

# Jose Tupayachi (Jose Alberto Tupayachi Silva)

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Experienced professional with a strong foundation in machine learning, signal processing for Internet of Things applications, and the design of scalable, intelligent systems. Skilled in integrating technologies such as retrieval-augmented generation, vector databases, and large language models into real-world applications. Proven track record in developing health-support applications, IoT-based monitoring platforms, and decision support systems in transportation and logistics. Solutions have leveraged sensor data, real-time analytics, and optimization techniques to enhance operational performance and support high-impact decision-making.

## Education

<b>University of Tennessee, Knoxville USA</b>   PhD Candidate in Industrial Engineering Advisor: Dr. Xueping Li	May 2024 - Present
<b>University of Tennessee, Knoxville USA</b>   MS in Industrial Engineering GPA: 3.9	Aug 2022 - May 2024
<b>Pontifical Catholic University of Peru, Lima Peru</b>   BS in Industrial Engineering	March 2014 - May 2020

## Publications

- **Design and Usability Testing of SmartSHOTS: A Mobile App to Reduce Vaccine Barriers for Children 0-24 Months** Wyatt Tami, Taylor Penny, Li Xueping, Lowe Sarah, Sharmin Aliza, Tupayachi Silva Jose, Wang Xudong, Mcneely Clea, Niederhauser Victoria  
*Proceedings of the 58th Hawaii International Conference on System Sciences* (2025)
- **A Simulation-Based Real-Time Deep Reinforcement Learning Approach for Fighting Wildfires**  
J Tupayachi, MM Ferguson, X Li  
*2024 Annual Modeling and Simulation Conference (ANNSIM)*, 1-12 (2024)
- **Drone-aided delivery methods, challenges, and the future: A methodological review**  
X Li, J Tupayachi, A Sharmin, M Martinez Ferguson  
*Drones* 7 (3), 191 (2023)
- **Towards next-generation urban decision support systems through AI-powered construction of scientific ontology using large language models—A case in optimizing intermodal freight**  
J Tupayachi, H Xu, OA Omitaomu, MC Camur, A Sharmin, X Li  
*Smart Cities* 7 (5), 2392-2421 (2024)
- **Automating Bibliometric Analysis with Sentence Transformers and Retrieval-Augmented Generation (RAG): A Pilot Study in Semantic and Contextual Search for Customized Literature**  
H Xu, X Li, J Tupayachi, JJ Lian, OA Omitaomu  
*Proceedings of the 2nd ACM SIGSPATIAL International Workshop on Advances in Urban-AI* (2024)
- **Better Efficiency on Non-performing Loans Debt Recovery and Portfolio Valuation Using Machine Learning Techniques**  
J Tupayachi, L Silva  
*Production and Operations Management: POMS Lima, Peru, December 2-4, 2021* (2022)

## Pre-Prints:

- **Empowering Cognitive Digital Twins with Generative Foundation Models: Developing a Low-Carbon Integrated Freight Transportation System**  
X Li, H Xu, J Tupayachi, O Omitaomu, X Wang  
*arXiv preprint arXiv:2410.18089* (2024)
- **Towards Next-Generation Urban Decision Support Systems through AI-Powered Generation of Scientific Ontology using Large Language Models: A Case in Optimizing Intermodal Freight Transportation**  
J Tupayachi, H Xu, O A Omitaomu, M C Camur, A Sharmin, X Li  
*arXiv preprint arXiv:2405.19255* (2024)

## Submitted Papers:

- **Towards Autonomous Urban Logistics Optimization via Generative AI and Agentic Digital Twins**  
H Xu, Y Sun, J Tupayachi, O Omitaomu, S Zlatanova, X Li  
Submitted to *International Journal of Production Research*  
Submission ID: 257622545
- **A Decentralized Learning Approach for Condition-Based Monitoring: Sub-Optimal Remaining Useful Life Prediction**  
J Tupayachi, A Kham, X Li  
Submitted to *Computers and Electrical Engineering*  
Submission ID: COMPELECENG-D-25-05978

## Graduate Researcher – Oak Ridge National Lab / Oak Ridge Institute for Science and Education

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**AI-Augmented Literature Retrieval and Exploration for Materials Research** | LLM-Powered Query Pipeline with BERT Tagging

June 2025 – Present

- Designing an AI-driven pipeline using large language models (LLMs) to enhance keyword-based search and retrieval for ion-irradiation research, with applications in nuclear reactor (LWR) materials.
- Developing a modular, three-phase system composed of user query intake, automated data scraping and tagging with BERT, and a responsive Q&A interface for literature distillation.
- Applying natural language processing (NLP) techniques to analyze, cluster, and summarize domain-specific research articles.
- Coordinating with nuclear materials scientists to ensure system alignment with research needs and DOE standards.
- Translating complex technical methods for multidisciplinary research teams and contributing to user-centered tool development.

## Hosted Researcher - Oak Ridge National Lab

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**ML-Assisted Atmospheric Hazard Modeling for Effective Geospatial Risk Analysis** | Frontend generation based on React and Tailwind CSS using LLMs

March 2025 – Present

- Fine tuning Large Language Models to generate automated, interactive dashboards for data visualization.
- Implementing an automated continuous deployment and integration system using web-based frameworks, with React for the front end and Python for backend processing and analytics.

## Graduate Research Assistant - Funded Projects Developer

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**RECOIL** | Cognitive Freight Transportation Digital Twin for Resiliency and Emission Control Through Optimizing Intermodal Logistics

Jul 2024 – Present

- Designed ontology-guided optimization models for large-scale freight transportation networks, integrating data from diverse GIS-based transport modes, including road, rail, and waterways, to minimize costs and emissions while enhancing operational efficiency.
- Leveraged Convolutional Neural Networks and Graph Neural Networks to analyze the impacts of weather, traffic, and demand on EV charging behavior, enabling data-driven, real-time optimization of EV charging station operations.
- Applied large language models to power a chatbot that provides domain-specific responses for non-technical users, enabling accurate trade-off analysis between cost, time, and  $CO_2$  emissions.
- Designed a real-time feedback loop for digital twins, utilizing "Simulated" sensor data and scrapping techniques to continuously optimize intermodal system performance based on real-world conditions.
- Investigating the use of BERT and sentence transformers to further refine provide a domain literature for QA providing accurate and reproducible responses supported by LLM and similarity based search.
- Collaborated with Oak Ridge National Laboratory researchers to create industry-ready solution that reduce emissions and enhance the resilience of intermodal freight and supply chain operations.
- Development of the unified UI using Flutter at <https://portal.recoil.ise.utk.edu>.

**Funding Agency:** U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E)

**Project Number:** #DE-AR0001780

**SmartShots** | Cross-Platform Application to Improve Childhood Vaccination Rates in Tennessee

Dec 2023 – Dec 2024

- Enhanced vaccination tracking with real-time data updates, guardian and dependent updates, notifications, and integrated alerts for users.
- Developed a scalable backend system using Laravel. Used Dart and Flutter based on flutter to ensure smooth functionality across platforms.
- Integrated community health information to offer users real-time access to nearby vaccination providers.
- Collaborated with the Tennessee Department of Health and local health agencies to align the app with state public health objectives and needs.
- <https://play.google.com/store/apps/details?id=com.ilab.smartshots>
- <https://apps.apple.com/us/app/smartshots-tn/id6526502640>

**Funding Agency:** Tennessee Department of Health

**Active Caregiver's Toolkit (ACTAPP)** | Mobile Application to Promote Physical Activity Among Rural Appalachian Caregivers at Risk for Cardiovascular Disease (CVD)

Jul 2024 - Present

- Development of the ACT APP as a digital solution for rural Appalachian caregivers, aiming to reduce cardiovascular disease risks through targeted physical activity interventions.

- Implemented latest mobile development standards based on Dart 3.0 and material design including custom components and state management using GetX.
- Inclusion of ChatBot for FAQ answering.
- Tracking metric for data analysis based on page and interactions metrics.
- <https://testflight.apple.com/join/PehxA8aW>
- [https://play.google.com/store/apps/details?id=com.ilabutk.fe\\_rich](https://play.google.com/store/apps/details?id=com.ilabutk.fe_rich)

**Funding Agency:** Hillman Emergent Innovation (HEI)

**Pathology Cancer Staging - UT Medical Center**

Jan 2025 - Present

- Development of Flutter UI and web map services for interactive demographic cancer visualization.

## Graduate Teaching Assistant

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**IE406/408: Simulation** – Teaching Assistant, Spring 2022

- Assisted students with their final project and Anylogic simulation use and preparation.
- Graded homework assignments and addressed questions during class sessions.

**IE483: Introduction to Reliability Engineering** – Teaching Assistant, Fall 2022

- Provided in-class support by answering student questions.
- Proposed new homework problems, evaluated and graded homework assignments.

## Awards & Scholarships

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**51<sup>st</sup> Conference on Computers and Industrial Engineering (CIE51)** *Best Paper Award: "Emerging AI and Cognitive Digital Twin Technologies Towards Low-Carbon Multimodal Freight Transport Systems – Sustainable Transport Systems"*  
 Sydney, Australia December 9–11, 2024

**IISE Data Analytics & Information Systems (DAIS) Student Mobile App Competition**  
 2024 Winners - SmartShots Project, Montreal | <https://www.iise.org/Details.aspx?id=33697>

**Graduate Fellowships and Awards**

*Holiday Fellowship:* 2022, 2023, 2024

**HIDA Helmholtz Visiting Researcher - Karlsruhe Institute of Technology (KIT)**

*Year:* 2024, Germany | Awarded.

## Industry Work Experience

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**Data Engineer** | INDRA SISTEMAS S.A. – Full-time

March 2022 – Aug 2022

- Developed and maintained data pipelines using Python and Shell scripting to streamline big data workflows.
- Worked with Apache Spark, Hadoop, and HQL for distributed data processing, querying, and large-scale data migration, including data migration from Oracle and SaaS to PySpark.
- Implemented Jenkins-based deployment strategies for automating ETL pipeline updates.
- Ensured data quality and performance through data governance practices and code optimization techniques.
- Managed memory allocation for distributed data processing tasks in High-performance computing.

**Business Intelligence Analyst** | GLOBOKAS PERU S.A. – Full-time

Jan 2022 – March 2022

- Developed and optimized Extract, Transform, and Load (ETL) pipelines using Transact-SQL to streamline data processing and improve efficiency.
- Designed and implemented a live platform for real-time revenue and administrative KPI monitoring, enabling data-driven decision-making.
- Leveraged Google BigQuery and custom macros to automate daily data parsing and dashboard updates, ensuring up-to-date insights.
- Enhanced data quality and integrity by applying statistical metrics to detect and mitigate inconsistencies.

**Data Analyst Trainee** | ENEL DISTRIBUCION PERU S.A.A. – Full-time

Nov 2020 – Dec 2021

- Optimized payment collection processes and client segmentation by employing advanced unsupervised clustering techniques, improving efficiency and effectiveness.
- Designed and implemented dashboards using Power BI and Tableau, providing strategic insights and actionable intelligence.
- Administered SQL and T-SQL databases alongside Salesforce, ensuring data integrity and delivering accurate, reliable reporting for Enel's Business Partners.
- Developed a robust desktop application using PyQt to streamline invoice collection verification and automate digital invoice processing,

enhancing operational efficiency.

**Developer – Portfolio Valuation Project** | GPS MANAGEMENT DEL PERU S.A.C. – Machine Learning Consulting

Aug 2020 – Nov 2020

- Developed a predictive model for valuing non-secure and secured portfolios of non-performing loans using Machine Learning.
- Conducted data compilation, feature engineering, modeling, and validation.
- Deployed the model on a web platform using Flask.

**Professional IT Intern** | SUPERINTENDENCIA DE BANCA, SEGUROS Y ADMINISTRADORAS PRIVADAS DE FONDOS DE PENSIONES

Sep 2020 – Oct 2020

- Automated PDF reports using Jinja-Python for user service indicators.
- Managed Help Desk tasks and Active Directory access control, complying with ITIL standards.

**Plant Intern** | MATMACK S.A. – Bottling Company (Brands Bells and Cencosud)

Dec 2019 – Mar 2020

- Improved inventory control, supplier coordination, and established reorder points.
- Developed demand forecasting models for products per client.
- Conducted cost analysis of raw materials and determined the Economic Order Quantity.
- Built a planning application based on a Master Production Schedule.

**Information Technology Intern** | ADMINISTRADORA CLINICA RICARDO PALMA S.A. – Medical and Hospital Services

Feb 2019 – Aug 2019

- Structured databases for the “Health and Insurance Plan” and implemented ETL workflows.
- Supported and monitored project development, scheduling, and cost evaluation.
- Developed Power BI dashboards for financial reporting and KPIs.
- Designed and structured the medical staff privilege database.

## Community Service

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**University of Tennessee Graduate Student Senate** - Senator, Industrial and Systems Engineering, 2024–2025

Represented students, advocated for academic and professional development opportunities, and fostered graduate student engagement.

## Paper Reviewer

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- **Journal of Robotics** (Wiley)
  - *Autonomous Planetary Rover navigation and crater-based map augmentation for path planning and Rock localization using space ROS*
- **Journal of Sensors** (Wiley)
  - *Manufacturing and testing of novel low-cost and flexible geopolymer-based tactile sensors*
  - *Optimization of excitation coil parameters for PECT of defects in laser welding of power battery pack based on Kriging surrogate model*
- **Winter Simulation Conference 2025 – Reliability Modeling and Simulation**
  - *Simulating the dynamic interaction between fleet performance and maintenance processes based on Remaining Useful Life*
- **Winter Simulation Conference 2025 – Invited Paper Track**
  - *Reliability Assessment of Convolutional Autoencoder-Based Wind Modeling for Autonomous Drone Training*
- **IISE Annual Conference 2025 – Logistics and Supply Chain (LSC)**
  - *Analyzing the Impact of Hurricane Florence on Freight Transportation in North Carolina using Telematics Data*
  - *Distributed Programmatic Demand Forecasting in Modular Construction Through Machine Learning and Simulation*
- **IEOM 2025 – University of Central Florida**
  - *Principal Component Analysis Machine Learning Technique on the Underground Big Diameter Steel Pipelines Condition Assessment and Related Data: South African Bulk Water Distribution Utilities*
  - *Investigation of the Mechanism Failures of High Temperature Components Occurring Inside Boiler Tubes*
  - *Service Model Based on Lean Six Sigma and Queuing Theory to Increase NPS in a Healthcare Company*
  - *Blockchain-enabled Information as a Service (IaaS) for Configuration Tracking and Control of Smart Manufacturing Systems*
  - *Production Model Based on 5S to Increase Productivity in a SME in the Garment Sector*

## Conference Presenter:

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Federated Learning Fault Detection: Towards a Decentralized Machine Learning Framework - IISE 2023

Rule-based Automated Cancer Staging from Scanned Pathology Reports - IISE 2024

Empowering Simulation Modeling: An Automated Ontology Framework Enhanced by Large Language Models - INFORMS 2024

Conversational Geographic Question Answering: LLMs & Continuous Retrieval-Augmented Generation - SIGSPATIAL 2024

## Technologies

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**Languages:** Python, SQL, Bash, Dart, PHP, Java, C++ , CUDA

**Frameworks:** Django, Flask, TensorFlow, PyTorch, Flutter, Laravel, Wordpress

**IoT:** Arduino, ESP32

**Databases:** PostgreSQL, MongoDB, MySQL, SQL Server

**DevOps:** Docker, Git, Jenkins, AWS, Virtualization KVM

**Optimization:** Networkx, Gurobi, cplex, AnyLogic Simulation, NetworkX

**Office Tools:** Excel, Microsoft Office, Linux

**GIS:** WMS, GeoSever, OverPass API

## Upcoming Publications

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- **Context Aware Visual Prompting:** A geospatial web dashboard development automation using large language models and self-validated embeddings to support decision making.
- **Predicting Electric Vehicle Charging Station Demand:** Using Spatial-Temporal Graph Neural Networks with Integrated Weather and Traffic Data.