost estimation) ensure that project is delivered on time. The Oil & Gas industry requires specialized skills and equipments. The use of such specialized skills can be deployed at the appropriate time and optimize spends on such resources.

Tackle complex client requirements in facilities management

When it comes to complex plant engineering and construction project management, fulfilling various stakeholders' requirement on the client side makes design engineering reviews and approval a time consuming process. The iteration costs, holistic view and review goes out of control impacting project timelines. Various production units of the main plant may have unique items on their wish list. In such a complex, manufacturing facility management, digital engineering tools serve as a decision making, consensus and planning tool. TCE solved such client-centric problems such that engineering solutions were presented digitally and simulations were presented virtually to various stakeholders in order to solve constructability issues. Dynamic models

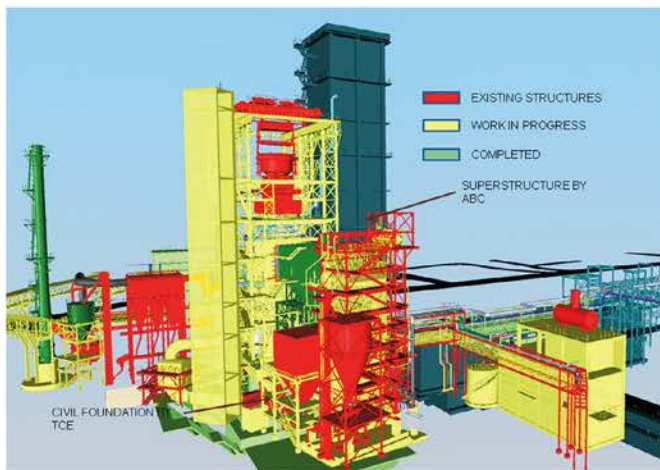


were used to present 30 to 40 infrastructure planning scenarios. In the case of a land development project, TCE presented terrain mapping and earth-walk calculations through automated visualization tools to all the stakeholders. Results and impact in terms of feasibility, constructability, costing etc of one specific plot on the surrounding plots were indicated in a virtual environment. The outcome - decision making and iterations were reduced to a single day.

Digital engineering tools provide a great deal of predictability as possible situations can be simulated; alarms and signals to avoid disasters can be planned

Digital solutions for Brownfield upgrades

Green field projects are easily designed and planned as digital technologies are used from the onset and progressive dimensions from 3D to 5D etc are added based on client requirements. The challenge lies in applying digital engineering tools to existing Brownfield facilities is tantamount to re-doing the design. In Brownfield facilities, structured technical data critical for working with progressive dimensions such as 3D – 6D may not be available. 3D data has to be re-created based on existing inputs which may not be in 3D compatible formats. This is done using 3D scanners to create point cloud 3D data of the facility, plant or terrain. Point cloud data is then used for surface reconstruction for integrating with digital engineering applications. Simulations and virtual walkthroughs are then created to plan and decide the iterations or upgrades to be done. Using 4D simulation and virtual construction, clashes among various parties can be foreseen. Data rich model information of existing plants will help in identifying impact of any particular alterations and



refurbishments on plant during maintenance activities. In a Brownfield project, upgrades and modernization can be done with minimum downtime and can provide huge cost savings.

Integrated Engineering is the Integration of Multi-disciplinary 3D Models developed during engineering design in different software platforms and Extraction of 2D Drawings

Smart cities - A web of sustainable infrastructure & utilities

A smart city corridor master planning by TCE comprises 22 villages and envisaged implementing base infrastructure, including water supply, sewerage, roads, highways, power and rail, performing extensive flood-control and drainage measures to protect the future city. The flood hazard potential of the area was high and required a planned flood management system. The flat topography of the area posed challenges in designing a positive water supply, sewerage and sanitation, storm water drains and solid waste management. The terrain was mapped on 3D to create contour maps to analyze 3D terrain, to manage, visualize and analyze all the information that makes up an entire city. Using 3D suites, surface watersheds and floodplain mapping were analysed. Civil engineering suites were used for scenario planning of roadways, compare the design of road elements against recognized industry standards or user defined standards. Logical town planning makes a modern Smart



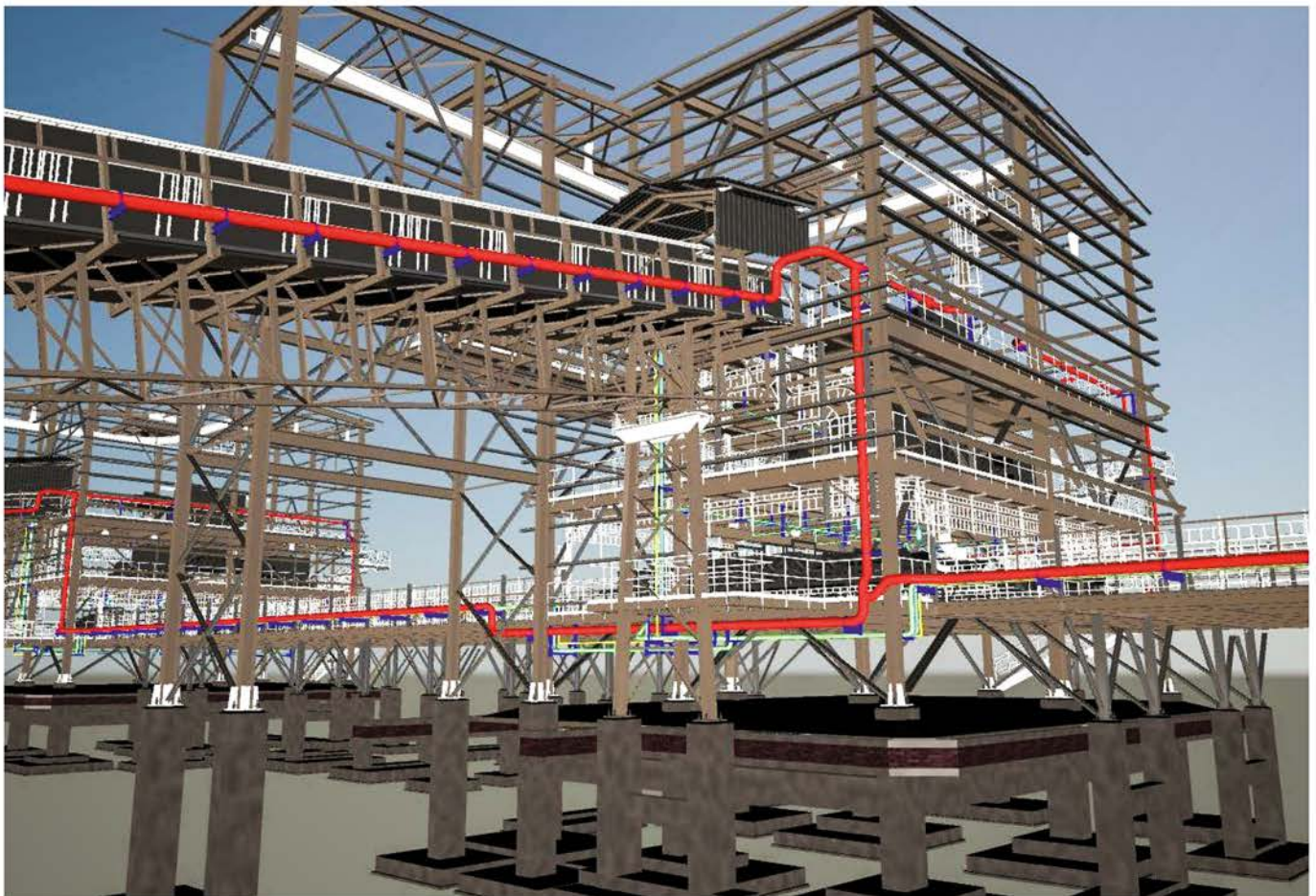
City sustainable and futuristic. This was possible with the use of digital engineering suites for design, civil works, terrain management etc.

Design engineering and planning for sewage and waste management & distribution of water in existing cities face challenges due to brownfield conditions such as railway tracks, existing infrastructure such as roads, bus stops and other public amenities. The need to re-use existing tunnel and piping networks especially for large scale infrastructure development calls for high-end digital tools. 3D solutions with GIS helps to create, map and leverage design data effectively. Modifications and reuse of existing infrastructure helps reduce costs. Digital engineering tools help with identifying and managing clash detection, constructability issues, coordination with multiple disciplines, mapping and leveraging existing infrastructure and reusing them where possible. Simulations and digitized data prove invaluable especially in the planning and management of modifications, upgrades, repairs etc. at a future date.

Steel, Metal & Mining – Collaboration is key

Mega projects such as steel plants consists of storage, raw material handling system, main steelmaking workshop, a continuous casting workshop and supporting facilities such as a boiler room, water treatment facilities, and more. A metallurgical project usually contains a lot of equipment and hence design collaboration is frequent among various disciplines including internal product design. Engineering design presented at the concept stage may have around 30% changes in the later stages, and rework can prove challenging with traditional design tools. The 3D Building Information Model (BIM) used by TCE provided a reliable representation of the actual building, and was used to check the feasibility of the design rationale and to clarify construction planning. Model simulation ensured safety during construction and

played a major role in efficient collaboration with multiple vendors visualizing the plan, engineering inspections, and construction planning. Such complex projects face delays in project commissioning primarily due to design clashes during construction stage. Rework at this stage, stalls a project and is a drain on resources. Simulation of the entire structure helps in freezing designs at an early stage when cost implications are less. The construction stage then moves smoothly within estimated costs and no delays. Since various disciplines interact on such a project, a simulated model serves as a collaboration platform for deliberating on structural, mechanical and civil issues for a smooth commissioning of the project.



The concept of modularization has enabled segregation of standard processes and customized elements which result in quick turnaround time. Efforts on design can be relegated to solely customised elements and integrated into the main plant design. Using various levels of digital tools, construction and project planning can be done virtually, prior to the execution stage.

Digital Engineering - Impact & Implications

Through digital engineering, the value that engineering design and project management consultants can provide customers is a direct impact on cost and commissioning efficiency.

This comes by with accuracy in project engineering & planning, reduction in project timelines, error-free implementation and accurate cost estimation – right at the planning stage when the risks are less and cost benefits are extremely high as opposed to corrections at the construction stage. While the IT industry is moving to cloud and big data technologies, engineering design firms are moving towards integrated digital engineering solutions by presenting engineering projects virtually.

Does this mean the end of the road for traditional engineering skills and engineers? Digital engineering tools help in the application of core engineering skills while reducing the iterations and risk implications in project management. Today, the way core engineering talent is used in the industry stands transformed dramatically. Modularity in engineering processes helps in efficiently streamlining and distributing tasks amongst various disciplines. In this scenario, re-learning, collaboration and working as a team are attributes that hold sway. Core skills are applied in unique ways combining digital suites and systems. It is in this space that new process innovations and killer solutions are waiting to happen. Today's engineer is one who dons the green hat of sustainability and enslaves digital suites to create engineering marvels that are cost efficient & environmentally sustainable.

Today's engineer is one who dons the green hat of sustainability and enslaves digital suites to create engineering marvels that are cost efficient & environmentally sustainable.



Green, **GREEN GAS**

A patent for biogas

Tata Consulting Engineers received right of patent for inclined cylindrical anaerobic digester for obtaining biogas from seed oil cake.

TCEXpression article, Catalyst to Fame (TCEXpression, Vol 53, June 2015) reported the award of patent for the conversion process from non-edible seeds to biofuel.

The new patent involves further processing of the biomass of de-oiled cake that is the residue from the oil generation process. This de-oiled cake is processed through an anaerobic digestion technology for conversion to biogas. TCE's unique process also involves processing the de-oiled cake through an Inclined Bio Digester Chamber that converts the biomass to biogas efficiently. The entire process eliminates pre-treatment and the requirement of an agitator. The Inclined Bio Digester Chamber allows free flow of slurry using gravitational force.

BioGas Technology Innovation

TCE's innovation involves a unique design of digester and feedstock for production of biogas. This innovation pertains to a simple and effective digester design which ferments feedstock of high solid content, particularly de-oiled cake in a plug flow manner. In this the feed passes in a sequential manner from inlet to outlet without agitation. The innovative digester configuration leads to retention and growth of desired micro-organisms and thus making fermentation process sustainable on continuous basis.



Coal to ACETYLENE

Pit stop fixes

Coal found in abundance in many countries, is a wonder feedstock for several major industries and utilities. The early industrialisation era used coal as feedstock in the manufacture of most chemicals, which were derived through mainly the coal to acetylene route. However the abundance of crude oil and natural gas replaced coal and this proved beneficial for large capacity production of polymers and petrochemicals despite the process being a complex e.g. one using steam crackers. This route requires significant unit sizes in order to realise economies of scale, and remain viable. It is indeed a good option when crude oil is available in plenty and at low cost.

In the case of relatively low volume, "fit for purpose" chemicals, the crude oil and natural gas route may not be a viable option especially when such feedstock is imported and the "mother" feed molecules are obtained from mega scale plants that require considerable capex outlay. The last decade has seen significant volatility in global crude oil prices. However, even at falling prices, dependence of imports as feedstock poses a risk especially when large production setups are built around such imports. For several countries like India, China, Australia, Indonesia, etc. coal as a feedstock is available in abundance and at low prices. Does it not make sound business sense

to exploit this feedstock instead, with due processes plugged in for efficiency?

Acetylene is a very versatile and reactive molecule, it is known to be "mother of organic synthesis" and many chemicals can be derived from acetylene with relative ease. Manufacturing of relatively low volume chemicals e.g. VCM/PVC, VAM, acrylics, BDO etc can be potentially considered from coal-acetylene route, which is a relatively low capex option, more suited for distributed productions. Further this process facilitates the capture of the carbon content as a valuable chemical product which contains carbon emission to that extent.



Coal to acetylene, the pit-stops

The manufacture of acetylene from coal can be made efficient and cost competitive through integrated process interventions through every stage of the production lifecycle.

- Managing the quality of coal – Coal drying, Coal beneficiation, de-ashing of coal, efficient coal handling and feedstock management and coal conversion
- Managing the conversion process -The process involves conversion of coal to carbide, carbide to acetylene, conversion of acetylene to product molecule
- Energy integration and optimization
- Plant and process efficiencies
- Managing the carbon footprint - Coal ash management and carbon capture , Re-utilization
- Effective project evaluation, design and execution, through the entire project life cycle

Tata Consulting Engineers through its wide knowledge base and expertise in coal, chemicals and logistics systems, can provide holistic support to this potentially path breaking route for Indian chemical industry and contribute to the "Make in India" campaign in a truly meaningful way.

The manufacture of acetylene from coal can be made efficient and cost competitive through integrated process interventions at every stage of the production lifecycle.

Emerging trends in DIGITAL ENGINEERING

Digital Engineering and its visual simulation capabilities make it possible to look, see, experience and construct. However, this is just scratching the surface when it comes to application of these tools to engineering design. New business models and service delivery options are being discovered from plant engineering for power plants, steel and metal process industries and more. The challenge of the day is reducing cost and project time overruns. These two aspects are key for profitability. Combining business process efficiency using digital engineering tools is the new business model that is being fast adopted by visionary organizations. Several industries are using standardization and modularization to bring about efficiencies in production. Applying this concept to plant engineering, can design solutions be modularized and put up on the shop window? The answer apparently is YES, Indeed!

Plant facilities such as power plants for simple cycle and combined cycle have certain standard elements and certain site specific requirements in design engineering. The standard elements for various disciplines of plant engineering can be mapped and standardised for re-use and the rest of the plant can be designed as per specifications.

Essentially this approach entails dividing a plant into modules that are standardized and then replicated multiple times.

Modularisation scenario

In the case of power plants, the modularisation concept involves developing a Power Island detail design with modular concept for the most competitive combined cycle plants, which can be replicated to reduce plant cost and schedule. The modularisation strategy considers all disciplines such as Civil, Structural, Mechanical, Electrical, Instrumentation etc. The market differentiator is set with goals to fast track simple cycle COD in 3 months and combined cycle COD in 12 months. Even as the Power Island is designed, the sales process is pipelined such that fast tracking in sales process, design and build is fully realized through cost savings, power output efficiencies and super-fast project commissioning. Overall operational flexibility, fast ramp-up to full load, compact footprint, reduction in installation and construction costs, lower project risks, reduced operation

& maintenance costs, enhanced reliability & availability and ultimately lower cost of electricity can be achieved.

Modularization approach is initiated right from design, procurement, contracting going all the way till construction of plant equipment and systems; these enable reduction of site construction hours and ensure shorter project timelines.

The key to the success of the modularization principle is a well defined business case for each module, drawing clear lines on the extent of standardization, customization and reuse of designed modules.

Equipment design, civil, structural utility designs may be modularized, standardized and reused in the case of a simple cycle plant with almost zero design changes or clashes.

This novel business process enables the compiling of a design library of modules built with multiple disciplines (spanning engineering, commercial, and procurement). Engineering design tools provide access to finalised modules and equipment lists complete with purchasing agreements for replication. Integrating, limited customization specific to a particular site, completes the process. Additionally, toll-gate processes are introduced in project management such that at each toll-gate stage, there is a parallel alignment of sales process. This speeds up the entire design-execution-production-sales cycle by up to 50% when compared to the traditional process.

The support of advanced digital engineering solutions such as 4D tools will make the fast tracking goal meet its logical finish line.

"GE Power selected TCE for developing 2X1 LM6000 combined cycle plant design through a Global competitive bidding process. The TCE team is very professional, diligent and customer focused. The team has delivered above and beyond GE expectations through state of the art digital engineering capabilities such as 4D construction simulation. Cost and Schedule reduction were primary objectives of the program. \$10M plant cost reduction could be achieved due to optimized design and accurate BOQ through plant 3D modeling. Accelerated schedule could be ensured through L3 schedule in Primavera and visualization of sequence of installation through construction simulation. Thus, TCE has demonstrated world class, state of the art design and engineering capabilities."

- Dipti Dash, Program Manager, GE Power



Integrated engineering design with digital tools

Efficiencies in engineering are brought about by the synergy of business process, design engineering, digital simulation, as well as final construction, installation and commissioning.

Standardisation and modularisation have been possible with the aid of integrated engineering design tools. Integrating various disciplines, planning, design, modelling and simulation tools. Most relevant at this stage in project management is one key concern that organisations must necessarily consider. The advantages of fast-tracking such projects need to be sustained and not lost to delays in construction due

to constructability issues and clashes. The support of advanced digital engineering solutions such as 4D tools will make the fast tracking goal meet its logical finish line. Yet another factor is the selection of appropriate digital engineering tools and integrating every discipline within the various applications.

The entire cycle of plant design planning, modelling; migrating modules to integrated plant engineering suites; progressing to construction planning/scheduling; finally construction simulation for better predictability and study of what-if scenarios; this is engineering design workflow. That is critical in accurate creation of standardised modules and replication success rate.



Enhancing the **CUSTOMER EXPERIENCE**

FY 2015-16 was a year dedicated to upholding our promise to customers by enhancing systems and processes and upgrade delivery standards. Several internal initiatives were undertaken to get employees' focus on enhancing customer experience. The Customer Xperience Contest was thrown open to employees across TCE to crowd source for new ideas. The employees formed teams of three or more members to brainstorm and present an idea. The first round of ideas submitted were screened and reviewed by a panel of judges drawn from the senior management team. Five semi-finalists were selected. The semi-finalists prepared a concept note and a presentation on their ideas to a jury chaired by the MD and other management members.

Several great ideas came up from TCE-ites across locations and across hierarchies.

Team Sahyog - Winners

Jitendra Tyagi
Navin Venkataraya Appa
Jitendra Kumar Singh

The idea: A structured process for customer engagement in various phases of service delivery

The idea is to involve and educate the customer at critical stages so

that the customer is informed well in advance on the various aspects of the project.

Modularise the client approval process, use systems to manage issues and escalations and conduct joint audits with clients for smother and informed project progress.

Effective customer redressal at early stages, managing project risks effectively by ensuring client involvement.



Team Rolling Mills - 1st Runner Up

Biswarup Pal
Dhiman Boral
Jyoti Prokash Mondal

Rajdeep Paul
Sujay Bhaumik
Saumen Mallick

The idea: Online Drawing Review Management System.

A web-based system to view & mark up engineering design drawings, reviews stampings and approval signature on drawings digitally.

Using online commenting, e-stamping and e-signature on drawing sheets is a smart approach which helps reduce human efforts

and speed up approval process. This reduces error on both sides. Retrieval and comparisons of earlier approvals are available online.

View and mark up of designs are documented and client's concurrence and revisions serve as a reference point. Time lags in iterations can be reduced and review process managed efficiently.

Team Zero Distance - 2nd Runner Up

Souvik Roy
Hardik Praveen Patel
Shashank Kumar

Three ideas: (Agile design data mining system, Micro blog for internal/external customer engagement, drones for construction management)

Agile design data mining system provides valuable back end information to capture and address front end customer issues.

Micro blogging tools for closely knit teams working in a distributed environment works well in ensuring cost effective but constant communication with project teams and client teams for instant decision making.



Drones serve as a great tool for identifying safety glitches in large project sites

The three winning teams will be part of an internal task force to implement their ideas and review progress. The exercise provided the right inputs directly from customer facing employees and the selected ideas were solutions based on on-ground realities.

TCE Triumphs

TCE received the 2015 Be Inspired Award from Bentley Inc, UK



Mr. Sandeep Zade from TCE's Infrastructure BU receives the award at a conference held in UK.



In a conference in Greater Noida, Mr Bentley presented the Be Inspired award to TCE. It was received by Dr. Rajashekhar Malur, DCH Delhi NCR

TCE was presented the award in the Innovation in Land Development, Engineering, and Management Category to recognise the very unique kind of project of Shrimad Rajchandra Mission Ashram infrastructure Development and Detailed Design of Utility Infrastructure – (Dharampur, Gujarat, India)

The Be Inspired Awards program has recognized more than 2,000 of the world's most outstanding & innovative infrastructure advancements. Ten independent jury panels comprising distinguished industry experts selected the 54 finalists across the world from more than 360 nominations submitted by organizations in 55 countries. TCE's approach to engineering design for a sloping terrain that posed challenges and the effective use of digital engineering technologies combining core engineering clinched the recognition.

Mr Sandeep Zade from TCE, Infrastructure BU presented at the conference held in UK and received the award.

TCE's women engineer honoured with Sherpa National Award by CEAI



Ms. D. Geethalakshmi, Electrical Dept. Head –Chennai, Tata Consulting Engineers Limited (TCE) was honoured with SHERPA NATIONAL AWARD in recognition of the outstanding role played by her towards design of Electrical system for 2 x 250MW MW Thermal station at Neyveli which

incorporated various innovative concepts for the first time in India. Distinguished women engineers were honoured at a function held at PHD House in South Delhi by the Consulting Engineers Association of India (CEAI), apex body of Consulting Engineers in India. CEAI represents the Indian Engineering Consultancy professional at the International Federation of Consulting Engineers (FIDIC). Geethalakshmi is an engineer with Tata Consulting Engineers since the past 15 years.

"Apart from tackling various technical challenges as an engineer, this project has helped me build up my interpersonal skills through numerous and tough technical/contractual meetings, debates and discussions. Participation of women in every field of work is increasing even in those professions once considered as a male bastion such as engineering. The presence of women engineers is gradually decreasing through the mid and senior level hierarchies. I urge young women engineers to capitalize every opportunity and set an example for others to follow." D. Geethalakshmi, Tata Consulting Engineers Ltd, Chennai.

Tata Engage Awards

TCE recognised at the TATA SUSTAINABILITY CONCLAVE MEET 2016

Tata Consulting Engineers Limited received recognition at the TATA SUSTAINABILITY CONCLAVE MEET 2016 held at Hyderabad. The recognition was in appreciation of TCE's participation at Tata Engage Volunteering Week III. With 1013 volunteers, 69 programs and a reach of 24K people on Facebook, TCE volunteers from across locations showed their passion and enthusiasm for contributing to society. Tata Engage, a group level volunteering program was made successful with the participation and conduct of CSR activities. TCE organised several programs in education, skill building, mentoring, career counselling, safety awareness, environment awareness and other community service programs. TCE received the awards in three categories; the Best Internal Campaign, wherein mailers, word-of-mouth & social media was used to encourage participation and drive visibility; Most Unique Collaboration for joining other group companies for a skit and flash-mob at Mumbai's Churchgate station; the largest Collaboration as the single largest collaborating team comprised of TCE volunteers. Congratulations to all the volunteers for creating awareness on Swach Bharat campaign and undertaking cleaning activities.



Mallika Sriraman, Head Corp. Comm. & CSR and Anindhya Chatterji, CSR Advocate, Mumbai receive the awards from Mr Shankar Venkateshwaran, TSG (extreme left) and Mr. R. Mukundan, MD, Tata Chemicals (extreme right)

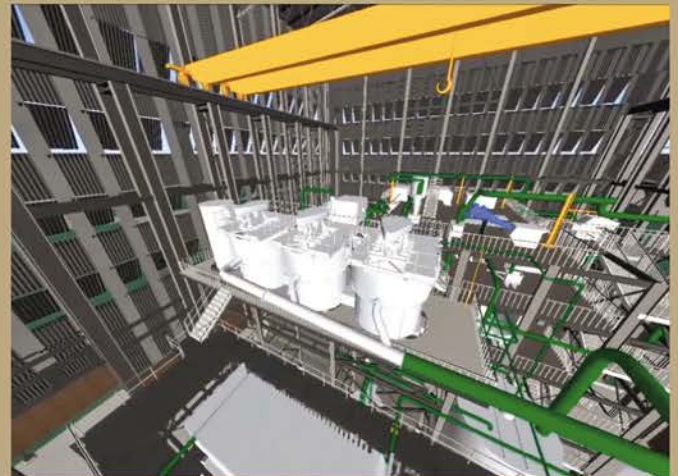
TCE Buzz

Young Engineers Development Program'16 - Future of TCE

TCE believes the future of engineering, technology and innovation depends upon the young engineers of today. In line with this belief, every year, TCE inducts fresh talent into the organisation. The Young Engineers Development Program (YEDP) equips these young minds with in depth subject matter expertise and hands on training for close to a year. Close to 300 talented engineering graduates met at Fasy Auditorium in Loyola, Jamshedpur to present the outcome of their training to an esteemed panel of guests comprising of senior leaders from TCE, Tata Steel



Ltd and AutoDesk. The young graduates showcased their 3D & 4D simulation skills acquired during training through case studies and project updates. Encouraging the graduates at the event were Mr S Padmanabhan, Chairman, TCE, Mr. Prasad Menon – erstwhile Chairman, TCE Ltd, Mr Amit Sharma, MD, TCE, Ms. Kalpana Jaishankar – Senior VP – HR, TCE, Mr T. V Narendran, MD, Tata Steel Ltd and Mr. Alok Kanganat – VP – Engineering, Tata Steel Ltd. Each of them urged these young minds on the importance of hard work and ethics while inspiring them with knowledge relevant to the industry today. Mr. Amit Sharma sensitised the young graduates on the to focus on understanding the needs of the customer and the importance of customer satisfaction.



New young graduates showcase their 3D & 4D modeling skills.



Mr. Narendran, MD, Tata Steel and Mr. Amit Sharma, MD, TCE at the event.



Mr. S. Padmanabhan, Chairman, TCE (in the centre) flanked by the TCE management and trainees.



Bangalore





Delhi



Jamshedpur





Kolkata

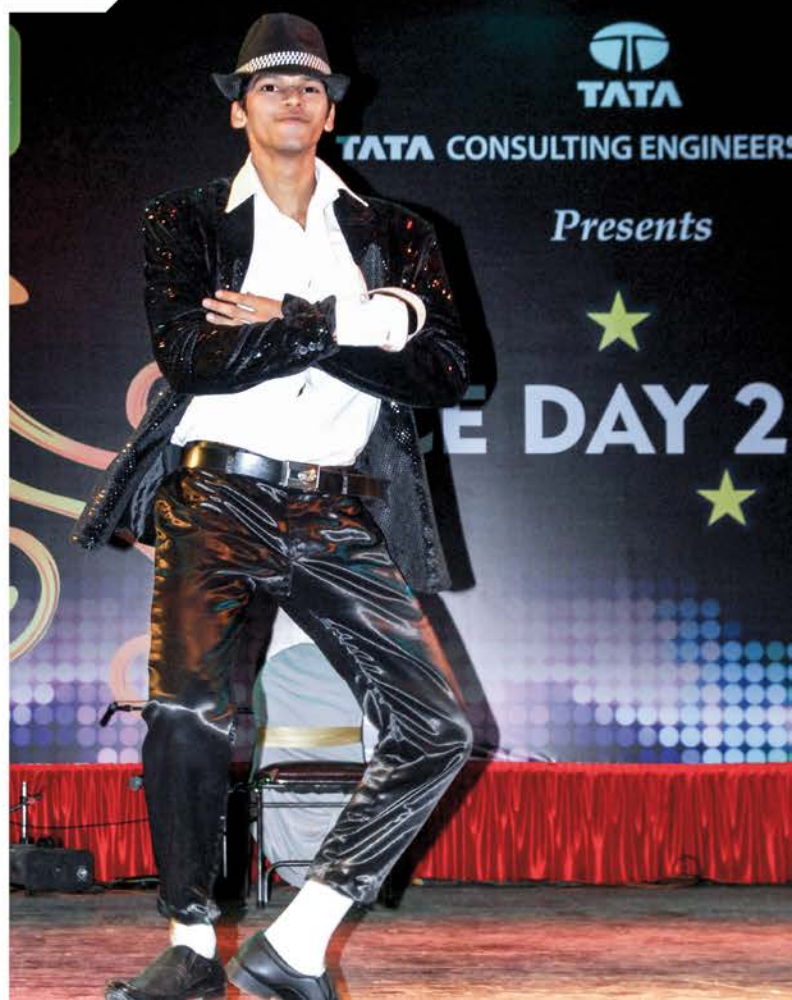


Pune





Mumbai



BUSINESS Brief

GCF 2016- The Building of Competitive Cities: How to Succeed in the Global Economy

The Global Competitiveness Forum 2016 Riyadh, Saudi Arabia featured a panel discussion with mayors from the world's most competitive and innovative cities. Mr Amit Sharma, MD, TCE as part of the panel discussion provided view points on how to turn cities into great engines of innovation and models of sustainability. Speaking at the forum, Mr Sharma said, "100 years ago it was about physical connectivity, infrastructure etc. Today it is digital connectivity. Cities of the future will be sustainable cities that will facilitate new generation entrepreneurs who live in the city and collaborate with the rest of the world. The point for deliberation will likely be rewiring existing cities or creating new cities or working on the hub-model." Other panellists included Mr. Fahd Al-Rasheed, Group CEO & Managing



Director - King Abdullah Economic City, Prof. Arturo Franco, The Future of Cities, Tecnológico de Monterrey (Mexico), Mr. Ashraf Mohamed Naguib, Chief Executive Officer - Global Trade

Matters, Dr. Ahmad Al-Yamani, Chief Operating Officer – TAQNIA. The session was moderated by Mr Stephen Sackur, presenter of Hardtalk, BBC World News.

PMP Certification teams felicitated

Tata Consulting Engineers Limited considers Project Management as an area of focus for sustainable and continuous growth of the organization and its people. Driving this focus, TCE has given special emphasis on grooming, training and certifying professionals in project management, that will help them benchmark to global standards in delivery.

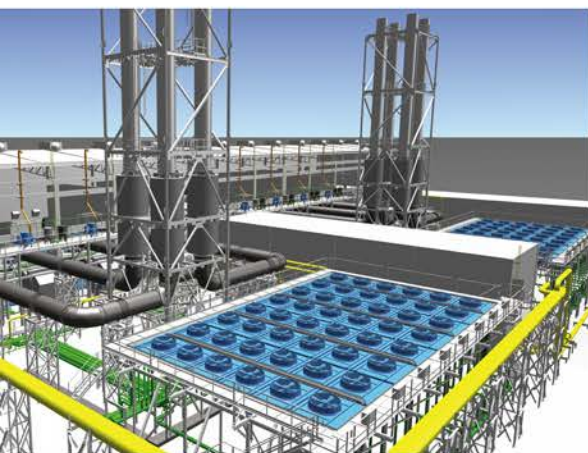
The Project management certification programme at TCE is being implemented since the past two years. Several batches of Project Managers have successfully completed the PMP Certification (Project Management Professionals); and many more are in the pipeline and so it was fitting to recognise the efforts of these Project Managers. TCE organized a PMP felicitation programme for certified PMPs to appreciate the achievements of those certified and to motivate more engineers to enrol.

The PMPs were unanimous in their opinion that this was indeed worth all the effort and look forward to give back to the industry in every way as globally recognised engineering professionals.

PROJECT Patchwork

Dry Quenching (CSQ) project for coke oven battery (cob) for Tata Steel Limited, Jamshedpur

TATA Steel Limited has planned to install a CDQ plant for both COB # 10 and 11 at its Jamshedpur Plant which would replace the current wet quenching process. Currently the coke from coke oven battery plant is being cooled using conventional "wet quenching process". TCE has been awarded the complete engineering of the Power Plant along with the balance of the CDQ Plant. The engineering for the entire project is being carried out using 3D Engineering methodology using various digital tools (Building Design Suite-BDS, Plant Design Suite-PDS, Infrastructure Design Suite-IDS etc.) relevant for each engineering discipline and finally integrating the same. This project is a classic instance of integrated digital engineering wherein several disciplines and the relevant digital tool for each discipline is applied and finally integrated.



Delhi-NCR

Gas Engine Based Power Plant at Bangladesh – Detail Engineering Services

A gas engine based power plant with 8 x B35:40 V 20G2 Genset is being set up at Chittagong, Bangladesh for Rolls Royce. TCE is providing detail engineering services for the project. The plant will be constructed in two phases and a plant capacity of 75MW, will run on natural gas. TCE's services include pipe and duct sizing calculations, pressure drop calculations, stress analysis, and fabrication detailing of civil structures. TCE created a virtual walkthrough of the power plant in 3D environment, providing the client with a simulated view of the model, thereby saving considerable time and effort.

EPCM Services for proposed 18 MW CCPP Project at Dahej Complex

TCE has been appointed for EPCM consultancy services by GNFC for their proposed 18 MW captive cogeneration power plant project at Dahej Complex. The scope of services include services as owners engineers, project management, procurement expediting and site supervision. The project will be executed in two Phases - Phase-I covering DPR, Project cost estimation, LSTK tender specification, bid evaluation and technico-commercial recommendation for preparation of bankable DPR; Phase-II involves LSTK contract finalization, review engineering, procurement expediting, supervision services for construction & commissioning, project planning & control and project closure.



Delhi Water Supply Improvement Investment Program

TCE will be working alongside the Asian Development Bank (ADB) in enhancing Delhi Jal Board's (DJB) readiness for the Delhi Water Supply Investment Improvement Program by carrying out data collection, surveys, investigations and preliminary analysis of the water distribution system supplied by a selected Underground Reservoir (UGR) within Wazirabad WTP command area. DJB will select an underground reservoir (UGR) for study purposes and will provide the approximate

physical boundaries of the supply zone, which will have in the order of an estimated 27,000 customer service connections.

TCE will prepare a hydraulic model of the existing distribution system, review customer meter reading and billing procedures, Delineate (identify number, boundary, and connections, etc.) District Metering Areas (DMAs), conduct preliminary assessment of NRW in the identified DMAs and prepare the overall preliminary design of the required improvements to the supply zone including the introduction of district metering area (DMA) zoning.

Jamshedpur

Hot air utilization from sinter coolers

The feasibility study for the proposed recovery of waste heat from the sinter coolers and utilize it in the ignition furnace as combustion air and in annealing hood will be undertaken by TCE for Tata Steel. Utilization of hot air in the annealing hood will improve the sinter strength and reduce gaseous fuel consumption. TCE is the maiden engineering consultant in India to have undertaken the detail engineering work of such a pioneering venture.

Feasibility study services for project proposal of Blast Furnace TRT

The project envisages meeting the in-house power demand of the steel plant by power generation through 'top pressure recovery turbine' in F-BF by depressurization of blast furnace gas (BFG), leading to reduction of green house gas emission. The feasibility study theory is formulated with various rewards (such as compact design and optimization, higher efficiency, lesser construction time and cost etc.) and alternative schemes. TCE is undertaking this study for TSL, Jamshedpur.



Feasibility Study of Slag Splashing

Under the pre-feasibility study report, TCE has made a comprehensive study of the existing facilities at site and put forth its findings and suggestions for accomplishment of 'slag splashing technology' for converters in LD Shop 1 and LD shop 2 at Tata Steel, Jamshedpur. Currently, slag splashing has become a dominant technique not only for increasing of the lining life of the converter but also for maximizing its production.

CES for CGL-1 up gradation project (Cold Rolling Mill Jamshedpur Works)

The project involves installation of tension leveller and bridle along with auxiliary system like hydraulics, lubrication system, pneumatic system with electrics & automation, in Continuous Galvanizing Line-1 inside CRM Complex of Tata Steel, Jamshedpur to advance the flatness of strip up to 1/10 of incoming strip flatness. Flatness is one of the most important measured quality constraints for galvanized sheet. Civil foundation of the job has been finished. Erection of offline equipment like pipeline, lubrication system, cable tray, cabling and earthing is being executed at site.

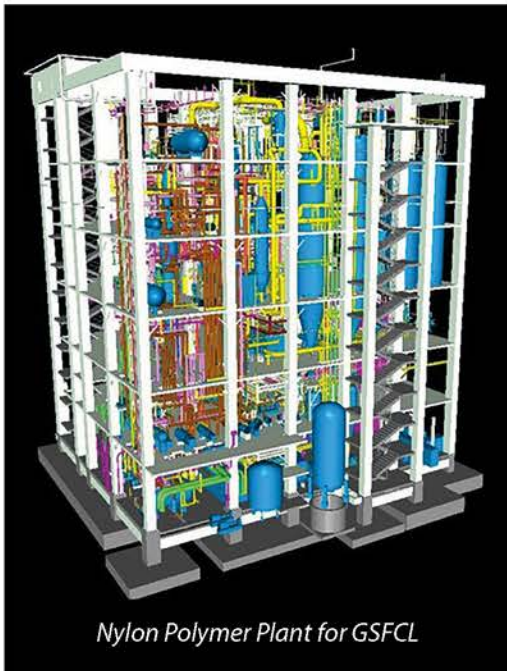


Mumbai

MSME (Ministry of Micro, Small and Medium Enterprises) has retained the services of TCE as a Consultant Management Consultant to deliver detailed engineering and construction supervision services for their Technology Centre's (TC) at 13 locations spread across India. The objective of the proposed TC is to provide professional training in various courses with focus on auto and general engineering. The TC is expected to contribute towards skilling youth (around 17,000 to 18,000 trainees in next five years) to make them employable in industry

by designing courses relevant to them. Major specializations in which training would be imparted includes Tool-making and metal cutting, Maintenance, CNC Manufacturing, CAD/ CAM, Advance Welding, Car/Bike service training, Information Technology, Industrial and Process Automation.

Nuclear Recycle Board (NRB), Bhabha Atomic Research Centre (BARC) proposes to setup an integrated chemical plant for which TCE has been appointed to provide design engineering services for Instrumentation & Control (I&C) system and assist in getting clearances as and when required, in close co-ordination with NRB, BARC. The project consists of about 20 major blocks comprising of chemical plants, storage buildings, service & utility buildings along with a number of small blocks & ancillary structures. TCE is involved in engineering design of Instrumentation & Control (I&C) System for this plant. Proposed work includes design, preparation and submission of design report; P&I diagrams; design of computer based data acquisition (CDAC) system architecture; seismic design & analysis design.



Nylon Polymer Plant for GSFCL

Nylon Polymer Plant for GSFCL

Gujarat State Fertilizers Corporation Limited (GSFCL) is coming up with 6 plants of 45 MTPD Nylon polymers and has appointed TCE to provide with EPCM services, Detail engineering, Procurement assistance, Inspection and expediting construction supervision along with start-up and commissioning assistance.

VCM Phase out & PVC upgrade project

SABIC has appointed TCE to complete Feasibility study, detailed engineering; procurement assistance and construction supervision along with 3D modeling using PDS engineering digital tools for VCM Phase out project and PVC refrigeration Upgrade Project in Saudi Arabia.

60000 TPA PVC Plant in Ethiopia

TCE has been awarded by M/s. Dejen Chemical Engineering PLC, Ethiopia to provide Design review, Supervision and Coordination work to be performed by EPC contractor and project management consultancy for its upcoming PVC plant having capacity of 60000 TPA.

Kolkata

First of its kind Zero Discharge Solution

TCE has been assigned by Jindal Steel & Power Limited, Odisha to provide Basic Engineering, Technical Specifications along with Procurement Assistance, Review of Vendor Drawings, Inspection Services, detail engineering for civil & structural, electrical & Instrumentation and over all Commissioning Assistance for its upcoming first of its kind zero discharge plant that aims to restrict Raw Discharge from Cooling Tower Blow-down & Backwash Waste Water as well as to reduce the Raw Water Requirements of the plant. The plant uses the technology of Reverse Osmosis (RO) followed by Ultra Filtration (UF) Treatment Technology for purification purpose using Ultra Filtration Membranes which acts on the principle of Capillary Action of Water.



Pune

PMC Services

TCE has been appointed by Wipro Limited for providing PMC services for several IT Parks in Bangalore, Chennai, Kolkata, Bhubaneswar, Hyderabad & Coimbatore. In Industrial sector TCE has been appointed as Consultant for providing Construction Supervision Service for Bosch at their upcoming Industrial set up at Bidadi in Bangalore & Torrent Pharma's API Plant at Sikkim.

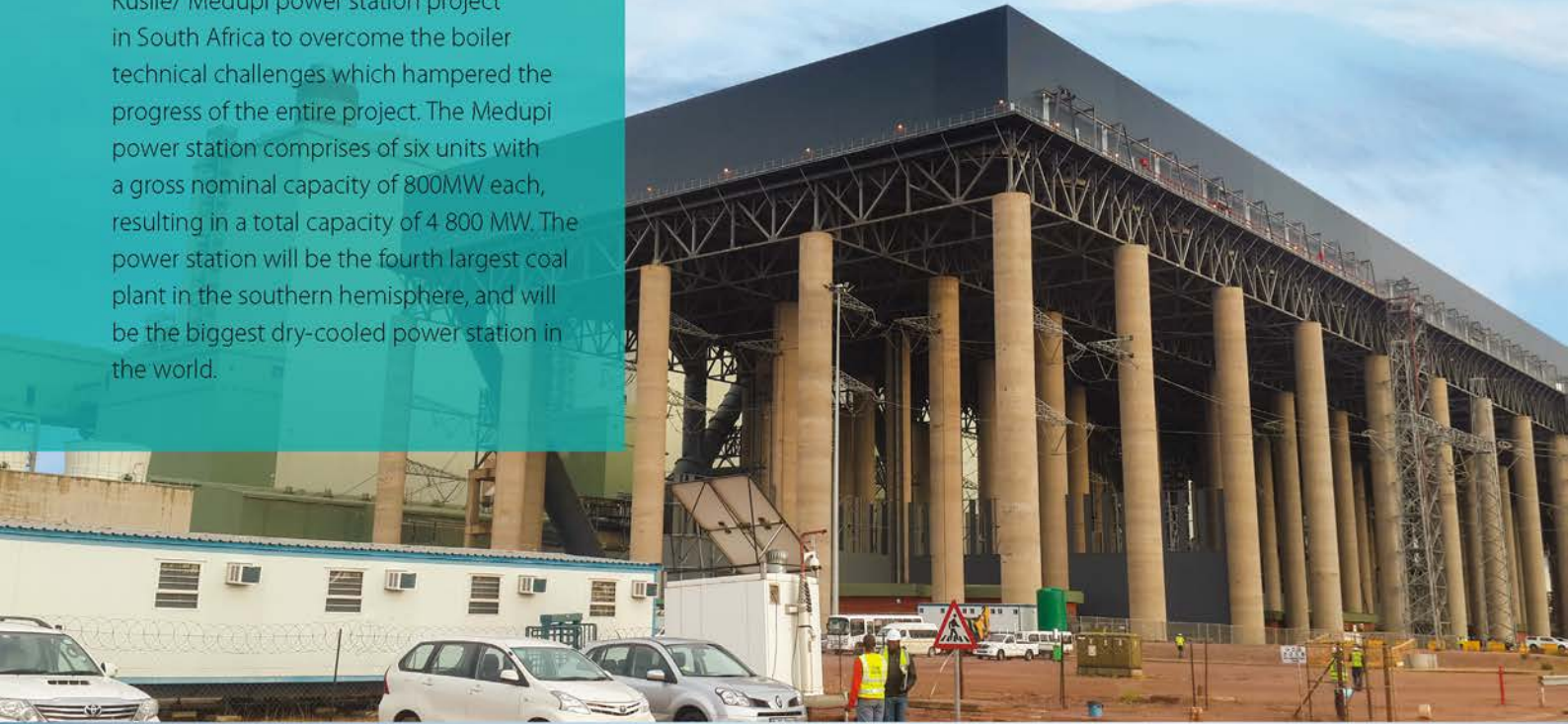
TCE has been awarded PMC assignments by MCGM Colaba, Gujarat Urban Development Mission & Sardar Sarovar Narmada Nigam Limited for water supply projects

Tata Steel has appointed TCE to provide PMC Services to their First pushing of Coke in battery 2 of KPO & many other industrial setups at Kalinganagar in Odisha.

Gujarat Narmada Valley Fertilizers & Chemicals Limited (GNFC) has appointed TCE as Project Management Consultants for their 45 MTPD Nylon polymers Plant for providing Construction Supervision Services.

Field & Quality Management Services at Kusile

TCE has been assigned by ESKOM to provide Field & quality Management Services at Kusile/ Medupi power station project in South Africa to overcome the boiler technical challenges which hampered the progress of the entire project. The Medupi power station comprises of six units with a gross nominal capacity of 800MW each, resulting in a total capacity of 4 800 MW. The power station will be the fourth largest coal plant in the southern hemisphere, and will be the biggest dry-cooled power station in the world.



TCE has been assigned by Indorama Eleme Petrochemicals Ltd to provide Construction Supervision Services at Nigeria. The feed conditioning unit achieves the separation of the Natural gas to Methane stream, Carbon-di-oxide stream and Heavies stream. The methane steam shall be fed to the Ammonia plant, CO₂ stream to the Urea plant. From the feed natural gas, almost all the CO₂ and H₂S are absorbed using an amine solvent in Amine contactor. The amine solvent is regenerated in Amine regenerator, where by CO₂ and H₂S are released. The amine solvent is used back in the Amine contactor. The acid gas coming out of the amine unit is treated in Sulphur reduction beds, compressed and sent to Urea plant.



Countering Nature's fury as a Team

The devastating floods in December threw Chennai city and the coastal regions in Tamil Nadu off gear, with life grinding to a halt and people left hapless at the mercy of nature. Tata Consulting Engineers' team in Chennai rallied together during the thick of the storm. When all communication lines, power systems and transport failed, TCE teams deployed creative means to stay in touch. Families clambered to safety as the water levels rose. Those lesser affected TCE-ites formed a Whatsapp group and kept adding people as connectivity got better. The MD, Mr Amit Sharma sent a re-assurance message which was forwarded through the mobile network. Mr K V Seshan, DCH, Chennai rallied his people around. The TCE office complex in Chennai was also deluged. People showed great courage in helping each other out. TCE teams in Chennai also extended a long helping hand to work with the Tata Sustainability Group team, stationed in Chennai for the Disaster Management and Rehabilitation efforts. The company and rest of the employees did their bit to contribute to the relief of the people and TCE-ites who had suffered damages. A team of volunteers were part of the ONE TATA project team to help the afflicted towns. The humongous task on hand included emergency services for immediate needs, surveys to identify most afflicted towns and people, preparation of kits, distribution of essential supplies, distribution of school kits to children etc.





Service to the poor is Service to God
- Kotteeswaran V



The word THANKS from the heart of the unknown person is the best gift in the world & I gained more than hundreds of it in this TATA Response Program;
Thanks TCE
- S Ramprasat



Smiles awaken
Dark Life Broken
To the people spoken
Love has frozen
Helping Hearts are few
The greatest is you
There are so many hearts standing in the queue
To heartily Thank You!
-Suvarna



Blessed to be part of the Tata Group's TN Flood Relief Team & thanks to TCE for this opportunity to serve my people
- Jeevankumar M

Making a difference in the lives of the people in the much needed hour is a satisfying experience. I feel fortunate enough to get this chance and I thank TCE for the opportunity
- Naresh





I felt honoured and humbled being one among the
TATA family and contributing towards the society

– Mohan Kumar



Great Experience working with other TATA Family
members helping the society

– Sathishkumar



The future depends on what you say and
what you do

– Santhosh



The external forces collapsed it,
ATA's internal forces rebuilt it

– Suresh

Khoripada – Life after the rains

The small hamlet of Khoripada near Jawhar, Palghar district is a hilly terrain with ample rainfall during the monsoon but faced with acute water shortage post monsoon. Water was the prime concern for people in the village. TCE helped by providing a rainwater harvesting tank to sustain post monsoon. Prior to the monsoon, TCE engaged an NGO in the region, MITTRA, to work with the villagers and expose them to the possibilities in water management and sustained income generation. 53 villagers were trained in backyard poultry, managing SHGs and exposure visits were arranged to introduce the villagers to floriculture and

horticulture. Village women were sensitised to health and hygiene programs and SHG management. TCE plans to work with the NGO to help with water management solutions to effectively cultivate crops during and post monsoon.

TCE's volunteers visited the village and distributed clothes, toys and books to the village women and children. During the Tata Engage volunteering week, employees from TCE spent a day in the village, teaching yoga, meditation, health and hygiene and introducing children to exciting games.



Digital Draughting - Skill building

TCE, as part of the skill development program for youth to drive employability, began training in CAD for youngsters from ITI. A part of the Tata Engage program, a group of students from Antarang Foundation were given basic training in AUTOCAD. These students showed great interest in engineering draughting and showed interest in learning more. Four enthusiasts went on to train in advanced CAD and were also given coaching in basics in engineering design. The youngsters worked hard and are now getting exposure to live CAD as apprentices during the summer break.

Similar CAD draughting programs are also being conducted in Pune and Bangalore for Government ITI college students, belonging to economically backward communities. The Draftsman's course complemented with Computer-aided Draughting enhances the employment prospects of these students. About 60 students were trained in basic CAD and issued certificates.



Volunteering THE TATA WAY!

Tata Engage Volunteering Week



Dr Nirmalya Kumar, Member, GEC, Tata Sons and Amit Sharma, MD, TCE, counsel students from Antarang Foundation.



TCE has been actively participating in the group level Sustainability program being held under the umbrella of Tata Volunteering week. TCE across all its location has conducted 69 programs with 1013 volunteers working with the community.

These were the key areas of volunteering:

- Education
- Community Service
- Safety
- Health and hygiene
- Swachh Bharat Abhiyan
- Skill building programs



1013

Volunteers



69

Programs across locations



77

Under privileged children from St. Patrick's given remedial classes



250

homes surveyed for Doorstep School to assess school drop out and drive enrolment



25

Hearing impaired children trained on MS Office

130

Students from Antarang attended the career counselling program



58

Students Trained in Cad drafting tool from Mumbai, Pune & Bangalore



54

Volunteers participated in road safety campaign.



81

Teachers in the Train the trainer program on Safety



39

Volunteers participated in Swachh Bharat Campaign



81

Volunteers prepared and distributed eco-friendly dustbins made from waste material



30

Doctors sensitized
on managing
Biomedical Waste
Management in
hospital



311

Volunteers
donated blood



32

Specially abled
children provided
with wholesome
meals



30

Elderly women in
an old age home
entertained



15

Under privileged
children given
basic IT skills



Converted school
books into audio
format for blind
students





TATA CONSULTING ENGINEERS LIMITED

Registered Office: Matulya Centre A, 249 Senapati Bapat Marg,
Lower Parel (West), Mumbai - 400 013

Corporate Office: 247 Park Tower 'A', LBS Marg, Vikhroli (West), Mumbai - 400 083

Email: mail@tce.co.in | Website: www.tce.co.in

TCE Corporate Communications

Engineering A Better Tomorrow