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Data analytics and AI: fostering science and innovation

Denis Bruno Virissimo

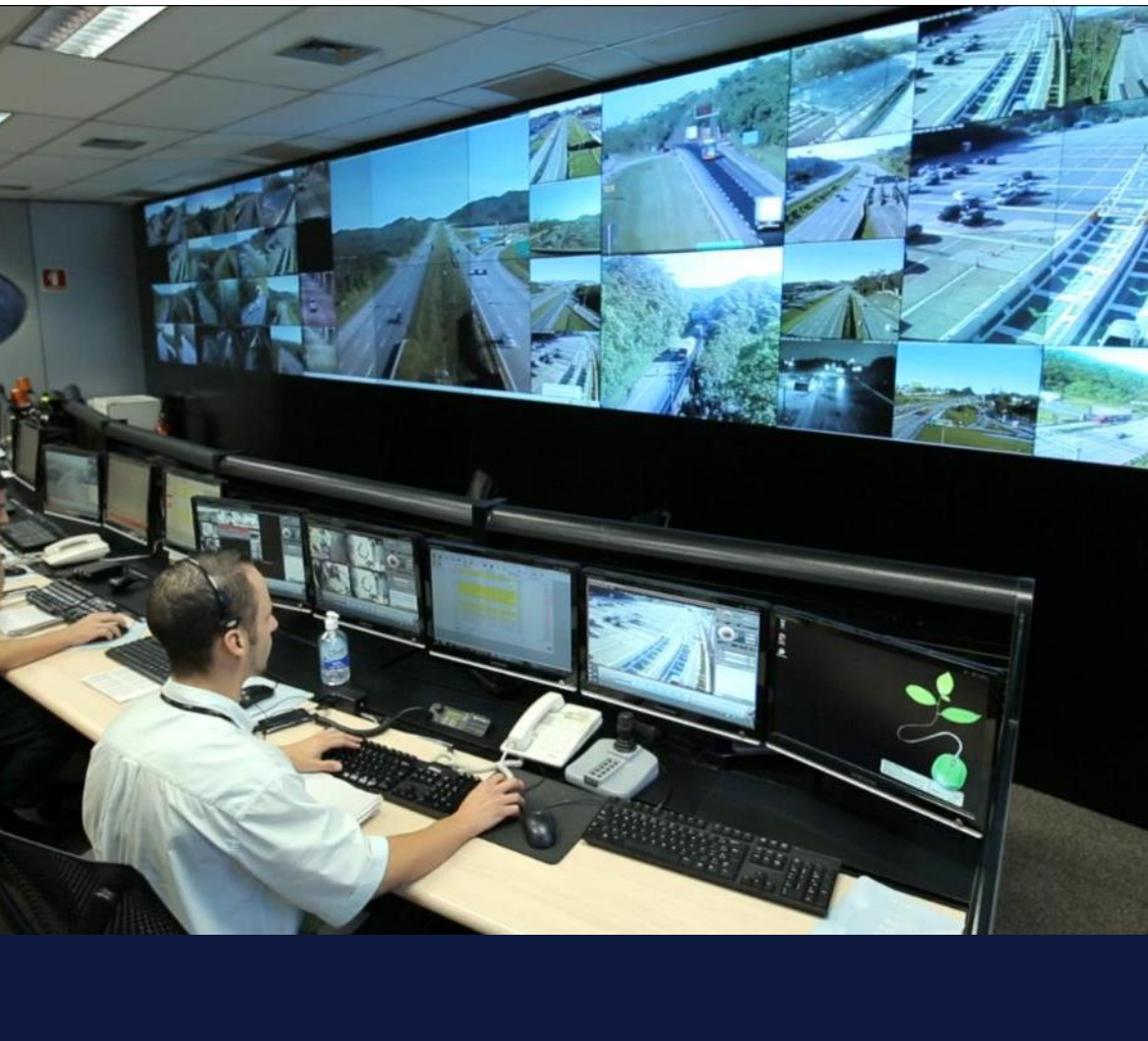
*Palestra apresentada no
INNOVATION AND SCIENCE
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A série “Comunicação Técnica” compreende trabalhos elaborados por técnicos do IPT, apresentados em eventos, publicados em revistas especializadas ou quando seu conteúdo apresentar relevância pública.
PROIBIDO A REPRODUÇÃO, APENAS PARA CONSULTA.



DATA ANALYTICS AND AI

Fostering Science and Innovation



ipt

INSTITUTO DE
PESQUISAS
TECNOLÓGICAS

DIGITAL TRANSFORMATION



DIGITAL TRANSFORMATION

INTERNET OF THINGS AND EMBEDDED SYSTEMS

- EMBEDDED SYSTEMS
- INTERNET OF THINGS (IOT)
- CONNECTIVITY AND DATA TRANSMISSION (LPWAN, RFID, 5G)
- INFORMATION SECURITY AND CYBERSECURITY



43 PROFESSIONALS

1 PhD
10 MSc
22 GRADUATED
10 TECHNICIANS

SOFTWARE ENGINEERING AND INTELLIGENT TRANSPORTS

- DATA ANALYSIS AND INTEGRATION FOR TRANSPORT SYSTEMS
- INTELLIGENT TRANSPORTATION SYSTEMS (ITS)
- INTEROPERABILITY OF SYSTEMS AND DEVICES
- DESIGN AND DEVELOPMENT OF SYSTEMS AND APPLICATION SOFTWARE
- SYSTEM COMPLIANCE AND TESTING



26 PROFESSIONALS

1 PhD
8 MSc
12 GRADUATED
4 TECHNICIANS

ARTIFICIAL INTELIGENCE & ANALYTICS

- ARTIFICIAL INTELLIGENCE
- PRESCRIPTIVE AND PREDICTIVE MAINTENANCE
- INTELLIGENT OPERATION OF INDUSTRY 4.0 EQUIPMENT
- MACHINE LEARNING ALGORITHMS
- BIG DATA & DATA CURATION



19 PROFESSIONALS

8 PhD
9 MSc
2 GRADUATED





- ✓ Decrease in downtime
- ✓ Reduction of losses and accidents
- ✓ Increase in productivity
- ✓ Decrease in inventory levels
- ✓ Intelligent maintenance

- ✓ Real-time business monitoring
- ✓ Data security and privacy
- ✓ Efficient management

- ✓ Digital healthcare and Telemedicine
- ✓ Management and logistics
- ✓ Health promotion
- ✓ Treatment and diagnosis



+ Connectivity
+ Smart operations
+ Digital transformation



- ✓ Digital services
- ✓ Public safety
- ✓ Energy efficiency and sanitation
- ✓ Efficient and sustainable transportation

- ✓ Efficient use of machinery.
- ✓ Efficient use of natural resources.
- ✓ Increase in human productivity.
- ✓ Sanitary safety and animal welfare.

DEMANDS OF SOCIETY

TECHNOLOGICAL AXES



Industry 4.0

- System and device interoperability.
- System compliance and testing.
- Development of Artificial Intelligence applications for the industry.
- Training in augmented, virtual, and extended reality.



Smart Cities

- Data analysis and integration.
- Development of applications for public management.
- Sensors.
- Operational Control Centers and Situation Rooms.



Mobility and Transportation

- Intelligent transportation systems (ITS).
- Evaluation of equipment applied to mobility (radars, traffic lights, cameras, etc.).
- Data integration and approaches for big data application.
- Simulation and scenarios in Intelligent Transportation.

USING DATA TO LEVERAGE INNOVATION – CASES IN IPT



HIGHWAY CONCESSIONAIRES

Online monitoring more than 8.000 km of highways in São Paulo State

We help the Regulation Agency of Transportation to manage its data flow



Cyberphysical Systems

Objective: training that allows us translating physical phenomena into a digital environment, implementing a support platform for smart solutions for cities and industry

Methodology



Architecture and Digital Infrastructure

Architecture and platforms

Sensors and IoT

Communication and Security



Computational methods and techniques

Artificial intelligence

Big Data and Business Intelligence

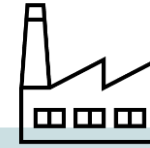
UX, Software Layer and Augmented Reality



Application in Smart Cities

Main prototype: Landslides

Secondary prototypes: contaminated areas, floods, tree fall



Application in Advanced Manufacturing

Milling 4.0



Public Policies

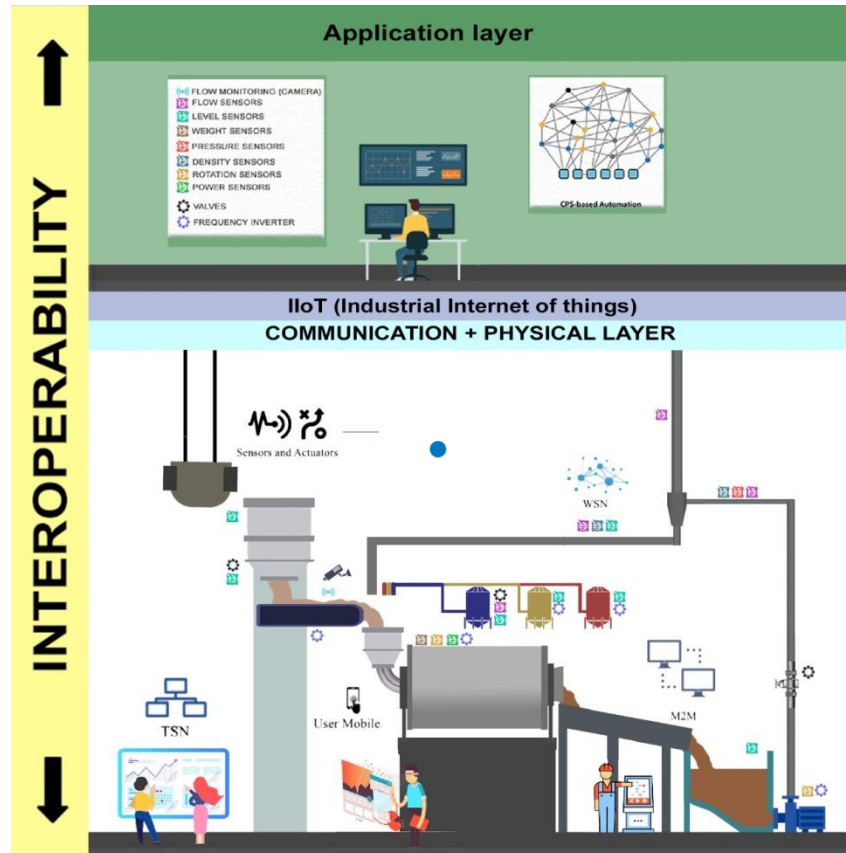
Good practices and Models of action

Proposition of regulations and standardization for use

Industry 4.0

Milling 4.0

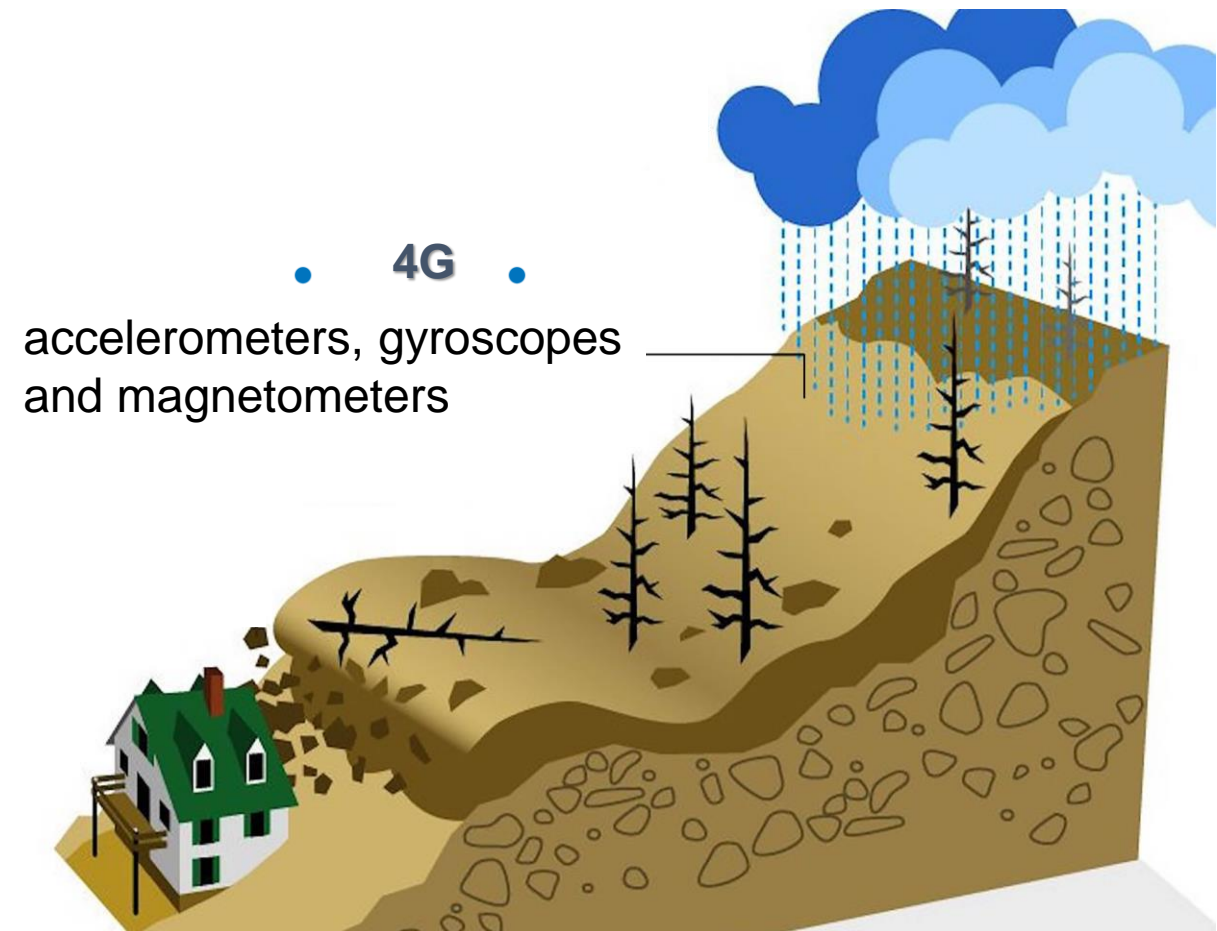
- IoT, AI and 5G
- Analytics e phenomenon analysis



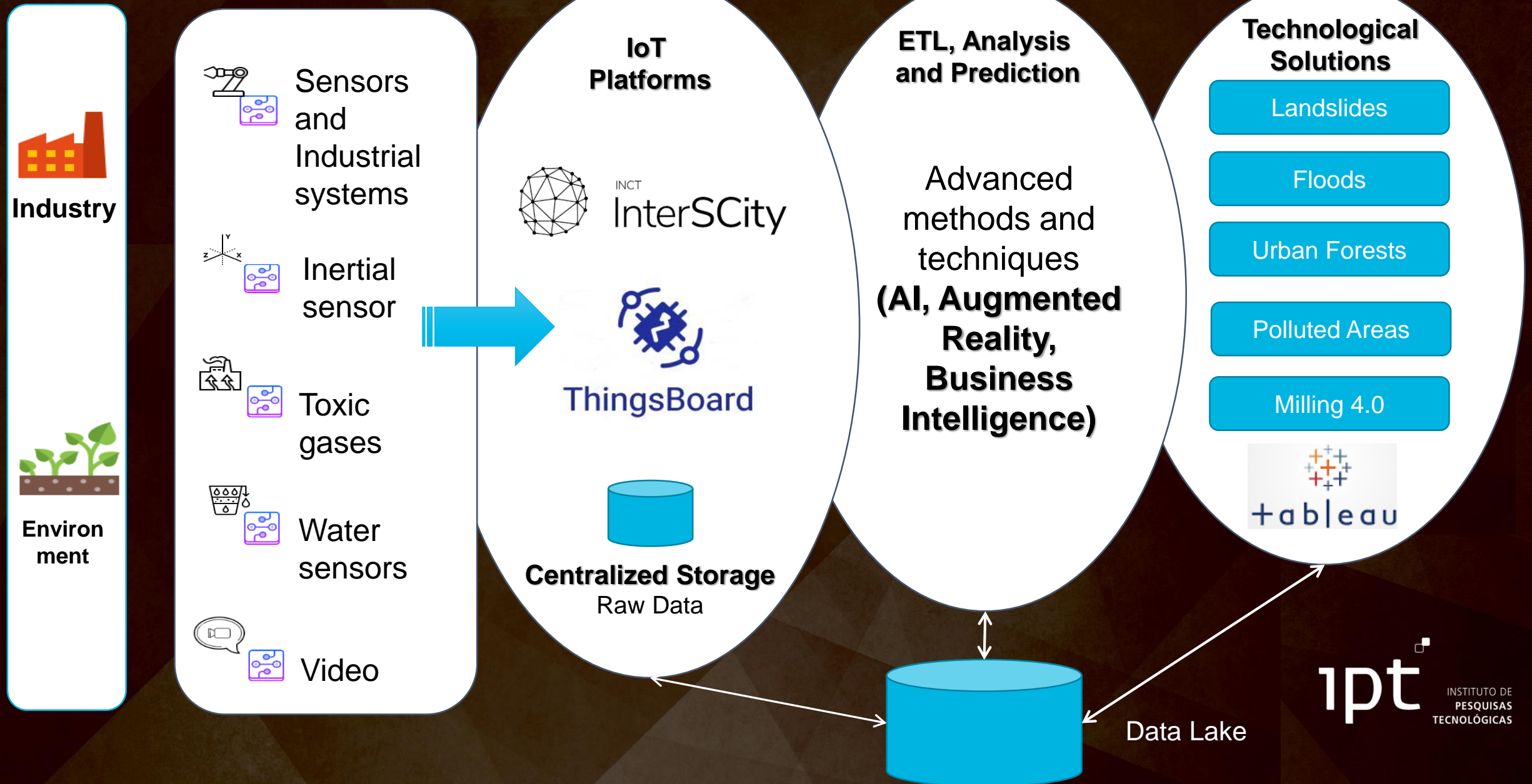
Smart, Sustainable and Resilient Cities:

Landslides

- IoT, LoraWan, IA, Analytics and phenomenon analysis



Implemented conceptual model



SOCIAL IMPACT: COVID MONITORING SYSTEM



Infrastructure and Training provided by FAPESP

Being the government's technological arm in managing the pandemic for 2 years, supporting the crisis committee.



EVOLVING BRAZILIAN INDUSTRY WITH AI





PLATAFORMA

IASMIN

Inteligência Artificial, Soluções para Manufatura Inteligente

IPT - Instituto de Pesquisas Tecnológicas
Av. Prof. Almeida Prado, 532 - Butantã, São Paulo - SP, 05508-901

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Universidade do Minho



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PRINCIPAL RESEARCHERS

ASSOCIATE RESEARCHERS

INTERNATIONAL INSTITUTES

BOSCH

Braskem

Klabin

SIEMENS

STELLANTIS

SIEMENS ENERGY



Jefferson de Oliveira Gomes

Main Researcher

Former President of IPT, advisor of the Center of the 4th industrial revolution of the world economic forum, Director of the Fraunhofer Project Center FPC@ITA.

He has already worked in the assembly of national innovation centers such as: Embrapii, SESI SENAI Inovação, CCM Manufacturing Competence Center – ITA.

Research Lines and Leaders



Izabel Machado

USP

**Real time
monitoring and
control**



Alexandre Simões

UNESP

**Autonomous
systems, robotics
and machine tools**



Lilian Berton

UNIFESP

**Prescriptive
maintenance and
intelligent
operations**



Paulo Eigi Miyagi

USP

Digital Twin



Flávio Soares Silva

USP

**Supply chain
integration and
interoperability**



Marcos Simplício

USP

Cibersecurity

Researchers expectations



Overcoming the limits of the state-of-the-art Artificial Intelligence applied to the industry to enable the digital transformation aiming to increase the competitiveness of the Brazilian industry



Technical and scientific development, **promoting know-how to transform innovative knowledge into applied and real solutions** in the industry through Proofs of Concept and Pilot Plants



Enabling human resources for the new generation of industry, including knowledge diffusion and Technology Transfer integrated in a digital society



Establish an Innovation Ecosystem, enhancing Research, Development and Innovation in Brazilian industry

Industrial needs and challenges

- ***Decentralization of AI** in mobile devices used in controlled and uncontrolled environment*
- ***Real time intelligence** for monitoring the production line*
- *Improve the **efficiency of preventive maintenance** with AI (prescriptive maintenance)*
- ***Supply chain traceability**, from manufacturing to the final customer*
- ***Productivity gains** using the preexisting information*
- *Large scale **evaluation of product quality***
- *Increase of **value added to existing solutions** as well as new products and services*
- *Improvements to the **supply chain management** (upstream and downstream)*
- *Creation of **open labs***

After the initial cycle of three years, we'll be ready to for big achievements for the Brazilian industry



REAL TIME MONITORING AND CONTROL

Automated Industrial Processes with real time monitoring and control.

Embedded Technologies with proven local and remote communications.

Equipment's and solutions development and integration with pre-existing ones.



PRESCRIPTIVE MAINTENANCE AND INTELLIGENT OPERATIONS

Prove and test prescriptive maintenance solutions development that apply AI.

Validate domain expertise.

Monitoring platform development with cyberphysical AI agents based on digital signature of process variables in the manufacturing environment to improve operations..



CYBERSECURITY

Adapt and implement proposed mechanisms in real applications. When needed, the methodology foresees a test and homologation phase with real data. The implementation is done substituting the existing system with load balance and redundancy.



AUTONOMOUS SYSTEMS, ROBOTICS AND MACHINETOOLS

Tested physical systems in and environment that simulated real industrial conditions for developed prototypes.

Tested and validated robots, machines and machine tools in operating environment.



INTEGRATION AND INTEROPERABILITY OF VALUECHAINS

Analyze empirically the effectiveness of developed systems in the Innovation nucleolus and apply them experimentally



DIGITAL TWINS

Implemented digital twin models in a laboratory environment, ready to be Applied in robotics, mining, O&G and manufacturing cells.

Our approach



WP1: STATE OF ART



WP2: R&D&I



WP3: PoC



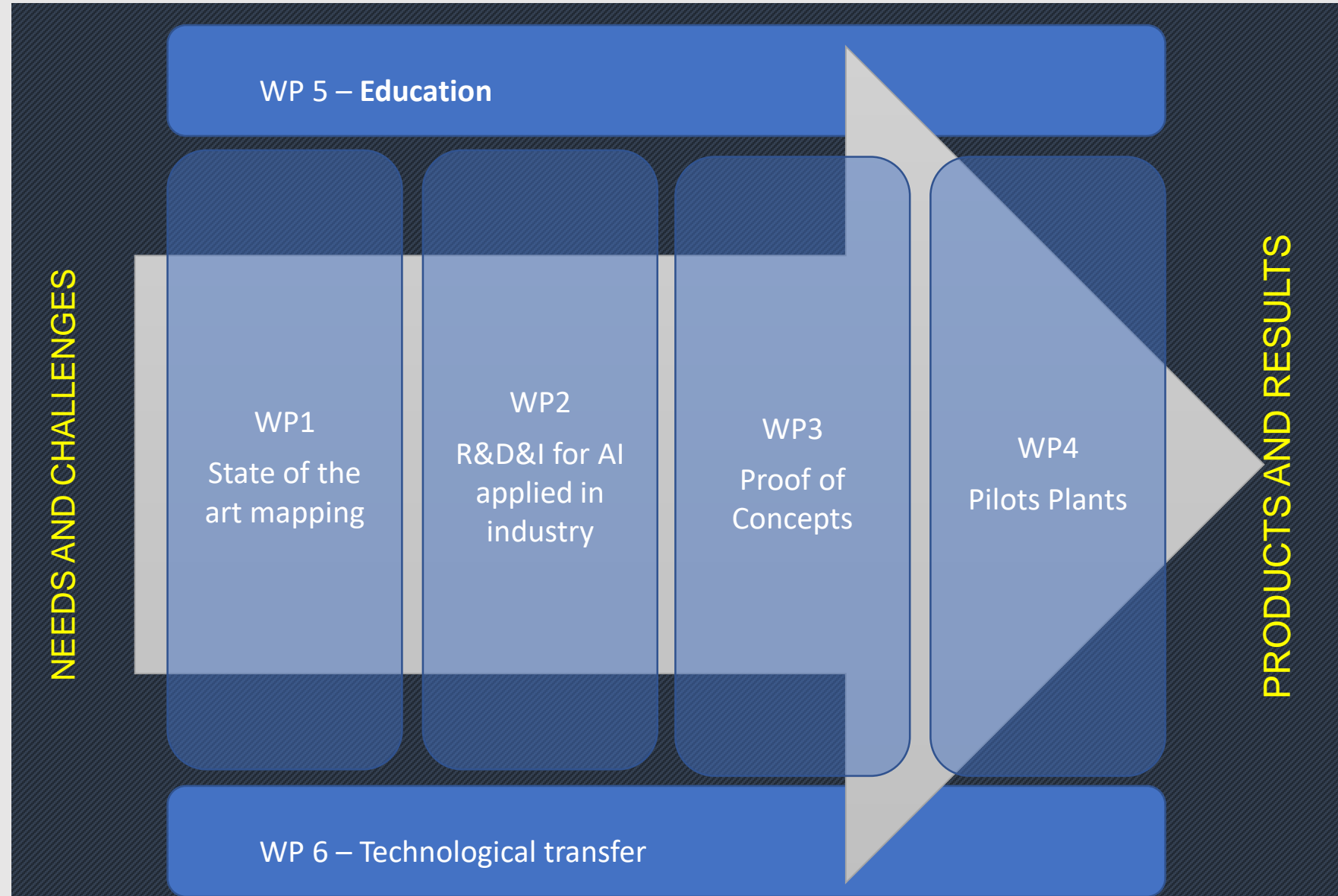
WP 4: PILOTS



WP5: HR TRAINING AND
DISSEMINATION



WP6: TECHNOLOGICAL
TRANSFER



Deliverables

FAPESP

- Training of 1 master, 2 doctors and 1 post-doc FAPESP scholarship holders per research line
- Students must publish a minimum of 8 articles (2 articles per student)

Companies

- Develop an open source library
- Develop automatic monitoring systems based on machine learning
- Systems for automating the data collection, modeling and scoring process as much as possible
- Automatic generation of explanations to identify possible causes of deviation
- Provide monitoring visibility across multiple system components

IAsmin Platform's Governance

Main researchers

- Execute the research projects
- Manage the research groups
- Report the results to all the partners

Director

- Lead the scientific and technological developments of the center
- Manage the daily routine of the Center

Vice-Director

- Support the Director as an intellectual leadership
- Manage the daily routine of the Center from the industrial sector perspective

Knowledge sharing / Tech transfer coordinators

- Manage the tech transfer and knowledge sharing activities

Executive Committee

- Approve the Strategic Guidelines of the Center
- Oversee the Center operation
- Connect the Center with National and International Ecosystems

Industry Committee

- Provide industry view of research priorities
- Evaluate the Center's performance

IP Committee

- Define and supervise the Intellectual Property strategy, exploitation of IP, and confidentiality conditions

International Advisory Board

- Propose scientific research objectives to improve the Center's international competitiveness
- Evaluate the Center's performance

INTERNATIONAL ADVISORY BOARD (IAB)

Roles and Benefits

Role

Propose scientific research objectives to improve the Center's international competitiveness;
Evaluate the Center's performance



Main activities

1 Annual meeting (in person): discussion of annual results and creation of portfolio for next year
3 Quarter meetings (videoconference): follow up on projects
1 showcase presentation by the IAB partners (to be recorded)

Benefits

Visiting researchers

- Each IAB partner may include **up to two researchers** as visiting researchers supporting each project. The project's executive committee will look for opportunities for funding of exchange activities.

Spin-off projects

- IAB partners may propose research projects. If approved by the Industry Committee, the Executive Committee will look for funding opportunities
- IP generated in HUB projects may be used as background IP for the spin-off projects

Thank you!

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