

10TH UMI Conference cum Exhibition and CODATU XVII Conference

Intelligent, Inclusive & Sustainable Mobility
4th to 6th November 2017

Plenary session, Day 3, 06-11-2017

Presented by

**Dr. Brijesh Dixit , Managing Director, Maharashtra Metro Rail Corporation
Limited**



Benefits of Digitalizing Metro Project from Concept to Commissioning

5D BIM & ERP - Digital project
management for Nagpur Metro &
Pune Metro



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Agenda

- Project management overview in India
- Nagpur metro overview
- Digital Project Management for Project Lifecycle
- Components & Benefits of 5D BIM & ERP
- Summary



Project Management Overview in India: Headlines

News » Business » Economy

295 infra projects delayed; cost overrun at over Rs 1 lakh cr

As many as 295 infrastructure sector projects worth Rs 150 crore or more are delayed with total cost overrun of Rs 1,01,436 crore, Parliament was informed Thursday.

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Delays in India's infrastructure projects have a large impact on key social indicators

Why India needs social infrastructure and needs it fast

94 infrastructure projects facing delay, cost overrun: Government

PTI | Updated: Mar 22, 2017, 04:58 PM IST



NEW DELHI: Big infrastructure projects worth Rs 150 crore and above are delayed and have cost overruns, government was informed today.

THE HINDU

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Cost overrun for 287 infrastructure projects hits ₹ 1.66 lakh cr

Business Standard

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Special on B2B

A COMMERCIAL FEATURE What's this?

Reduce construction disputes to accelerate India's infrastructure roll-out

It is important to demystify the conundrum of construction disputes, so that India can accelerate its infrastructure growth and wasteful disputes are avoided.

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Accelerating implementation of infrastructure projects

Roadblocks in accelerating infrastructure development

Home » India » Cost overruns, delays in 83% infra projects, plan panel tells PM Modi

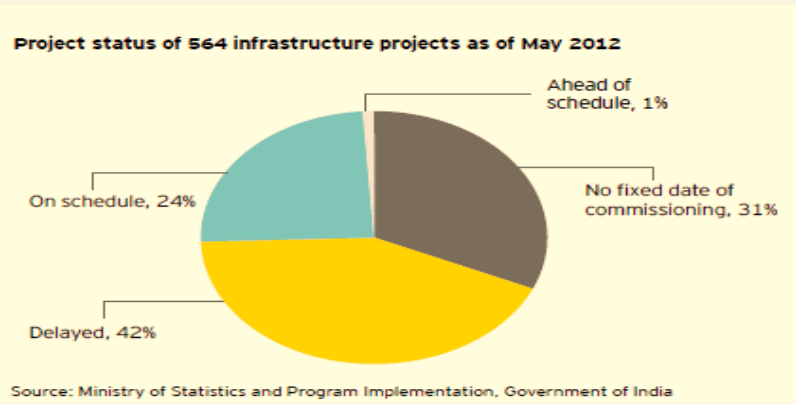
Cost overruns, delays in 83% infra projects, plan panel tells PM Modi

Railways is followed by the road sector as 118 of its projects are delayed, with 26 having no date of commissioning.



Project Management Scenario in India

Time and Cost Overruns in Infrastructure Projects



Sector	Mean % Cost Overrun	Mean % Time Overrun
Urban Development	12%	66%
Railways	95%	118%
Road Transport & Highways	16%	50%
Shipping & Ports	-1%	119%
Atomic Energy	15 %	301 %
Civil Aviation	-2%	69%
Petrochemicals	-12%	74%
Power	52%	34%



Project Management Scenario in India

Reasons for **time** overrun across all sectors

Major Reasons :

- Land/site handover
- Delay in regulatory approvals
- Contractual Disputes
- Design/scope change
- Coordination issues within stakeholders

Human resources	Petroleum	Power	Coal	Steel	Civil Aviation	Railways	Roads & Highways	Port & shipping	Telecommunication
Land/site handover	●	●	●	●	●	●	●	●	●
Delay in regulatory approvals	●	●	●	●	●	●	●	●	●
Geological surprises	●	●	●	●	●	●	●	●	●
Relationship with other projects	●	●	●	●	●	●	●	●	●
Ineffective procurement planning	●	●	●	●	●	●	●	●	●
Design/scope change	●	●	●	●	●	●	●	●	●
Weak/ineffective project monitoring	●	●	●	●	●	●	●	●	●
Inadequate availability of skilled resources	●	●	●	●	●	●	●	●	●
Contractual disputes	●	●	●	●	●	●	●	●	●
Lack of awareness of modern equipment	●	●	●	●	●	●	●	●	●

● Very high impact
● High impact
● Moderate impact
● Low impact

Source: KPMG in India- PMI survey on cost and schedule overruns, 2012



Project Management Scenario in India

Reasons for **cost** overrun across all sectors

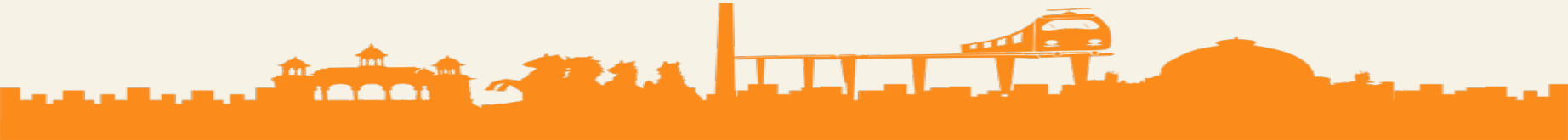
Major Reasons :

- Scope creep
- Design change/iterations
- Material price escalations beyond projections
- Location and connectivity of project site

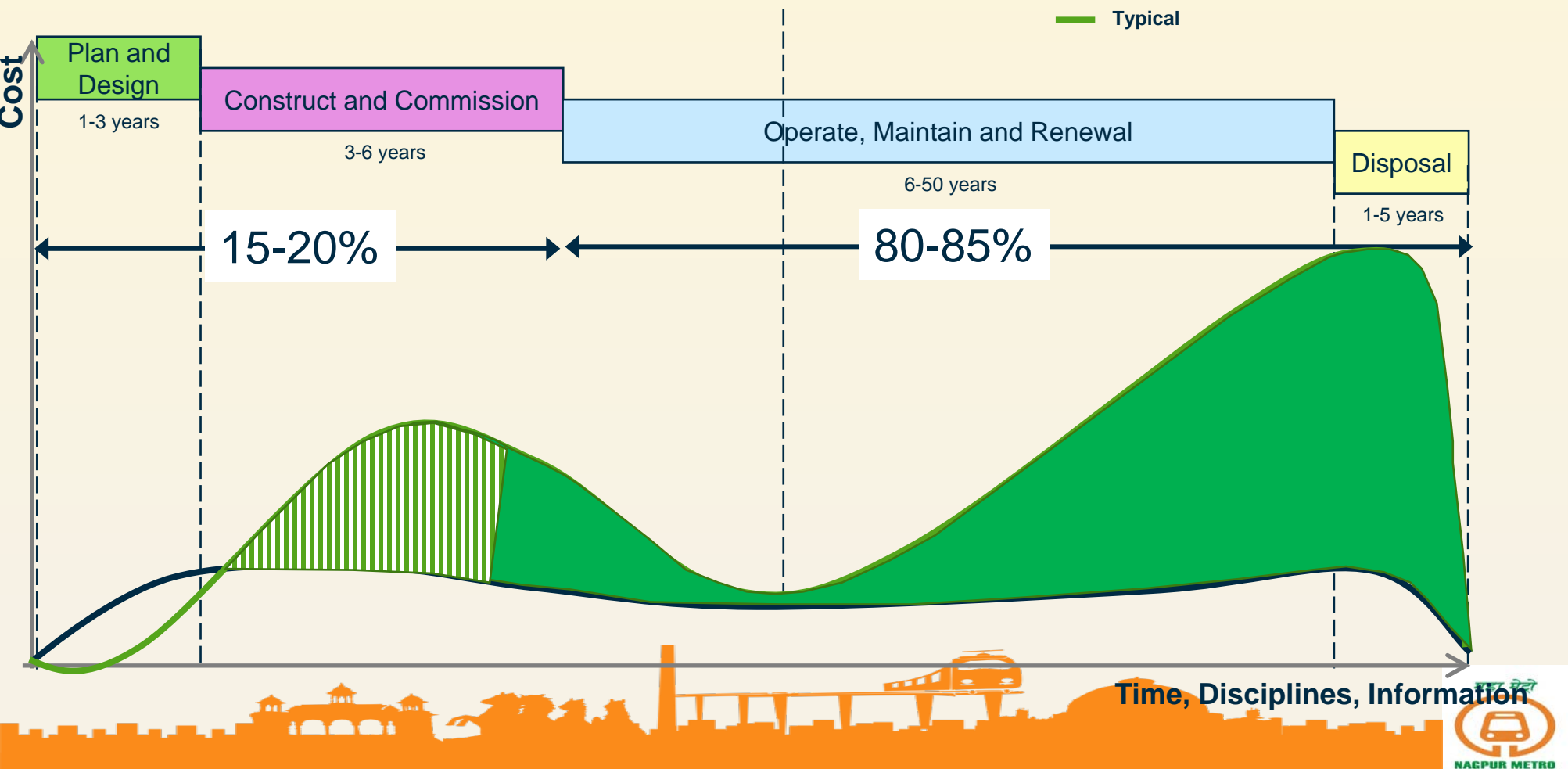
	Human resources	Petroleum	Power	Coal	Steel	Civil Aviation	Railways	Roads & Highways	Port & shipping
Scope creep	●	●	○	●	●	●	●	●	○
Design change/iterations	●	●	○	●	●	●	●	●	○
High cost of environmental safeguards	○	○	○	●	●	●	○	○	○
Acquisition of land at market price	○	○	○	○	○	○	○	○	○
Inadequate DPR	●	●	○	●	○	○	○	○	○
Weak procurement planning	○	○	○	○	○	○	○	○	○
Material price escalations beyond projections	○	●	●	●	●	○	○	○	○
Poor selection of consultant	○	○	○	○	○	○	○	○	○
Location and connectivity of project site	●	○	○	○	○	○	○	○	○
Incremental financing cost	●	●	●	○	○	○	○	○	○

● Very high impact ● High impact ○ Moderate impact ○ Low impact

Note: The telecom sector does not experience cost overruns for the surveyed projects.
Source: KPMG in India- PMI survey on cost and schedule overruns, 2012



Lifecycle : Concept to Operations (Common / Connected Data Environment)

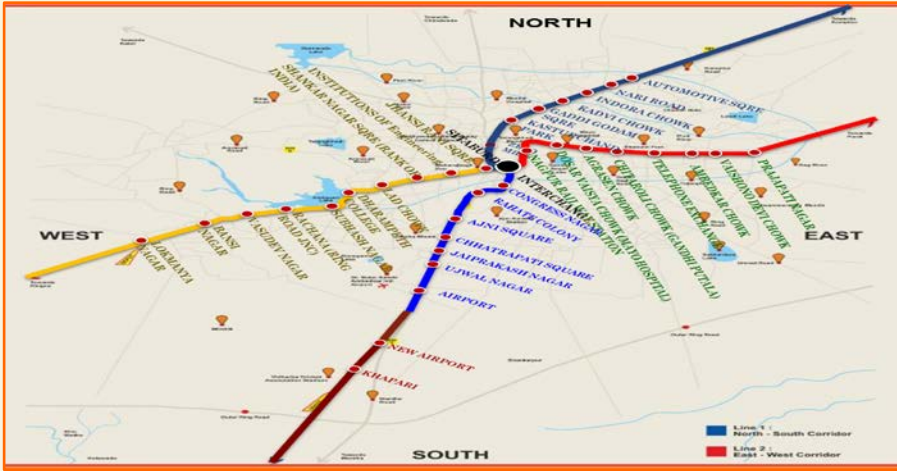




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Nagpur Metro Network Details



38.215 Km in length; 40 Stations
~ 48 months of construction phase
~ USD 1.4 Billion
~ USD 18 Million (1.3%) spent on digitization
with nearly 50+ major consultants/
contractors on board

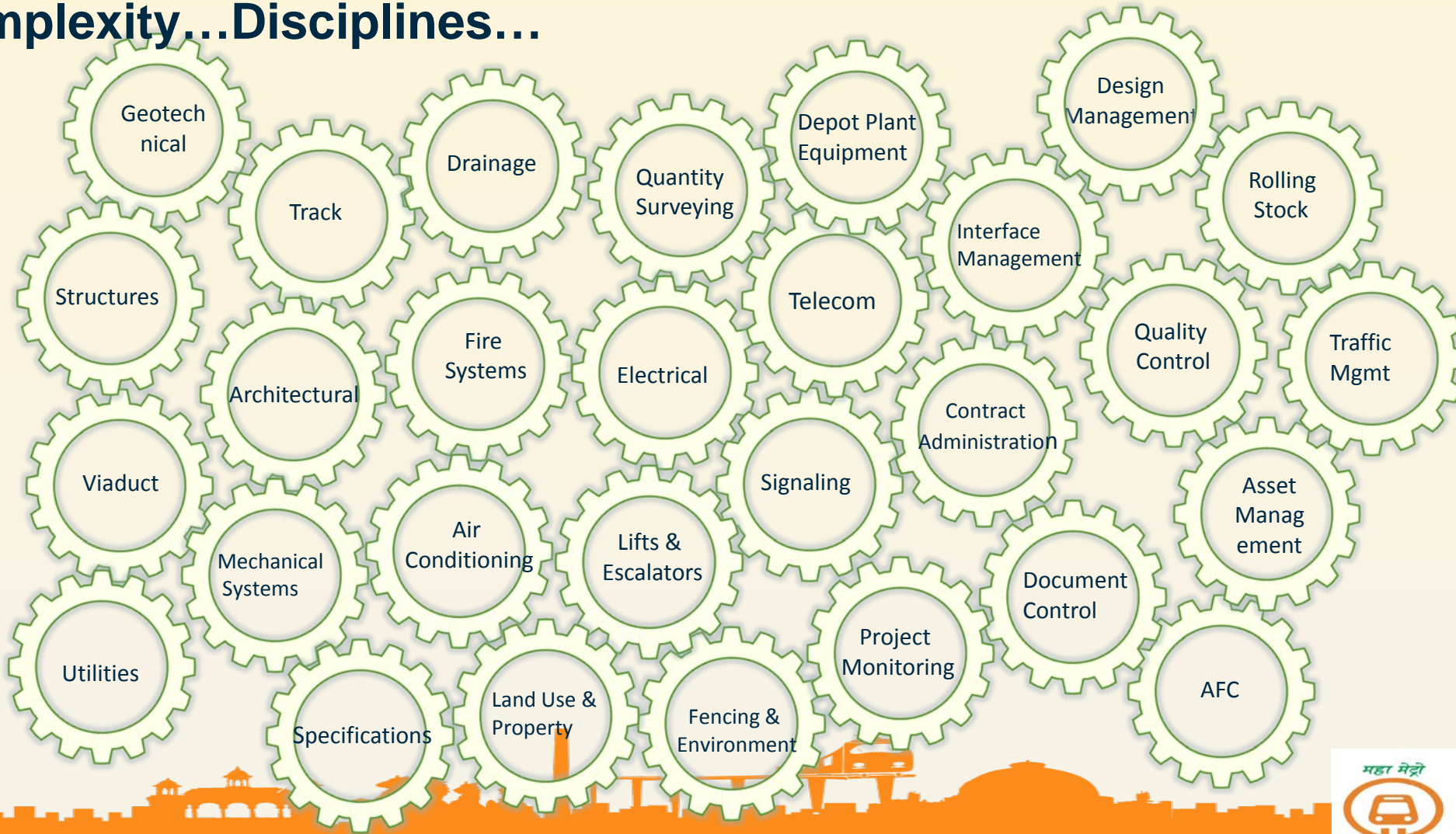
Pune Metro Network Details



31.254 Km in length; 30 Stations
~ 5 years of construction phase
~ USD 1.73 Billion



Complexity...Disciplines...



5D BIM + ERP - One project one platform



Design Management



Time & Progress Management



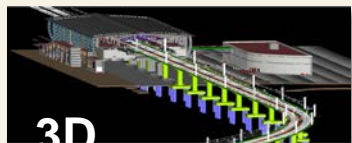
Multiple Contracts Management



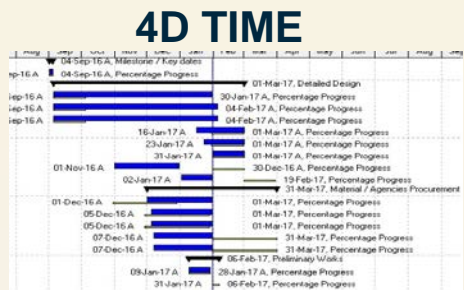
Cost & Revenue Management



Integrated Asset Management

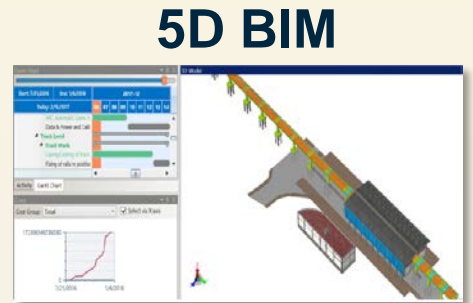


3D Bentley Advancing Infrastructure



5D COST

Item	Code	Quantity	Unit	Rate	Amount
1.00	1.00	1.00	1.00	1.00	1.00
1.01	1.01	1.01	1.01	1.01	1.01
1.02	1.02	1.02	1.02	1.02	1.02
1.03	1.03	1.03	1.03	1.03	1.03
1.04	1.04	1.04	1.04	1.04	1.04
1.05	1.05	1.05	1.05	1.05	1.05
1.06	1.06	1.06	1.06	1.06	1.06
1.07	1.07	1.07	1.07	1.07	1.07
1.08	1.08	1.08	1.08	1.08	1.08
1.09	1.09	1.09	1.09	1.09	1.09
1.10	1.10	1.10	1.10	1.10	1.10



Nagpur Metro: First metro on 5D BIM integrated with ERP

2

Corr.1 - North South: 19.7 km; 20 Stations
Corr.2 - East West: 18.6 km; 20 Stations

20+

Major contractors (> 200 Cr)

53

Major contract packages worth 8680 Cr

30+

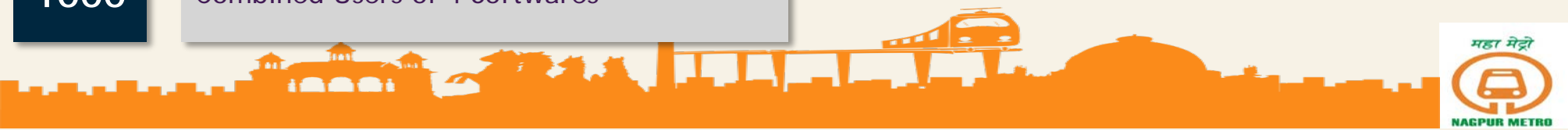
DDCs & 3D Modeling teams

50+

Construction project schedules

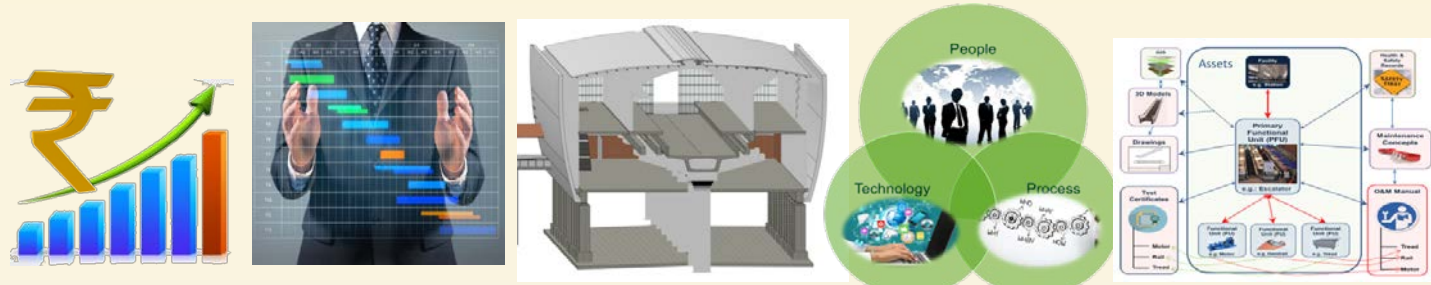
1000

Combined Users of 4 Softwares



Digital Project Management : Uniqueness @ Maha Metro

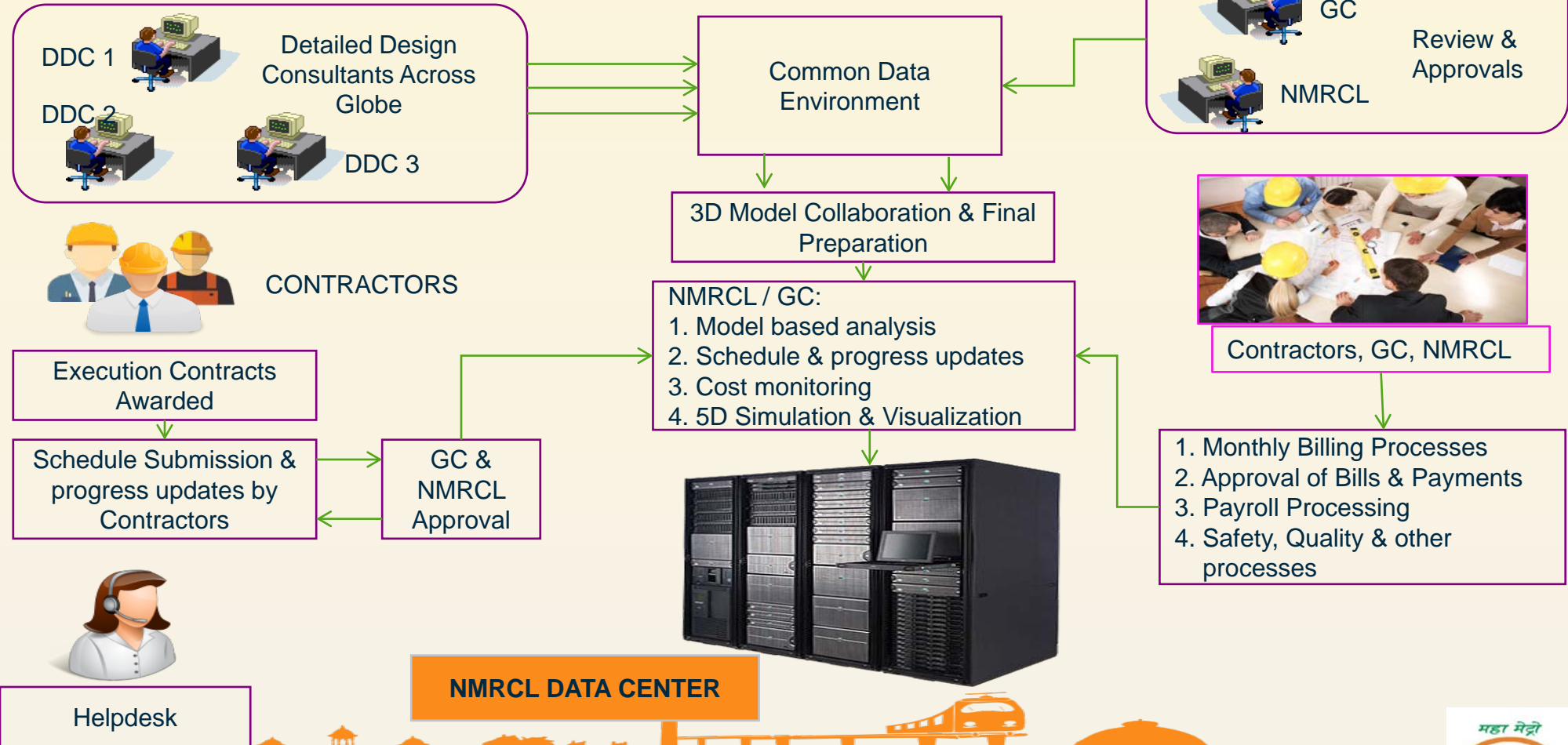
- 3D BIM (Building 'Verb' Information Modelling)
- 4th Dimension : Time
- 5th Dimension : Cost
- Enterprise Resource Planning
- Integrated Asset Management
- Driving O&M through digital platform
- Owner's Support Office with Digital Project Management



Cost Overrun Time Overrun Weak documentation Disputes & Litigations O&M Challenges



How NMRCL Ecosystem Works



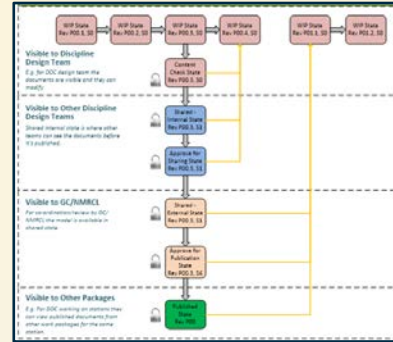
Managing design-documentation with common data environment (CDE)

CDE:

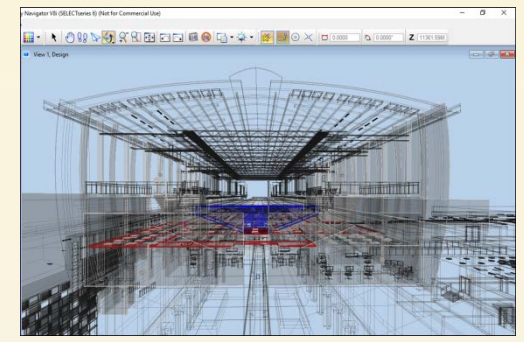
- Single source of information for design & drawings.
- Adopted using BS 1192 standards

Benefits:

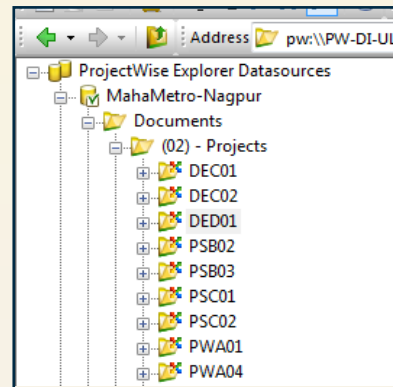
- Design consistency & uniformity in models & drawings
- Online review & approval process
- Automated CAD QA checks
- Early detection of issues
- Detailed analysis using federated 3D model



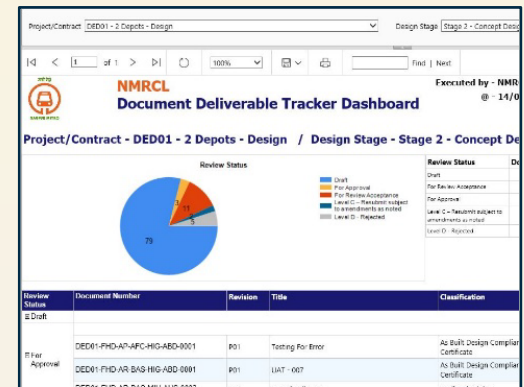
BS 1192 : 3D Model Practice



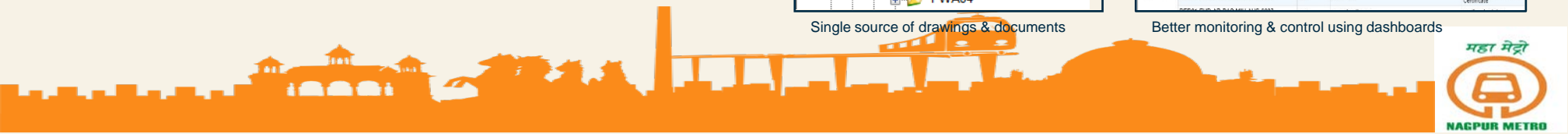
3D Model: Clash Detection & conflict resolution



Single source of drawings & documents



Better monitoring & control using dashboards



Adopting the world's best scheduling engine

Primavera EPPM (Enterprise Project Portfolio Management):

- Single place of work for all contractors
- Integrated project schedule management

Benefits:

- Dynamic working and progress updates on all project schedules
- Avoid delays by identifying obstacles due to interdependencies & take proactive measures
- Obtain holistic view by integrating time with cost information (from ERP)
- Various reports for detailed analysis and prevent time overruns

EPS / Project Name	Weightage (%)	Project % Complete(Project)
◆ Nagpur Metro Rail Project	100.00	50.04
◆ Land Acquisition & Property Development	12.64	11.21
◆ Project Milestones / Contract Key Dates (CKD)	0.00	0.00
◆ Consultants	8.12	5.63
◆ Contracts Procurement	10.00	9.81
◆ Execution Phase	67.24	22.97
◆ North South Corridor	37.97	17.23
◆ Mihan Depot -NS (CH:20.412)	2.46	1.10
◆ Interchange Package (Interchange Stations, Z...	2.43	0.47
◆ Priority Section (CH:20.412 to CH:14.400)	14.04	11.38
◆ Reach-1 (CH:14.400 to CH:6.790)	10.33	3.48
◆ Reach-2 (CH:6.650 to CH:-0.504)	8.72	0.80
◆ HV Substation Works -NS	0.00	0.00
◆ East West Corridor	24.99	4.76
◆ Hingna Depot - EW	1.62	0.48
◆ Reach-3 (CH18.358 to CH +7.825)	13.58	3.09
◆ Reach-4 (CH+7.700 to CH -0.497)	9.79	1.19
◆ HV Substation Works - EW	0.00	0.00
◆ Rolling Stock	4.28	0.98
◆ Feeder Service	2.00	0.42



Enterprise wide accounting through ERP

SAP-ERP:

- Integrated process mapping to capture complete accounting and other key information

Benefits:

- Monitor budget of 8680 Cr INR
- Track variation contracts effectively
- User-friendly employee self service portal
- Better quality checks & control
- Land records & registration process
- File & Daak management
- Monitor Safety & Environment parameters
- Capture operations & maintenance process after commissioning

Enterprise Project Structure

Budgeting

Contracts Procurement

Contractor Billing

Quality monitoring

Office Automation

Finance & Accounts, Funds
Management

Plant & Maintenance

HR, ESS & MSS

EHS Management

4th / 5th Dimension: Integrating 3D model with schedule & cost

Time analysis on 3D model:

- Integrate 3D model with schedule for monitoring time.

Benefits:

- Timely Rectification of the flaws in construction sequencing by Contractor in schedule with the help of simulation
- Identify interdependencies visually for better & informed decisions.
- Model based progress monitoring during execution.

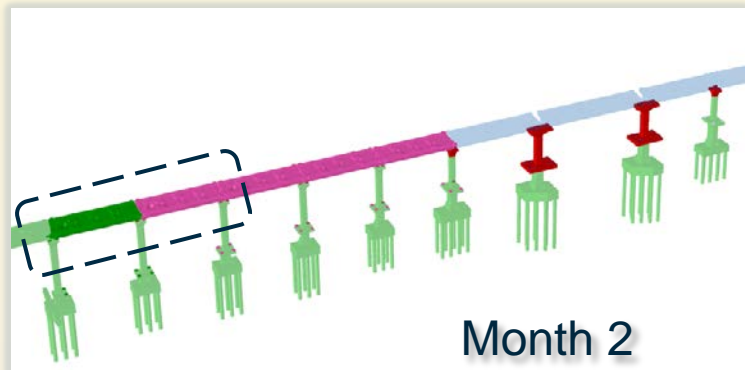
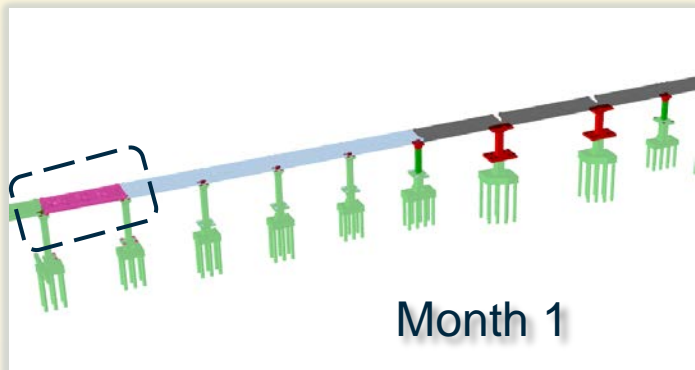


3D Model Based Delay Analysis

Integrate 3D model with actual progress.

Benefits:

- Analyse current delays
- Forecast probable obstacles & take precautionary steps.



- Work planned in next reporting month
- Works planned in current reporting month but not yet executed
- Delayed works in current reporting month
- Work completed in current reporting month
- Work in progress in current reporting month
- Work completed in previous reporting month
- Work planned in later periods



Achieving 5DBIM integration through RIBiTWO

- Provided integrated view of project by linking 3D model (Bentley), schedule (Primavera), cost (SAP)
- Single platform for 3D Model, Scheduling (4D) and Cost (5D)
- Integrating schedule & actual cost information from SAP to analyze physical progress and financial progress
- Earned value management through controlling structure

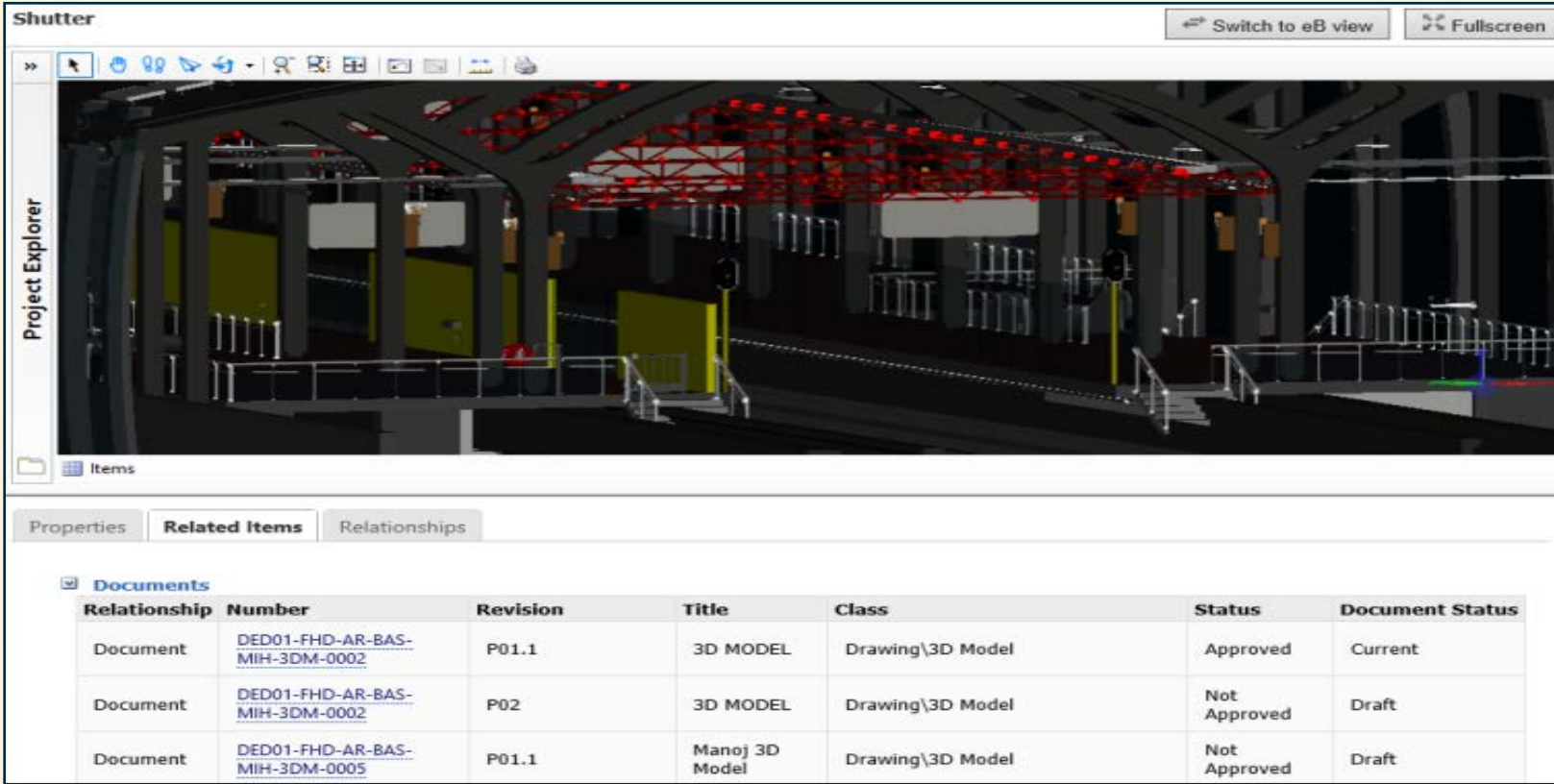




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Digital Platform: Playing significant role in Asset Management



The screenshot displays a software interface for asset management. At the top, there are buttons for 'Switch to eB view' and 'Fullscreen'. Below the toolbar is a 3D rendering of a station platform with a door shutter. The interface includes a 'Project Explorer' on the left and a 'Documents' table at the bottom. The table lists three documents related to the door shutter, including their relationship, number, revision, title, class, status, and document status.

Relationship	Number	Revision	Title	Class	Status	Document Status
Document	DED01-FHD-AR-BAS-MIH-3DM-0002	P01.1	3D MODEL	Drawing\3D Model	Approved	Current
Document	DED01-FHD-AR-BAS-MIH-3DM-0002	P02	3D MODEL	Drawing\3D Model	Not Approved	Draft
Document	DED01-FHD-AR-BAS-MIH-3DM-0005	P01.1	Manoj 3D Model	Drawing\3D Model	Not Approved	Draft

User can see linked documents of door shutter on station platform



Digital Platform: Playing significant role in Asset Management

Relationship	Number	Revision	Title	Class
Document	DED01-FHD-AR-CAI-MIH-ABD-0001	B01	DEMO	Document\As Built Design Compliance Certificate

Relationship	Code	Name	Path
Location	MIH	Mihan Depot	Nagpur Metro Rail Corporation Limited

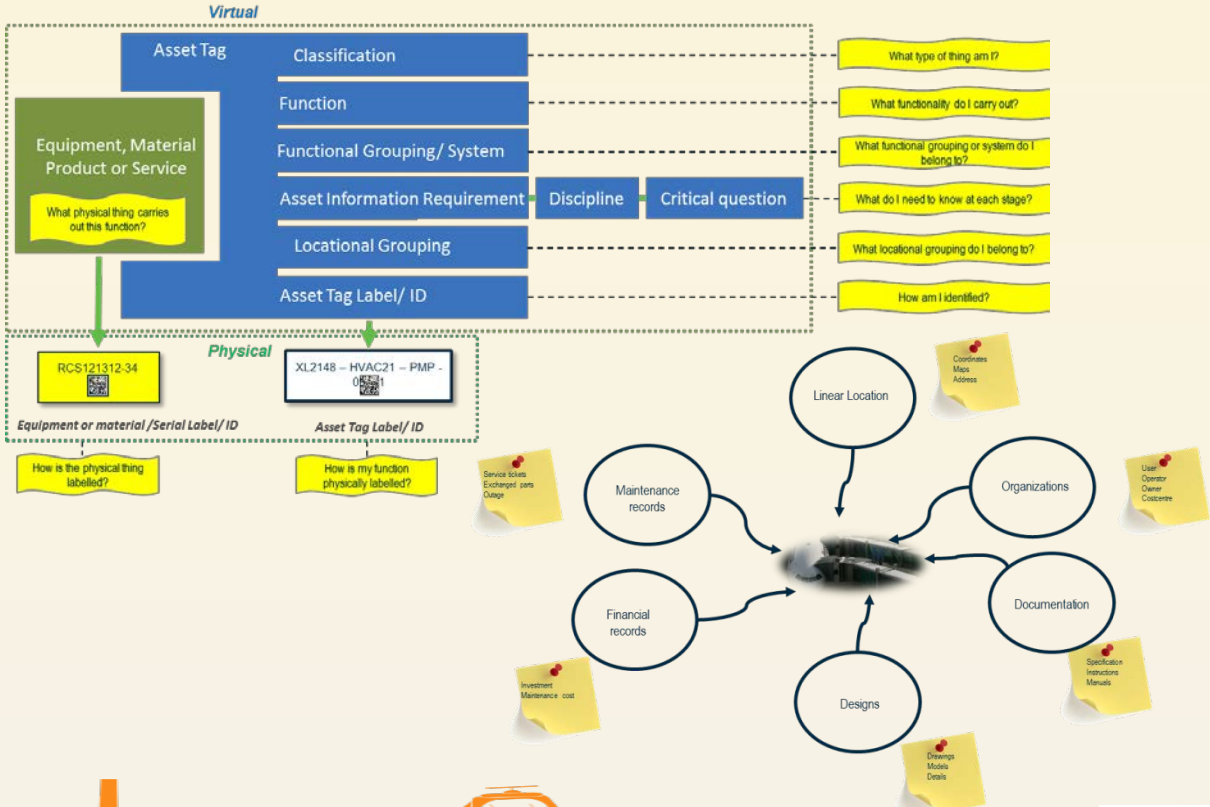


Documents are linked to Assets identified through relations (Ex: linked documents to CCTV are shown above)

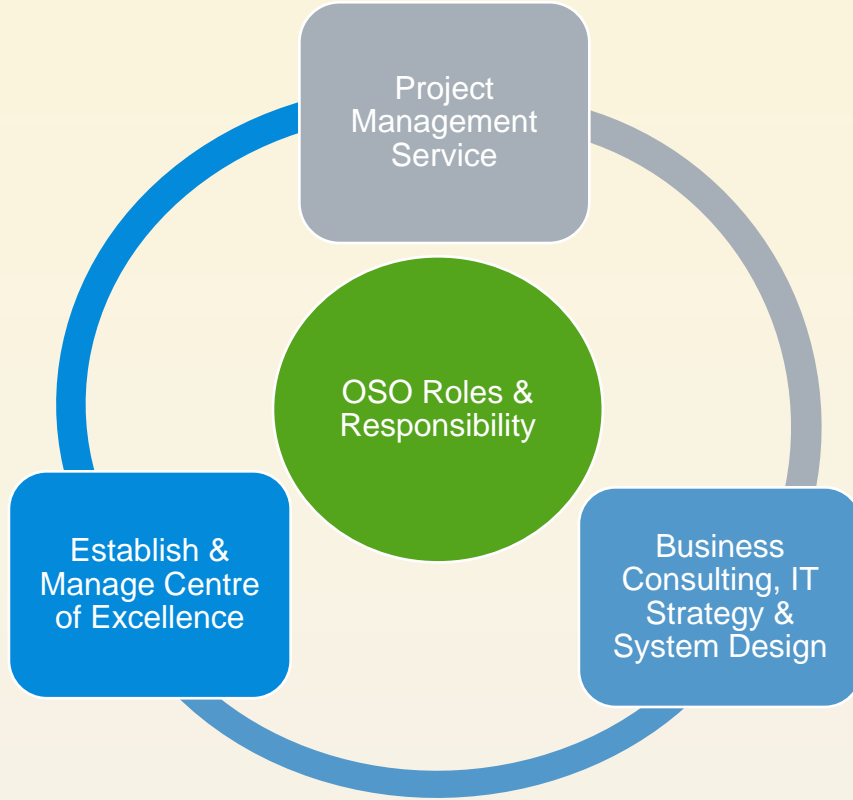


Digital Project Management in O&M Benefits

- Asset Information Management System (AIMS) being developed for effective handover to O&M
- AIMS along with common data environment will support effective O&M
- Complete maintenance processes through ERP



Owner Support Office through Digital Project Management

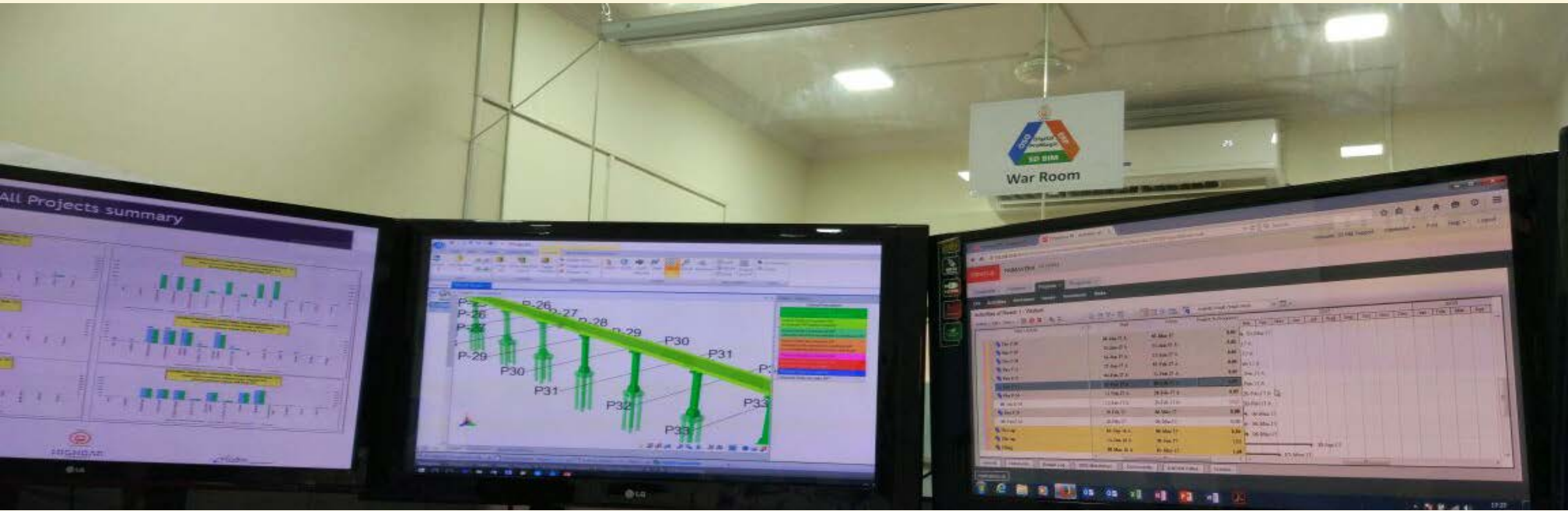


OSO (Owner's Support Office):

- Project Management Service
- Establish & Manage Centre of Excellence
- Business Consulting, IT Strategy & System Design
- Ensure adoption of digital platform across ecosystem



War room managed by Owner Support Office



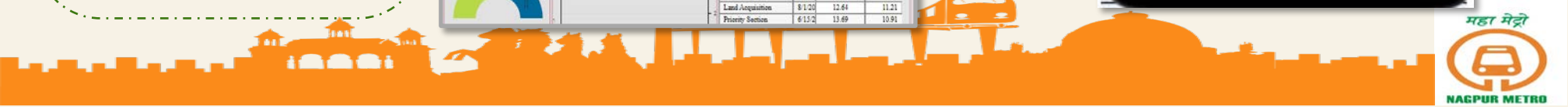
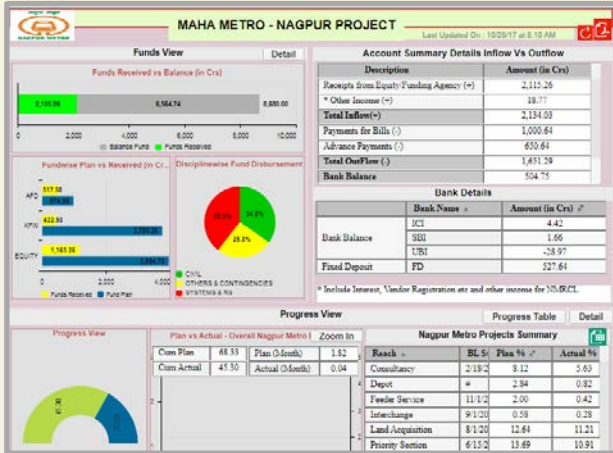
Key activities managed in war room set up by Maha Metro in Nagpur office:

1. Monitor execution of project closely, identify probable bottlenecks and take necessary steps to avoid
2. Gather vital information from various stakeholders in one place
3. Communicate accurate and timely information with key decision makers

Digital Project Management Platform: The Way Ahead

Current Usage

Way Forward





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Nagpur Metro Current Project Status...headlines



The Rs 8,680-crore project comprises two corridors with a total length of nearly 39 km. Express

In two years, Nagpur Metro reaches trial stage in record time

EXPRESS NEWS SERVICE
NAGPUR, SEPTEMBER 30

THE TRIAL run of Nagpur Metro rail was flagged off here on Saturday by Chief Minister Devendra Fadnis and Union Surface Transport and Shipping Minister Nitin Gadkari. It has become the fastest Metro project to reach the trial run stage.

The project was inaugurated by PM Narendra Modi on May 30, 2015. Funded by the central gov-

ernment (20 per cent), state government (20 per cent), Nagpur Municipal Corporation (5 per cent), Nagpur Improvement Trust (5 per cent) and 50 per cent loan from Germany agency KfW (Rs 4,000 crore) and French agency AFD (Rs 600 crore), the Rs 8,680-crore project comprises two corridors, east-west and north-south with a total length of a little over 39 km.

On Saturday, a three-coach train steered by woman driver Sumedha Meshram travelled a

distance of 5.6 km on the at-grade section (ground level) between the Mihani area and Khapri railway station.

The trial run will continue over the next two months for verification of different safety parameters and for final safety certification by the Commissioner of Railway Safety.

State Bank of India Chairperson Arundhati Bhattacharya, who was present on the occasion, launched MAHA CARD, a common mobil-

ity card for various modes of transport.

"The Nagpur Metro with this trial run is said to be the fastest completed Metro rail project in the country," Fadnis said, assuring to extend it to the adjoining Kanhan, Hingana and Burtibori satellite towns.

Gadkari congratulated the MAHA-METRO, headed by Managing Director Brijesh Dixit, for "speedy and excellent quality implementation" of the Nagpur project.

Nagpur Metro may be the fastest to start commercial operations

Ashish.Roy@timesgroup.com

Nagpur: If Mahametro manages to begin commercial operation of Nagpur Metro's at grade section by December, it will be the fastest one in the country. Lucknow Metro made a 8.5km stretch operational in 36 months. Mahametro may make a 5.4km stretch operational in 30 months. It promises to make another 5 to 6km stretch operational in another six months.

The formal trial run of the at grade stretch will be

City	Time	Distance
Kochi	45	13
Delhi	50	8.4
Jaipur	56	9.6
Chennai	72	10
Mumbai	75	11
Kolkata	224	17
Lucknow	36	8.5
Nagpur	30*	5.4

(Figure is expected, not actual; duration in months; distance in kms)

held on September 30. According to Mahametro managing director Brijesh Dixit, the commercial operation will start in December end. Work on the project had started on May 31, 2015.

Commenting on the overall project, Dixit said that 50% work had been completed and 32% financial progress had been achieved.

Dixit showed the Nagpur Metro coaches to the media on Thursday.

► 4 CCTV cameras, P 7





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