

MINUTES OF THE TENTH MEETING OF MEMBERS OF HUB GOVERNING BOARD OF NMICPS TECHNOLOGY INNOVATION HUB ON AUTONOMOUS NAVIGATION (TIHAN) FOUNDATION HELD ON WEDNESDAY 30TH JULY 2024 AT ADMIN BLOCK, BOARD ROOM, IIT HYDERABAD, KANDI CAMPUS, SANGAREDDY, TELANGANA, INDIA - 502284 AT 10.30 A.M.

Time of commencement of the Meeting: 10.30 A.M.

Time of conclusion of the Meeting: 11.30 A.M.

1. ATTENDANCE

Sr. No.	Name	Designation	Mode of Attendance Physical/Electronic mode
Members:			
1.	Prof. P Rajalakshmi	Project Director	Physically
2.	Prof. Chandrashekhar Sharam	Academic Member	Physically
3.	Mr. S. K. Marwaha	Scientist 'G' & Group Coordinator Ministry of Electronics & Information Technology (MeitY)	Physically
4.	Dr. Ekta Kapoor	Mission Director, DST Govt. of India	Through VC from New Delhi
5.	Mr. C S Sharma	Member, Quality Council of India	Through VC from New Delhi
6.	Dr. Reji Mathai	Director, Automotive Research Association of India (ARAI)	Through VC from Pune
7.	Dr. Gopichand Katragadda	Industry Member	Through VC from Bengaluru
8.	Dr. Kumar N. Sivarajan	Industry Member	Through VC from Bengaluru
9.	Mr. Samir Kumar	Industry Member	Through VC from Bengaluru
10.	Dr. Aravind Kumar Rengan	Academic Member	Physically
11.	Prof. Bheemarjuna Reddy Tamma	Academic Member	Through VC from Hyderabad
Executive Team & Invitee:			
12.	Mrs. Lopa Mishra Jana	HEO	Physically
13.	Dr. Venkat	TiHAN Team	Physically
14.	Dr. Santhosh	TiHAN Team	Physically
15.	CA Saurabh Dashottar	Auditors	Through VC from Hyderabad
16.	CS Jayata Agarwal	Practising Company Secretary	Through VC from Jaipur

2. ELECTION OF THE CHAIRMAN:

As per article 27 of Articles of Association of the company, the Director of IIT Hyderabad (Host Institute) is deemed to be the chairman of NMICPS TiHAN Foundation, and as per Mission communications, Chairman of Host Institute will be Chairman of the HGB. But due to unavoidable circumstances Prof. B. S. Murty was unable to attend the meeting, and he nominated Prof. Chandrashekhar Sharma, Dean SRC, to become a chairman of this meeting. The Board considered the same and Prof. Chandrashekhar Sharma occupied the chair.

3. QUORUM:

At 10.30 a.m., the Chairman welcomed the Members present physically and through video conferencing. Thereafter, the Chairman announced that the requisite quorum was present and called the Meeting to order. The Chairman extended a warm and hearty welcome to all members at the Hub Governing Board Company Meeting (HGB).

4. LEAVE OF ABSENCE:

Leave of absence was granted to Prof. B S Murty, Mr. Krishna Bodanapu, who were unable to attend the meeting.

5. CONFIRMATION OF MINUTES OF THE MEETING OF MEMBERS OF HGB HELD ON 25TH APRIL 2024:

Minutes of the Hub Governing Board meeting held on 25th April 2024 duly initialed by the Chairman placed before the Board and approved. Prof. P Rajalakshmi explained the activities and decisions taken in the previous meeting to all the members.

6. ACTION TAKEN ON DISCUSSION HELD IN PREVIOUS MEETING:

Dr. Ekta Kapoor informed the TIH to engage more in the commercialization of the technologies and make the hub more self-sustainable. TiH should also be involved in scaling up the R&D activities for Phase II towards establishing Technology Research Parks (TRPs).

TiHAN-IITH Response:

1. TiHAN-IITH has published an expression of interest (EOI) for the commercialization (ToT, and licensing) of the following technologies:

TiHAN-ToT-01: Drive-by-Wire Technology for the Electric Buggy / Cart / Campus Shuttle

TiHAN-ToT-02: Mapping & Waypoint Generation for Autonomous Navigation for the electric Buggy / Cart / Campus Shuttle. TiHAN-ToT-03: Autonomous navigation, Obstacle detection, Autonomous emergency braking (AEB), and Vehicle control signal generation for the Electric Buggy / Cart / Campus Shuttle.

2. TiHAN-IITH incollaboration with CDAC Hyd has published EoI for the Connected Vehicles – CV2X Technologies.

TiHAN-IITH is focusing on translational research with collaboration with academia and industry as a step towards establishing itself as a technology research park.

Mr. Gopichand Katragadda raised a question about the number of patents filed and technology products.

TiHAN-IITH Response: TiHAN-IITH has filed 43 patents, 3 copyright documents, and 1 trademark. Out of the total number of filed patents, 14 are granted. TiHAN-IITH has a total of 70 technology products with TRL 7 and above for commercialization.

Dr. Reji Mathai suggested that research has to be translated with the support of Industry Collaboration. He also mentioned that ToT is to be carried out with appropriate consideration of ToT Costing and market intelligence.

TiHAN-IITH Response: TiHAN-IITH is already collaborating with industry partners in the development of technology solutions. The ToT process is being carried out with appropriate costing and market evaluation, and the above ToT document has been published accordingly.

Mr. Kumar Sivarajan mentioned that the ToT products should be discussed with industry partners and taken further and also suggested ToT should be non-exclusive.

TiHAN-IITH Response: TiHAN-IITH has discussed with the relevant industry partners before the publication of the above ToT document on anon-exclusive basis.

Mr. Rohit Kumar informed about the ToT agencies such as TiFAC, BCIL, National Research Development Corporation (NRDC).

TiHAN-IITH Response: Meetings convened with NRDC and NCL, and preparation of ToTs is ongoing.

7. TiHAN VISION & MISSION, ACTIVITIES, RESEARCH AREAS:

Prof. P Rajalakshmi informed the members of the HUB regarding the primary focus, vision and mission of TiHAN. The vision of this hub is to become a global destination for next-generation smart mobility technologies that utilize reliable and efficient autonomous navigation and data acquisition systems. The mission of this hub is to accelerate the adoption of autonomous navigation and next-generation smart mobility technologies for use in intelligent transportation and other sectors, not only in India but also in a global context.

She further informed the HGB Members about the research areas of TiHAN. The R&D focuses on addressing the challenges in realizing the adoption of autonomous vehicles and navigation systems (UAVs, ROVs, etc.) in real-time use cases. The hub aims at translational technology research and development along with commercialization in the areas of autonomous navigation

and data acquisition systems. The broad application sectors of the hub include Autonomous Transportation Systems, Agriculture, Infrastructure, Surveillance, and Environmental.

The hub TiHAN-IIT Hyderabad has developed several futuristic autonomous multimodal transportation solutions like ground, aerial, surface and underwater vehicles & also a first of its kind testbed for R&D of autonomous navigation technologies.

The solutions are embedded with sensors, in-house developed actuators, control systems, mapping, and AI algorithms, which enable autonomous driving navigation in different scenarios like highway merging, autonomous parking, Adaptive Cruise Control (ACC), pedestrian detection, and negotiation of obstacles.

Such technologies can help mitigate risks, ensure safety, increase efficiency, accessibility, and reduce environmental impact, paving the way for evolution of safe & convenient automated transportation in the country.

8. TIHAN TARGETS & ACCOMPLISHMENTS SO FAR:

Prof. P Rajalakshmi explained that the Research and Technology Nurture the R&D portfolio of the hub and promote commercially viable translational research. She explained the increase in CPS Research Base Hub projects - 89 collaborative R&D projects. Periodic project reviews have been done through an expert project review committee. She informed the board about the:

Prof. P Rajalakshmi has informed the members regarding job creation that TiHAN has already launched a three-month certified programme on development of autonomous drones.

Technology Development: No of Technologies (IP, Licensing, Patent Etc.) – 47 (includes copyrights, patents, Software IPs- and Trademark), Technology Products - 70, Publications, PR and other Intellectual activities - 340, Increase in CPS Research Base – 89.

Entrepreneurship Development: Technology Business Incubator (TBI) - 6, Start-ups & Spin-off companies – 39, GCC - Grand Challenges & Competitions- 8, Promotion and Acceleration of Young and Aspiring technology entrepreneurs (PRAYAS)- 3, CPS-Entrepreneur in Residence (EIR)- 29, Dedicated Innovation Accelerator (DIAL)- 3, CPS-Seed Support System (CPS-SSS)- 2, Job Creation – 726.

Human Resource Development: Graduate Fellowships – 356, Post Graduate Fellowships – 125, Doctoral Fellowships – 67, Faculty Fellowships – 19, Chair Professors – 5, Skill Development - 7673, Postdoctoral Fellowships – 22.

International Collaborations: International Collaborations - 23.

9. FUND STATUS:

Prof. Rajalakshmi informed the members about the funds received from DST till date and its utilization. TiHAN-IITH has received around Rs. 38.10 crores non-recurring funds and the

same has been utilized completely. The recurring funds received was 52.330 Crores and out of which 53.10 Crore is utilized till date.

She further informed about the revenue income and interest amount generated by the TiHAN till date.

TiHAN has made a request to release next grant amount of Rs. 44.57 Cr, (NR-6.45, R-38.12 Cr) to DST.

10. TECHNOLOGY DEVELOPMENT:

Prof. P. Rajalakshmi explained about TiHAN IIT Hyderabad – ToT Procedure and Guidelines Proposed and ToT Committee Members. Prof. P Rajalakshmi informed the HGB members about the ISO standards – Testing and Validation at TiHAN Testbed and NABL Accreditation Process initiated at TiHAN for eVTOL Lab. Prof. P Rajalakshmi explained the Testbed on Autonomous Navigation (Aerial/Terrestrial) which is set up at IITH and also explained the ongoing construction activities of testbed with long test tracks for high-speed testing of AVs, Rainfall and Fog generation testing facilities, and Autonomous Vehicles (AVs) – Driving in Adverse Weather and GPS-denied conditions. She also informed about Multi-modal sensor data collection across India which include Lidar-camera fusion, Radar-camera fusion, Lidar-based real-time object detection, and Radar-based object detection.

She mentioned Edge-Based Autonomous Vehicle (AV) navigation and Connected vehicles – TiHAN has implemented 5G-based data offloading to TiE in the TiHAN testbed for autonomous navigation. This setup was designed to enhance the efficiency and responsiveness of the autonomous navigation system. It tested autonomous navigation using a MiniKube server to deploy in the TiE Kubernetes environment within the TiHAN Testbed. The objective was to evaluate the system's performance and reliability in a controlled Kubernetes setup. It has also implemented performance-based network adapter switching between Wi-Fi and 5G. This ensures optimal connectivity by dynamically selecting the best network based on performance criteria and also implemented authentication for vehicle actuation to ensure secure control access. Additionally, tested 5G signal strength to assess its suitability for campus-wide deployment.

Current Research Activity:

TiHAN has implemented encryption for vehicle commands sent from the server to the vehicle to ensure secure communication and prevent unauthorized access. It is deploying edge-based navigation systems in the TiE environment to enhance real-time decision-making and reduce latency in autonomous navigation. The deployment of ACS 4, an edge-based navigation system, is being extended from the IITH main gate to the hostel circle, aiming to cover critical areas on campus. Efforts are underway to improve latency in the autonomous navigation system, ensuring faster response times and smoother operation. Campus mapping and navigation testing are being conducted to validate the accuracy and efficiency of the navigation system across various campus locations. It is also implementing a Graphical User Interface (GUI) in ACS to provide a user-friendly interface for monitoring and controlling the navigation system.

C-V2X Communications, Autonomous Unmanned Aerial Vehicles (UAVs) Activities, Drone-based Traffic Data Analytics Framework Using Edge, Drone-based Traffic Data Analytics

Framework, Fault detection analysis for unmanned aircraft systems, Heavy Payload Drones, GPS Denied Navigation/ Indoor Navigation, Bioinspired Unmanned Aerial Vehicles (UAVs), Fail safe mechanism on drone, Autonomous Surface Vehicles (ASVs), Subsea Pipeline/Cable Inspection & Underwater Object Identification.

DoT Sangam: Digital Twin Comprehensive Mobility Planning, An Auspicious Initiative from the Department of Telecommunications.

Sangam: Orchestration of digital twin (DT) components: 3D GIS models, Simulation tools, environment models, disaster management models, privacy enhancement technologies (PET).
Data sources – Telecom data, GIS, Infra with Geo Tags, Demographics, environment, public transport, rural planning, etc.

TSDSI: AERT – TRIP Forum* Automated Electric Road Transportation (AERT) White Paper by TRIP Forum-Its objectives are to study and develop a standardizable reference architecture for the operation of automated electric vehicles in separated lanes. It enables the adoption of electric and automated road transport to solve safety and traffic congestion problems and high-speed intercity road transport.

TiHAN's Role in Developing Advanced Air Mobility (AAM) in India

TiHAN is actively involved in certifications and vertiports to develop Advanced Air Mobility (AAM) in India with DGCA. Prof. Rajalakshmi participated in a work group discussion with the Directorate General of Civil Aviation (DGCA). TiHAN is involved in reviewing the Airworthiness codes for B-VTOL (Bharat-Vertical Take-off & Landing

Drone training for farmers developed in regional languages

Drones in Agriculture course is designed **in Telugu** specifically for farmers. This course simplifies the fundamental operations and applications of drones to ensure ease of understanding for farmers. It is being launched in collaboration with **Professor Jayashankar Telangana State Agricultural University**.

TiHAN proposal accepted for CES 2025

TiHAN proposal got accepted and will be showcasing in CES 2025 JAN 7-10, 2025 LAS VEGAS, NV.

TiHAN's Recognitions:

TiHAN is recognized as Scientific & Industrial Research Organization (SIRO) by the Department of Scientific and Industrial Research (DSIR) from April 2023 to March 2026.

❖ NMICPS Technology Innovation Hub on Autonomous Navigation Foundation, has achieved ISO 9001:2015 certification for Quality Management System.

❖ Applied for TiHAN's Foreign Contribution Regulation Act (FCRA) Account –In progress

❖ We are in the Process of the National Accreditation Board for Testing and Calibration Laboratories (NABL) for UAV Propulsion Test Centres – Calibration certificates received, final application in process.

She also talked about Impactful Start-Ups projects Supported by the NMICPS TiHAN Foundation - Autonomous Drug Delivery Robots for Healthcare Industry, Special People Mobility EV Wheelchairs, Autonomous Long Endurance Aerostatic Drones, Smart Electric Power Tiller for Low-Income Farmers, Powered staircase load carrier with automatic weight balancing, Mobinav (Ground Control station). She also gave TiHAN-IITH– Executive Summary, Start-Ups, EIRS, PRAYAS, Seed Support System (SSS), Faculty Fellowships, Chair Professors, Women Scientists, R&D Collaborators, Hub Review Mechanisms, Expert Committee Members, TiHAN Recognitions, Suggestions from The Members, Discussion, And Action Plan and concluded the meeting.

11. SUGGESTIONS, RECOMMENDATION AND INFORMATION FROM THE MEMBER:

Mr. Kumar Sivarajan asked about the targets of the company regarding the utilisation of the funds received from the DST to which Prof. P Rajalakshmi informed him in detail.

Dr. Ekta Kapoor-Mission Director DST appreciated working of the TiHAN and remarked it as going satisfactory to keep the company in position for growth in subsequent years. She also informed the members that the mission period is of nine years. It was observed that the Job creation target set for the Hub is ambitious and might get revised.

Mr. Gopichand Katragadda raised a question about the self-testing of the innovations to which Prof. P Rajalakshmi explained very well about the Autonomous campus shuttle developed in-house and is running since August 2023, in the IITH campus covering more than 5000 km

Mr. C S Sharma and Dr. Kumar N. Sivarajan appreciated the work done for sustenance of the Hub and has recommended to work towards becoming more self-sustainable with enhanced value proposition.

Dr. Reji Mathai emphasised to focus on basic Research and development along with applied research and suggested that research must be translated with the support of industry collaboration. He also mentioned that ToT is to be carried out with appropriate consideration of ToT Costing and market intelligence.

Prof. Bheemarjuna Reddy Tamma suggested to have an industry showcase day and invite industry members to look at the technologies developed at TiHAN.

Mr. Samir Kumar discussed about working with OEMs (Note: TiHAN is working with OEMs like Tata, Suzuki, LTTS, and is exploring opportunities to work with more proposals with OEMS). He would be facilitating industry connects for the aforementioned.

VOTE OF THANKS:

Prof. Chandrashekhar Sharma announced the summary of the discussion, recommendations, and decisions taken in the meeting. Before the conclusion of the Meeting, CS Jayata Agarwal, Company Secretary, made the roll call after the meeting and ensured the presence of a quorum throughout the meeting.

With the agenda item being transacted, Jayata thanked the members for making it convenient to attend the meeting and thanked them for their active participation.

Thereafter, the members declared the meeting as concluded.

Signatures:

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Prof. B. S. Murty
Chairman of HGB

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Prof. Chandrashekhar Sharma
Chairman of the Meeting

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Prof. P Rajalakshmi
Project Director/Member Secretary