



Redefining Steel Construction Using AI

4 registered patents

6 years of testing and improvement

Built more than 3,50,000 Sqft .
Work in progress on 40,00,000 Sqft.

WE ARE INDIA'S ONLY AND FAST-GROWING AI DRIVEN STEEL DESIGN & CONSTRUCTION COMPANY.

We offer customized design and build services for bare structures in construction using steel, using patented technology, process, and building systems.

We currently focus on nonresidential real estate projects with higher loads and spans.

We use
Technology & Design to
BUILD SMART !

Save cost

(40% cheaper than any existing steel construction also cheaper than a grade A RCC construction)

Save labour

(Require 70% lesser labour on site)

Save resource

(40 – 50 % savings in resource consumed, negligible energy consumption on site)

Improve efficiency

(Artificial intelligence driven smart structure and robotic fabrication)

Save time

(40% faster than RCC)

Better design freedom

(16 m column free spans , flexibility to core cut and erect walls anywhere)

Improve quality

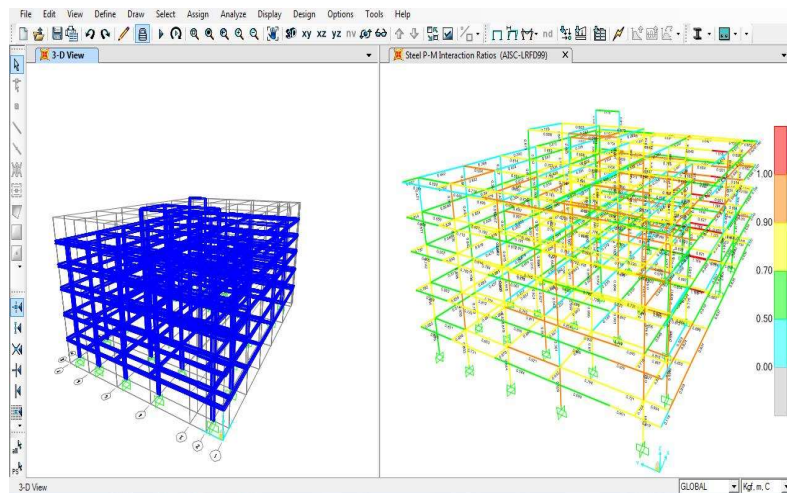
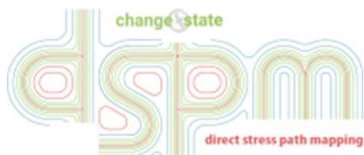
(Sigma 4 quality standards achieved through stringent process manual)

Improve performance

(Best in class for earthquake resistance, stress distribution and vibration mitigation)

OUR KEY PATENT – THE DSPM TECHNOLOGY

Patent in India by Change of State – IPA-05-2019-08-162271



DSPM (direct stress path mapping) works with a brute force algorithm to find the most optimum structural geometry.

It identifies the nearest possible path a force takes from the loading point to the support.

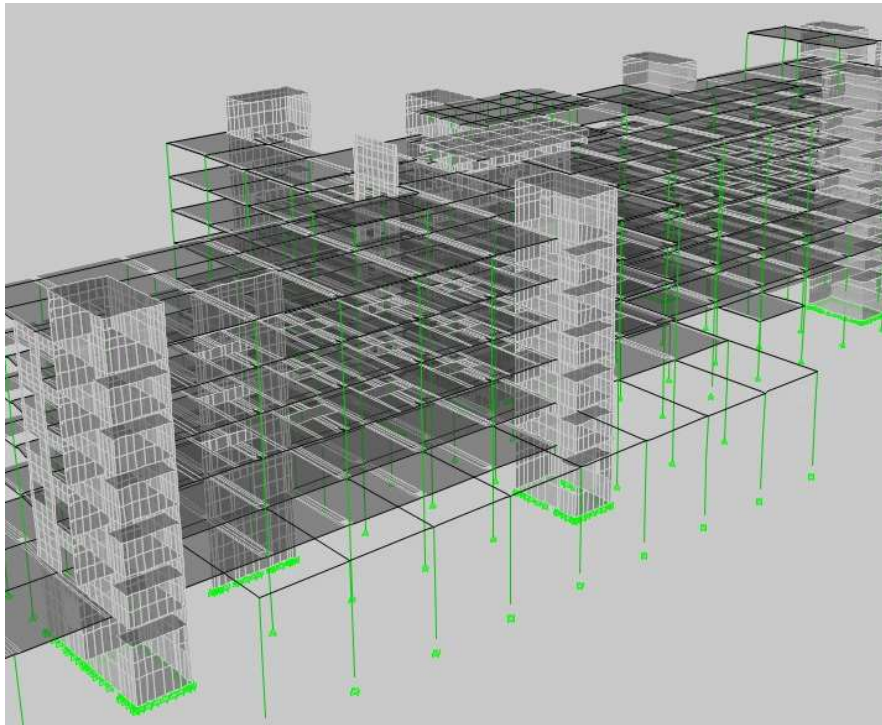
The stress path geometry designed by the algorithm **allows steel construction to be optimised to nearly 40- 50% of savings in resources**, while bettering the performance of the building.

The design has been carried out with **dynamic analysis employing response spectrum multi modal analysis** for earthquake resistant design.

Result is **verifiable by most Structural Analysis tools in use today** (Staad, SAP2000, Etabs, Tekla, NISA, FEM /FEA).

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DSPM helps in optimizing the structural design by redefining the structural geometry.



Testing over 4000 combinations and structural configurations in minutes, DSPM helped optimize the structural design of 2million sqft office space for L&T constructions. Reducing the over all cost by 35%.
(200 mm displacement of 2 columns keeping the architectural intent intact led to a saving of 150 tones of steel)

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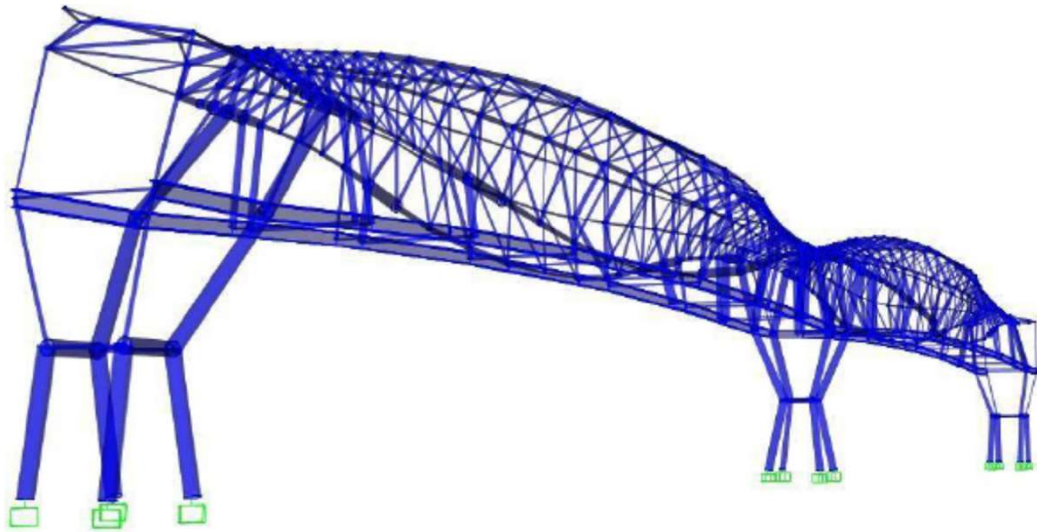
DSPM helps in reduction of material



Inclined columns along calculated stress paths provide better stress distribution. Further, by varying the flange thickness on the tension and compression sides (6mm and 8 mm) of the specially designed column DSPM helped reduce the material consumption of the steel in the Aurinko School by 50%.

We custom build our section using 350 /450 mpa steel giving us double performance for the same quantity of hot rolled steel, resulting in lower dead loads.

DSPM help in generating the most optimum structural design solution. (Generative design)



DSPM proposed the generative designed geometry for the foot over bridge at golf course road, leading to a cost reduction of 50% and better structural performance through a bionic form.

What started as a regular truss design resolved to a shell form structure that proved to be consuming a fraction of the material while keeping the strength and performance factors the same.

DSPM help in reducing the reaction forces of a structure.



The reactions (Force) of DSPM at the foundations level is typically 55% of that of an RCC Structure, rendering savings on the foundations.

It also brings efficiency / increasing constructible areas in under construction projects with revised functionality .

OUR KEY PATENT – THE DEEP DECKING SYSTEM

Patent in India by Change of State – IPA-05-2019-08-162271

Inspired by the continuous vaults. **The patented geometry of the deep decking system, removes the need of using any secondary structural member.**

- It reducing the material consumption by 25% and cuts the fire proofing cost by 60%.
- It mitigates vibrations better than conventional decking system.
- The 230 mm completed slab follows IS – 456 code for fire safety.
- It allows for intermediate beam free exposed ceiling that can accommodate smaller services better.

It is produced and supplied by us along with robotically cut and bent rebars for precision.



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OUR KEY PATENT – THE DSPM BEAM JOINTING DESIGN

Patent in India by Change of State – IPA-05-2019-08-162271



The patented DSPM joint design using doubler plate follows continuous stress path across all joints to **ensure ductility of joints** to improve wind / earthquake / cyclic loading resistance.

It also improves the stability of the structure permitting for 400mm x 1200 mm service opening on both the ends of the beam leading to increased ceiling heights.

All connections are bolted for dimensional accuracy. This prevents catastrophic failure and **eliminates the need for on site hot work and labour, there by reducing the required man power by 70%** as compared to conventional RCC buildings.

THE DSPM PROCESS & QUALITY GUIDELINES



The strict and through process guidelines helps us achieve production automation and achieve sigma 4 quality standards and avoid on site delays.

With quality inspections and process manual at each step of construction our error rates are less than 3mm over a span of 10m, in 1:1000 cases.

Our Joints are detailed to be rust proofed by a 70-120 micron coat of molten aluminium spray.

All Beams and Columns are fire-proofed using resistant low-density concretes such as Pyrocrete (25 mm for 2 hrs resistance).

THE DSPM DESIGN SENSE



Aesthetically designed optimum clutter free design that follows all requisite building codes.

Flexible possibilities of walls and service cores with 6KN/ SQM live loads and 16 m column free spans.

Lean columns and bracing of structural cores frees a lot of usable space.

Structure designed to incorporate all services, giving maximum ceiling heights.

The aesthetics of the decking sheet allows for exposed ceiling.

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THE CODES AND CERTIFICATIONS FOLLOWED

Design, material and construction standards

IBC2006, AISC LFRD99

IS 1642 - Fire safety

IS 456 - Reinforced Concrete components

IS 800-2007, IS 3757 - Connection Bolts

IS 875 – Part 1,2 for Dead and Live loads

IS 875 - Part 3 - Wind Loading

IS 1080-1985 & 2950-1981 For Foundation design

IS 1893-2002 - Design for Earthquake Resistance

ASTM 572 – 350 MPa

IS 5624-1993 - Anchor Bolts

IS 15916 – Precast Slabs

Certified and vetted by



Dept. of Civil Engineering
Indian Institute of Science
Bangalore, India



Dept. of Civil Engineering
Herriot Watt University
Edinburgh, UK

Computing standards

Numerical analysis /FEM/FEA
applications (SAP ETABS, STAAD)

HOW DO WE COMPARE



RCC Structure



Conventional steel



DSPM

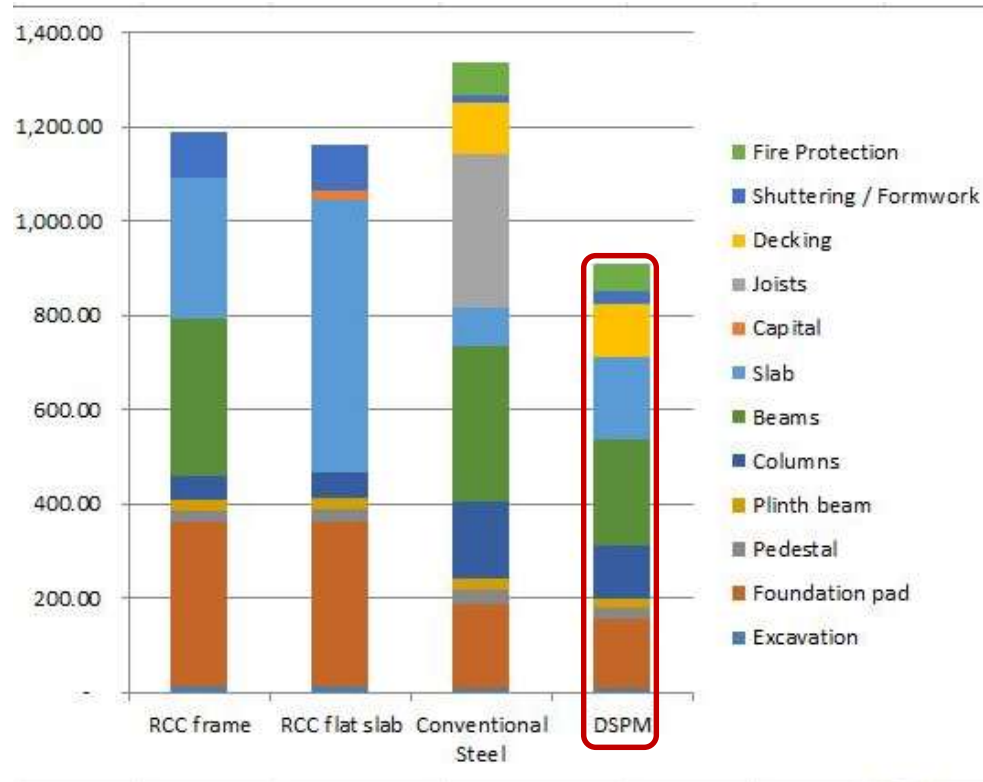
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How do we compare in Zone 2

Comparative study done for grade a construction for 1lakh sqft project spread over B+ G+ 3 floors in Zone 2, Loading 5 kN / sqm

		RCC Frame	RCC Flat Slab	RCC PT Slab	Conventional Steel Frame	DSPM
COST of Construction (Rs/sft)		1150	1135	1100	1350	910
TIME of Construction (days)	4 - 7 floors	250	250	250	130 (52%)	150 (60%)
	8 - 12 floors	350	350	350	170 (49%)	210 (60%)
Typical Column size (mm)	4 - 7 floors	900 x 900	900 x 900	900 x 900	500 x 300	500 x 300
	8 - 12 floors	1200 x 1200	1200 x 1200	1200 x 1200	600 x 300	600 x 300
Economical Spans (m)		5-7	7-10	8-12	5-7	8-15
Slab Thickness (mm)		180-220	250-350	200-300	125-180	240-250
Optimum Live Load (kN/sqm)		2.5 - 5.0	3.5 - 5.0	3.5 - 5.0	5.0 - 8.0	4.0 - 8.0
Height lost due to beam depth (mm)		500-750	100	100	300-600	100
Flexibility in building walls		poor	average	poor	good	good
Earthquake Resistance		good	average	average	good	very good
Fire Safety		good	very good	very good	poor	very good
Vibration resistance		very good	very good	good	poor	good
Stress Distribution		good	good	good	very good	very good

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Why are we more cost effective?

- **Optimum design** of the structure using DSPM.
- **Elimination of secondary beams / joist** because of the decking system.
- **Structural members custom designed and fabricated** for best efficiency using 350 / 450 mpa steel.
- **Reduction of onsite labor by 70%.**
- **Reduction in cost of fire proofing by 60%.**

Construction cost Comparisons

Average figures taken for 50,000 sft to 5L sft grade A construction upto 15 levels in zone 2

How do we compare in zone 5

Comparative study done for grade a construction for 5lakh sqft project spread over B+ G+ 3 floors in Zone 5, Loading 5 kN / sqm

		RCC Frame	RCC Flat Slab	RCC PT Slab	Conventional Steel Frame	DSPM
COST of Construction (Rs/sft)		1500	NA	NA	1650	1246.7
TIME of Construction (days)	4 - 7 floors	250	NA	NA	130 (52%)	150 (60%)
	8 - 12 floors	350	NA	NA	170 (49%)	210 (60%)
Typical Column size (mm)	4 - 7 floors	900 x 900	NA	NA	500 x 300	500 x 300
	8 - 12 floors	1200 x 1200	NA	NA	600 x 300	600 x 300
Economical Spans (m)		5-7	NA	NA	5-7	8-15
Slab Thickness (mm)		180-220	NA	NA	125-180	240-250
Optimum Live Load (kN/sqm)		2.5 - 5.0	3.5 - 5.0	3.5 - 5.0	5.0 - 8.0	4.0 - 8.0
Height lost due to beam depth (mm)		500-750	NA	100	300-600	100
Flexibility in building walls		poor	average	poor	good	good
Earthquake Resistance		good	poor	poor	good	very good
Fire Safety		good	very good	very good	poor	very good
Vibration resistance		very good	very good	good	poor	good
Stress Distribution		good	good	good	very good	very good

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OUR SERVICE OFFERINGS : STRUCTURAL DESIGN AUDIT

To review existing structural design proposals for efficiency improvement and cost reduction using DSPM.

Output : Revised structural geometry and bill of material.

How it works :

1. Advance payment for assessment
2. Review the existing STAD models of the structure through DSPM for improving efficiency. Based on the defined parameters of constraints.
3. Get revised bill of quantities (with and without DSPM building solutions)
4. Pay per SQFT or fraction of saving as success fee
5. Get revised design geometry of the most efficient structure in DFX format.

OUR SERVICE OFFERINGS : STRUCTURAL DESIGN SERVICE

To offer complete structural advisory and design using DSPM.

Output : Analysis and DBR , BOQ / BOM, STAD / ETAB files for 3rd party verification, GA drawings , Shop drawings and fabrication process guidelines.

How it works :

1. Advance payment for assessment
2. Based on the architectural drawing and usage intent we design the most optimum structure using DSPM.
3. Get revised bill of quantities (with and without DSPM building solutions)
4. Pay per SQFT or fraction of saving as success fee
5. Get the STAD files for third party verifications.
6. Pay for design services
7. Develop the GA and production ready soft drawings.

OUR SERVICE OFFERINGS : DESIGN + PMC

To design and manage the complete construction of the structure.

- **Offering** : Analysis, Estimation, detailed design, project planning , vendor shortlisting , procurement coordination , Quality control and supervision, Managing Safety / quality and efficiency of execution.

How does it work :

1. Advance payment for design
2. Analysis and estimation.
3. Structural vetting (3rd party)
4. Financial Guarantees and Advance for build
5. Detailed design and project planning
6. Vendor identification and procurement coordination
7. QC during Fabrication
8. Supervision and coordination for safety/ quality and on time execution of project onsite
9. Inspection and hand over

OUR SERVICE OFFERINGS : **DESIGN & BUILD**

To offer complete end to end design and build services for steel structure as a contracting company.

We also do complete turn key projects.

Offering : Analysis, Estimation, detailed design, project planning , procurement , fabrication and erection of the steel structure.

How does it work :

1. Advance payment for design
2. Analysis and estimation.
3. Structural vetting (3rd party)
4. Financial Guarantees and Advance for build
5. Detailed design and project planning
6. Fabrication and QC
7. Onsite job work and civil works (outsourced)
8. Erection of the steel structure
9. Decking and concreting of the slabs
10. Inspection and hand over

Case studies :

NESARA TECH PARK , MYSORE
AURINKO SCHOOL , BANGALORE

NESARA TECH PARK FOR L&T TECHNOLOGY SERVICES

Mysore — 2019, Seismic Zone -2



The building was designed and built as an office for L&T technology services .

Bare Structure finished in record time 4 month .

Complete project with interiors finished in 8months .

Designed for a live load of 4KN/sqm

Our scope : Turn key (Design and build)

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Construction journey



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Cost :

Basic structure (excavation/ foundation/ column / beam and slabs)	900 Rs / Sqft
Warm shell (walls , elevation treatment and common areas treatment)	210 Rs / Sqft
Services and MEP	700 Rs /Sqft
Interiors (fitout with data)	600 Rs/ Sqft
Landscape	100 Rs / Sqft

Salient Features :

- The structural design from DSPM led to 30% saving in steel consumption from 320 tones to 240 tons.
- The project was completed in 4 months.
- The structure was designed for 4 KN/ Sqm live load.
- The patented decking sheet used made for the open plan and gave a lot of room to cut open cores and shafts where needed later during construction.
- The structure is designed to foster todays IT needs of Agile Office layouts with large open plan or large clusters.
- Services such as HVAC is ceiling hung and pass thru openings made in the beams. Other such as cable trays for electrical, fire, data, voice etc also pass over the beams along the troughs in the decking slab
- The façade and its elements as aking to todays IT / commercial building needs and do not alter due to this building being a steel building.

AURINKO ACADEMY

Bangalore — 2015, Seismic Zone -2



The school building is constructed over a leased piece of land. The structure is designed to be moved in its entirety and re-erected for 5 cycles.

Configuration:

Ground + 1 Floors

Construction:

Steel frame + Precast floor panels

Area:

24,000 sft

Our scope : Structural design services

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Salient Features :

- The structural design from DSPM led to 40% saving in steel consumption from 140 tones to 70 tons.
- By varying the flange thickness on the tension and compression sides (6mm and 8 mm) of the specially designed column DSPM helped reduce the material consumption of the steel
- The project was completed in 60 days.
- The structure was designed for 3 KN/ Sqm live load.
- The double T pre cast slab was especially designed for the project.
- The structure is designed to be completely modular including the foundations (designed in 3 parts tied by a tension strand , and kept below 7 tones for ease of logistics)

OUR JOURNEY

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- 2014** **Change Of State (Bangalore) is formed** as a research, design and consulting company with focus on new construction methods (especially steel).
 - 2016** **DSPM algorithm is developed** and soft testing of the technology begins.
 - 2016 -19** **Test projects of different sizes (total 2.5 lakh sqft) are done using DSPM through our licenced partner Acero**
 - 2017** **DSPM is certified by Heriot watt University, Edinburgh, UK . DSPM gets EN certification 5950-1 and begins projects in UK.**
 - 2019** **DSPM is certified by the Indian Institute of Sciences, Bangalore**
DSPM technology is patented in India – IPA-05-2019-08-162271 with 4 patents of product and technology.
 - 2020** **Vertical Performance Structure is registered** as a design and build steel construction company.

Associated with

DLF
Godrej Properties
L&T Technology Services
Maruti Udyog
J.W. Marriot , UK
Lexmark
TVS motors
Cisco
Future Group
Panacea Medical Technologies
Phoenix Market City Mall
South India Mall

Indus Tree Foundation
Sumadhura Constructions
Varsha Cables
Kudankulam Nuclear Power Plant
High Altitude Warfare School, Indian Army
Stanley Furniture
Manipal University
Bounce
Metropole Developers
The World School
Aurinko Academy

THE LEADERSHIP TEAM



Kiran Kakde - Director

Technology and Development - VPS / Founder at Change Of State.

Bachelor's degree in Civil Engineering from Bangalore University, Bangalore
Master's degree in Architectural and Engineering Studies from Florence University, Florence, Italy.
He has held several positions as Design Director at Idiom Design, Bangalore, Head of Planning and Integration at Netlink Blue Construction, Dubai, Design Head at Crystal Gallery, Dubai. He also is a visiting faculty at Srishti School of Art, Design and Technology, Bangalore.
Kiran is a keen innovator who is driving key researches at has several published academic papers to his credit (including the core program that became the base for SAP200 and Etabs).



Nimesh Pilla – Director

Design Strategy and Outreach- VPS / Partner at Change Of State.

Architect from SPA, Delhi and holds a masters degree in Design Strategy from Polytechnico, Milan, Italy. He has over a decade of experience leading brands and innovation.
Nimesh has held several positions as Design strategy lead at Idiom Design, Bangalore, DGM design and brand experience at Godrej Properties, Design strategy and innovation lead at Future ideas/ Future group , Design strategy lead at IBM IX for India among other companies along the path to innovation.
He is a leading corporate trainer and visiting faculty at various universities in India.
Nimesh heads the key accounts, manages business growth and customer experience.

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