

Journée Mondiale de la Normalisation World Standards Day

13.10
2026



INTERVENANTS



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Responsable
Cellule technologies disruptives,
Direction générale Industrie,
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Ministère de l'Économie



Dr. Jean-Philippe HUMBERT
Adjoint à la Direction
ILNAS



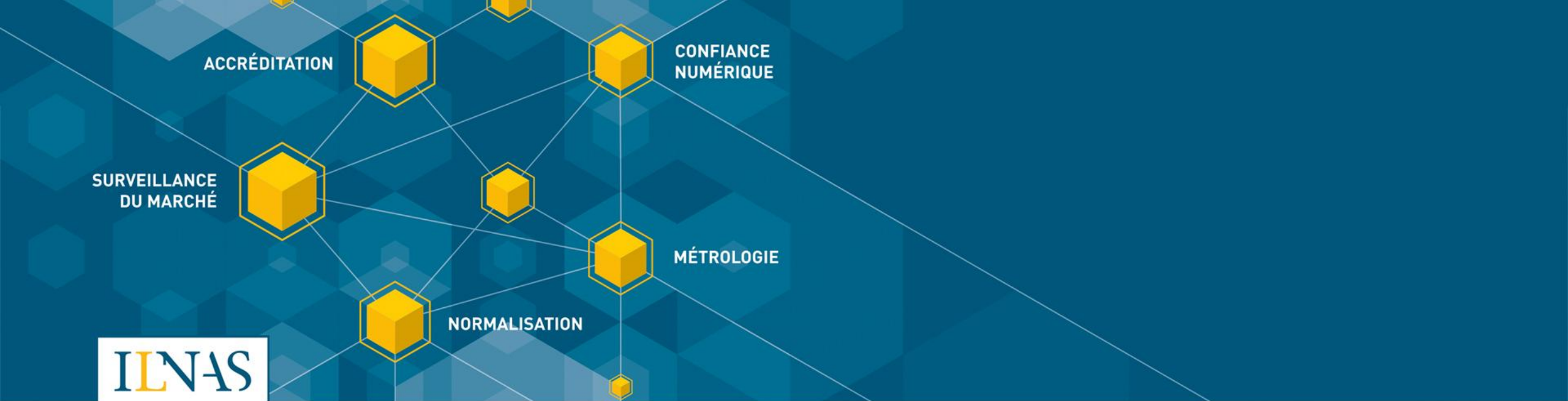
M. Nicolas DOMENJOUR
Responsable
« TIC & Normalisation »
ILNAS/OLN

Mot de bienvenue (FR) - Word of welcome (EN)

Dr. Jean-Philippe Humbert – ILNAS

Prof. Eric Tschirhart – Université du Luxembourg





Standardization developments in Luxembourg

13th October 2026

Dr. Jean-Philippe Humbert
Adjoint à la Direction - ILNAS



I - INTRODUCTION OF ILNAS AND ANEC EIG

ILNAS

Public administration under the authority of the Minister of the Economy, SME, Energy and Tourism

Creation: Law of May 20, 2008

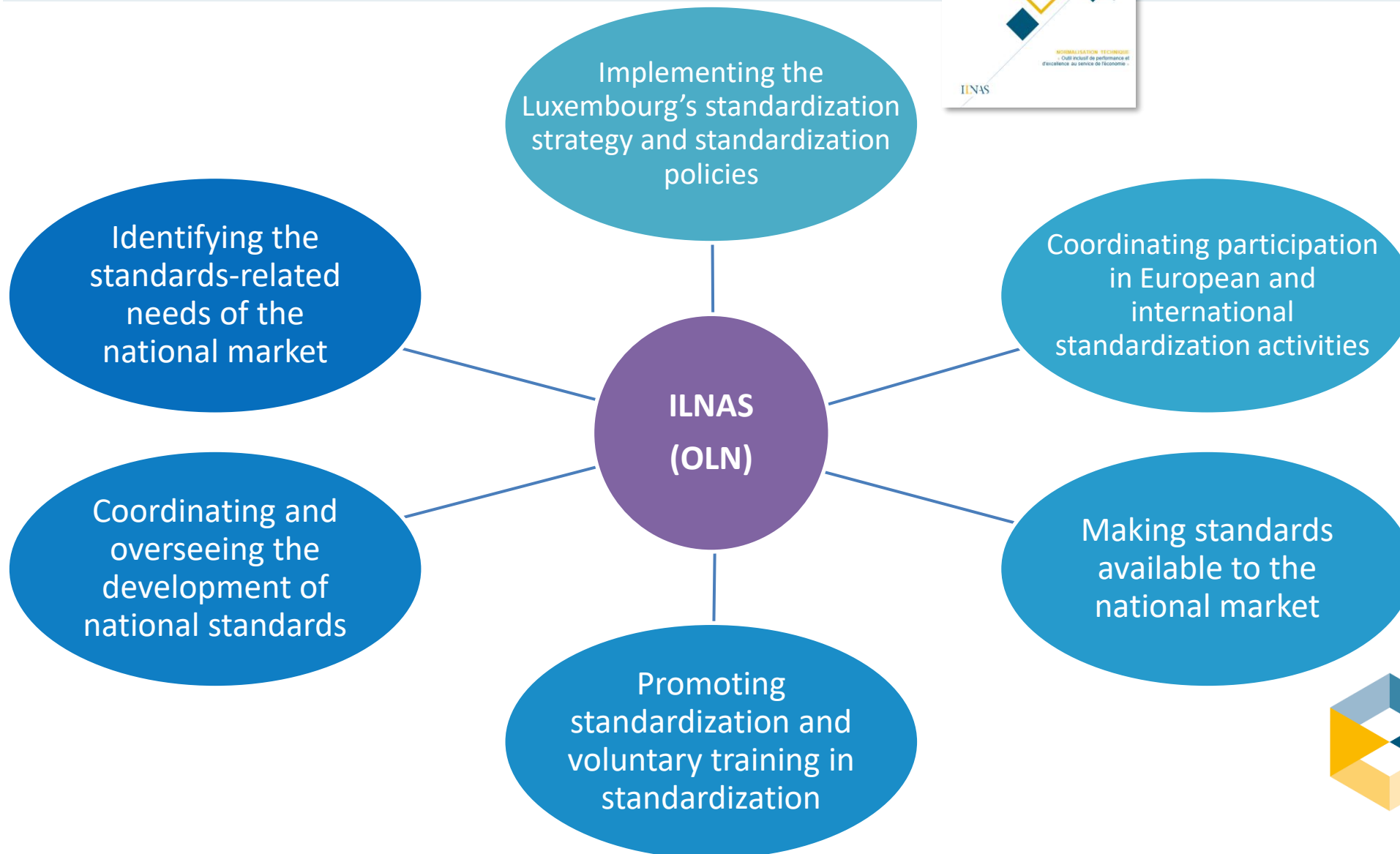
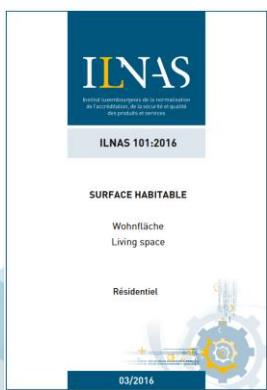
Legislation in force: amended Law of July 4, 2014 reorganizing ILNAS

Total staff: 68 (October 2026)

NATIONAL STANDARDS BODY (OLN)

- Total staff: 8
- Close collaboration with the E.I.G. ANEC-N







Economic Interest Group

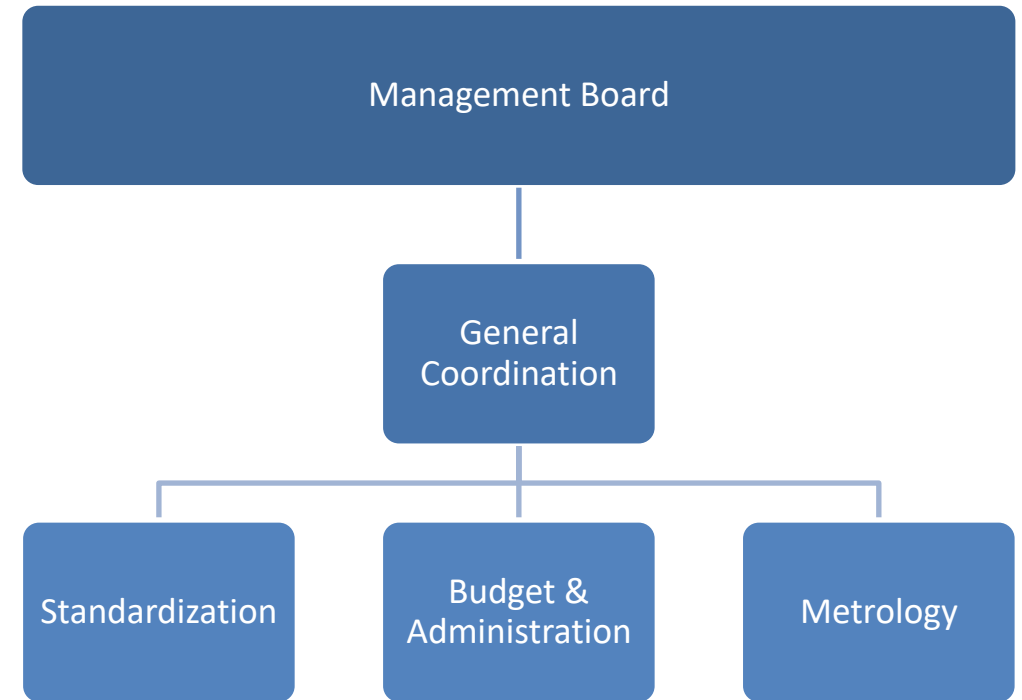
Object: Promotion, awareness raising and training, applied research in the field of standardization and metrology in order to support companies' competitiveness in Luxembourg

Creation: October 4, 2010

Standardization department

- Total staff: 4

Partners:



➔ Support for the implementation of the Luxembourg's Standardization and Metrology strategies



II - NATIONAL STANDARDIZATION STRATEGY 2024-2030



TECHNICAL STANDARDIZATION

"INCLUSIVE TOOL FOR PERFORMANCE AND EXCELLENCE TO SERVE THE ECONOMY"

PERFORMANCE

Pillar 1 – Use of relevant technical standards

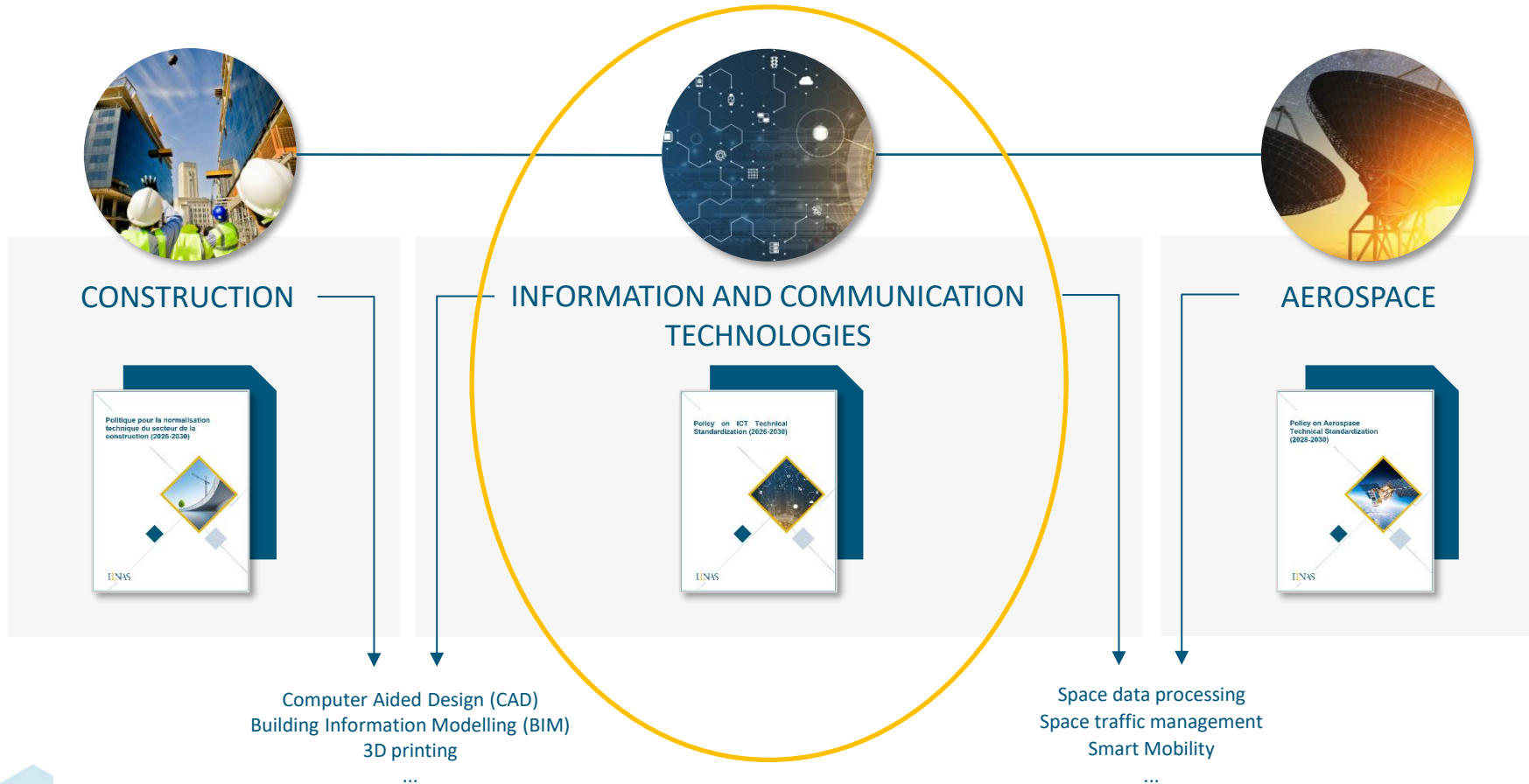
Pillar 2 – Involvement in the standardization process

EXCELLENCE

Pillar 3 – Active participation of the NSB in the European and international standardization organizations

Pillar 4 – Development of research and education about standardization

3 GROWTH SECTORS IDENTIFIED



2 RELEVANT DOMAINS



➡ Sectoral policies updated this year for the period 2026-2030

III - STANDARDIZATION POLICIES – FOCUS ON THE ICT DOMAIN

“Foster and strengthen the national economic sectors involvement in standardization work”

1

Identifying and following technical standardization activities related to the ICT sector

- Drawing up a national standards analysis for the ICT sector
- Following relevant technical committees
- Following the standardization developments related to European policies and strategies

2

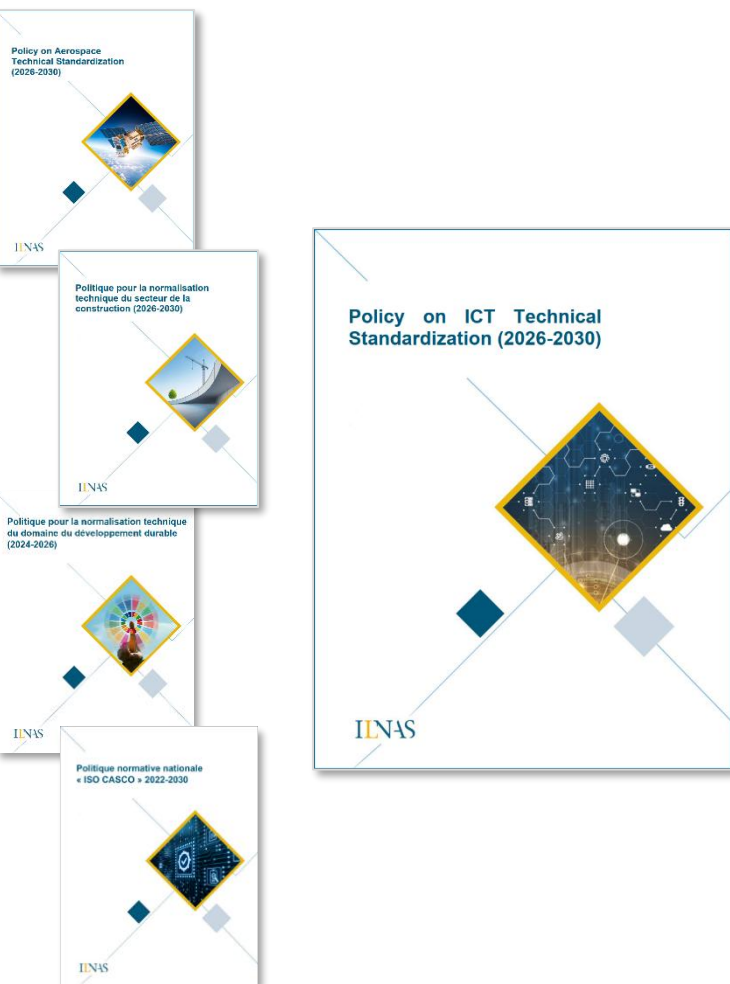
Promoting ICT technical standardization and strengthening national market involvement

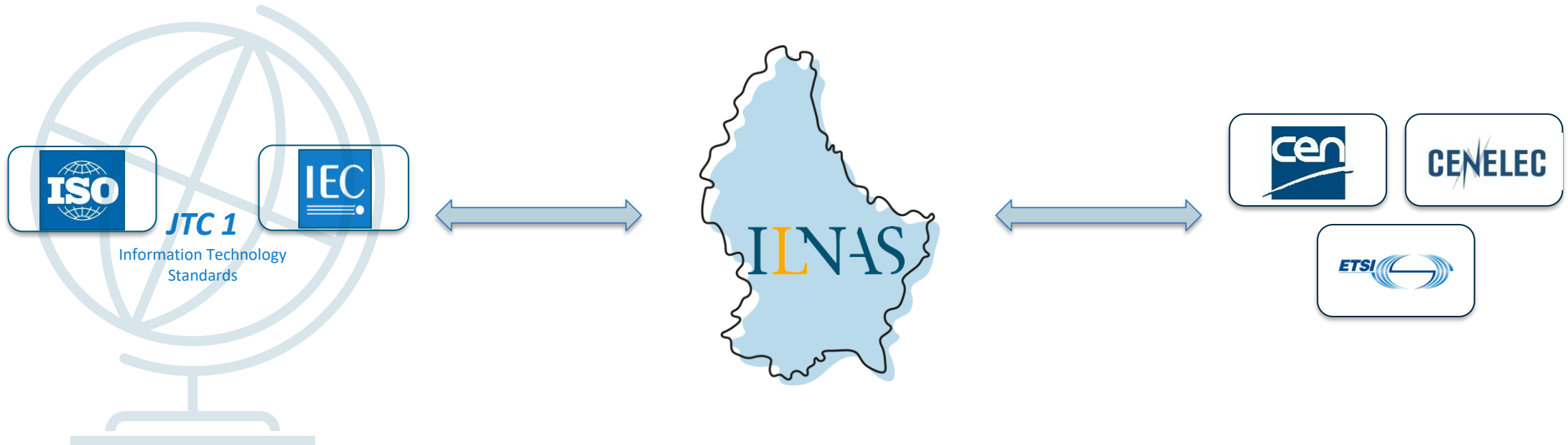
- Promoting the use of standards and the participation of the national market in technical standardization activities
- Supporting the national participation to standardization activities
- Create transversal links with other sectors and domains identified by the national standardization strategy

3

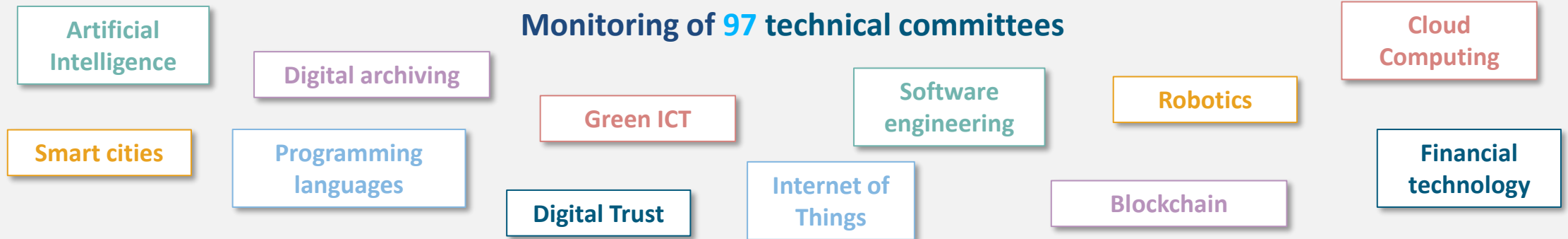
Supporting and strengthening the education about standardization and the related research activities

- Developing new education about standardization and research activities in the ICT field
- Managing the Master MTECH





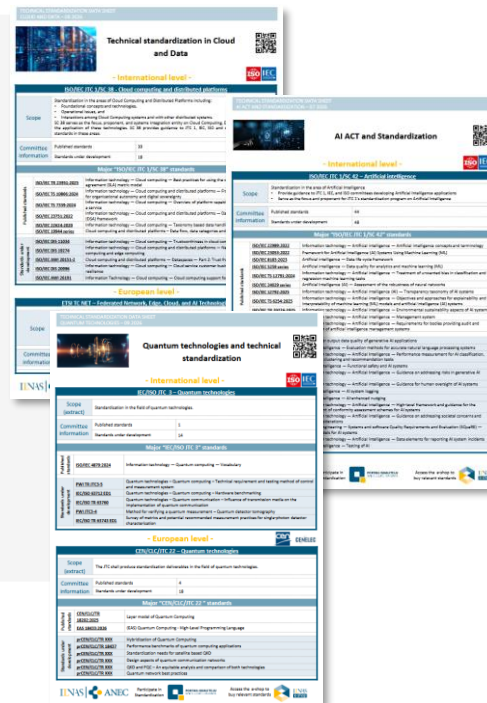
Monitoring of 97 technical committees



Recent developments

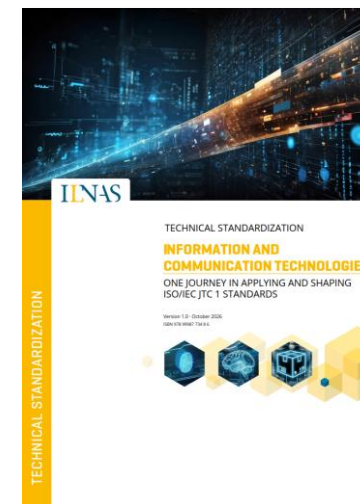
Technical sheets

- Cloud and Data
- AI ACT and Standardization
- Quantum Technologies
- Blockchain and Distributed Ledgers
- Secure Internet of Things
- Digital Twin
- ICT for education and learning
- ...



Technical reports

“One Journey in applying and shaping ISO/IEC JTC 1 standards” (10/2026)



CATALOGUE 2026

FORMATION - TRAINING

NORMALISATION
STANDARDIZATION



Trainings and Awareness sessions

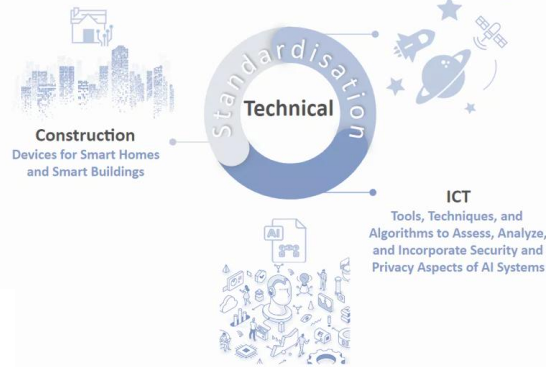
- Quantum technologies and technical standardization
- Standardization and legislation: AI use case
- Technical standardization in data governance and cloud environments
- Green ICT and technical standardization

Standardization Analysis “ICT” (07/2026)

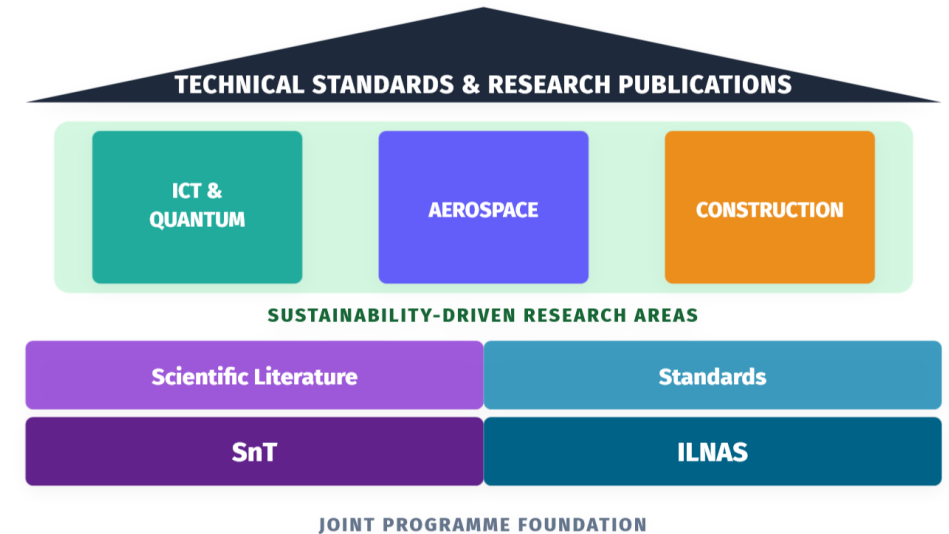
<https://portail-qualite.public.lu/fr/normes-normalisation/secteurs/tic.html>

IV – EDUCATION ABOUT STANDARDIZATION AND RESEARCH

“Technical Standardisation for Trustworthy ICT, Aerospace, and Construction” (2021-2024)



“Technical Standardisation for Trustworthy and Sustainable ICT, Construction and Aerospace” (2025-2028)





MASTER MTECH

Since 2021

→ Next edition in February 2027



With the support of:  THE GOVERNMENT OF THE GRAND DUCHY OF LUXEMBOURG
Ministry of the Economy



UNIVERSITY CERTIFICATE “STANDARDIZATION FOR SUSTAINABLE DEVELOPMENT”

Under development

→ Start planned in February 2027



UNIVERSITY CERTIFICATE “ECONOMY OF TRUST”

Proposal under development



Pan-European Certificate on Standardization

Under development

Aims to support European competitiveness by fostering the next generation of standardization professionals, aligned with EU policy priorities, and by enabling wider participation by SMEs, students, and young professionals in standardization work.



Involvement of many NSBs (including ILNAS)



ILNAS

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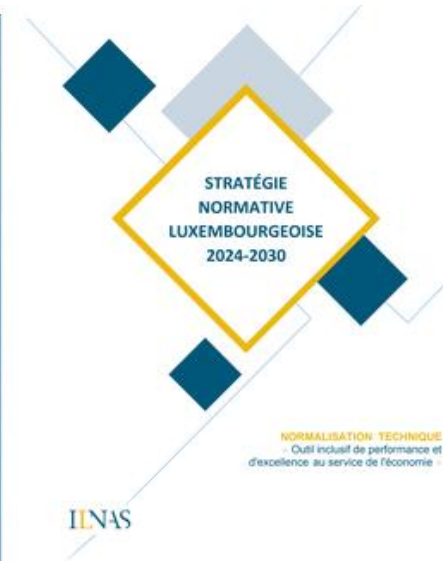
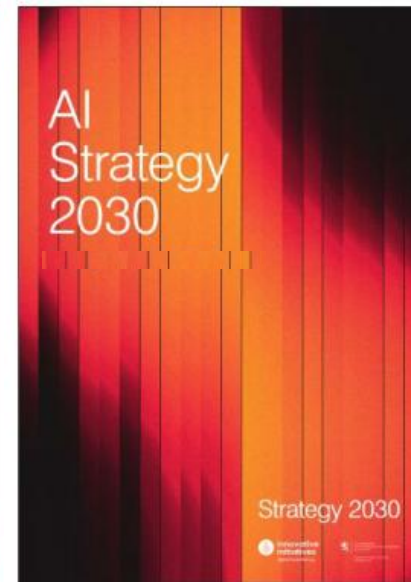
www.portail-qualite.lu

Session 1 – ICT Technical Standardization



Accelerating Digital Sovereignty 2030

Data, AI and Quantum Technologies



Digital Strategies and Technical Standardization



LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie

Strategic context: two complementary frameworks



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Ministère de l'Économie

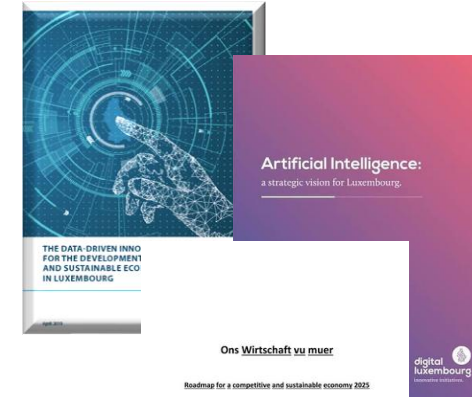
➤ Accelerating Digital Sovereignty 2030:

- Launched in May 2025 under the 2023–2028 coalition agreement.
- Structured around three technological pillars: Data, Artificial Intelligence and Quantum Technologies.
- Builds on existing initiatives in digital transformation, regulation and skills.
- Follows a whole-of-government approach involving public and private stakeholders.
- Aims to foster innovation and strengthen Luxembourg's economy and technological sovereignty.

➤ Luxembourg Standardization Strategy 2024–2030 :

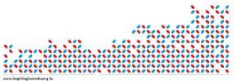
- Positions technical standardization as an inclusive tool serving the economy.
- Gives particular attention to ICT, construction and aerospace.
- Promotes the use of standards and active participation in European and international standardization.
- Supports standards-related research, education and national expertise.
- Recognizes ICT standards as a horizontal enabler for all economic sectors.

Technical standardization helps to translate the ambitions of the “Accelerating Digital Sovereignty 2030” Initiative into deployable technologies, interoperable infrastructures and trusted markets



Ons Wirtschaft vu muer
Roadmap for a competitive and sustainable economy 2025

Ministry of the Economy / June 2021



ILNAS

➤ What it means in the Luxembourg context

- **Strategic autonomy, not self-sufficiency:** Maintain control over critical technologies, data and infrastructure while remaining open to global innovation, investment and talent.
- **Leadership in selected strategic areas:** Focus national capabilities and investments on data, AI, quantum technologies, cybersecurity and advanced computing.
- **European cooperation as a source of sovereignty:** Use the EU Single Market and shared European initiatives to achieve the scale that Luxembourg cannot build alone.
- **Resilience and economic competitiveness:** Reduce critical dependencies through open standards and interoperability.

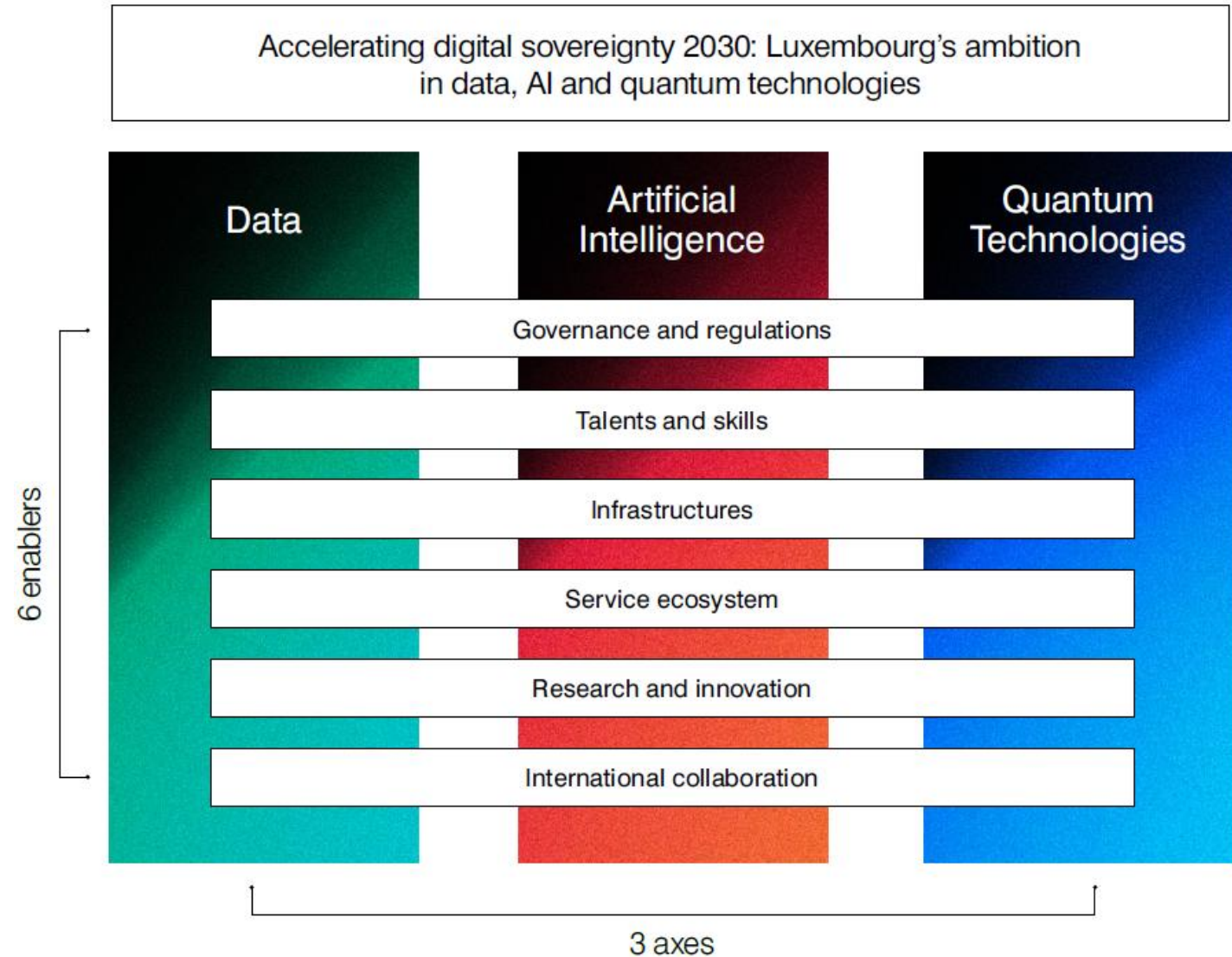
➤ The role of technical standardization

- **Reduce proprietary dependencies and fragmentation:** A company or administration using standards-based systems is potentially less dependent on one vendor, one interface or one technological architecture.
- **Shape standards rather than simply adopt them:** Early participation prevents new dependencies on rules developed elsewhere.
- ➔ **Participation in European and international processes:** ILNAS operates national standardization structures covering AI (ILNAS/NSC 04), Cloud and Data (ILNAS/NSC 05), and Quantum Technologies (ILNAS/NSC 03) and connects national experts to the European and international standardization work (ISO/IEC, CEN-CENELEC, ETSI).

For an open economy, sovereignty depends on managing dependencies, switching suppliers and influencing technical rules.

National digital strategies

A unified approach: leveraging interactions between Data, AI and Quantum Technologies



➤ Ambitions:

- establish a **coherent national framework** for the management, access and valorization of data
- make data **findable, accessible, interoperable and reusable (FAIR)** within a trusted environment
- use data to support **innovation, better public services and evidence-based policy**
- position Luxembourg as a **European center of excellence** for secure data exchange and data-driven value creation

➤ Centralised data governance to ensure data reuse and exchange in a trusted environment



Single information point	Single data authority	Secure processing environment	Access and reuse support
Ministry for Digitalization Data catalogue and access information	Government Commission for Data Protection (CGPD) Harmonized decisions on public data access and reuse	CTIE Secure processing, anonymization and pseudonymization	LNDS Support for access to European data spaces and reuse requests

Luxembourg Data Factory

Collaborative support structure for implementing the strategy, coordinating stakeholders and enabling accessible, interoperable data products and services across the ecosystem.

33 concrete measures such as:

- Governance and regulations
 - #1) Centralised governance for access to public-sector and European data
 - #2) Standardizing data access conditions
 - #4) Define interoperable standards
- Talents and skills
 - #6) Establishing data literacy across society
 - #8) Attracting and retaining data skills
- Infrastructure
 - #9) Developing the IT infrastructure needed for public-sector data valorization
 - #11) Ensuring adequate sovereign storage and computing capacity
- Services ecosystem
 - #12) Data discovery and intermediation services
 - #13) Catalogues of data and data products
 - #18) Facilitate the generation of synthetic data
- Research, development and innovation
 - #26) Promoting data excellence and FAIR research data
 - #27) Establishing sovereignty for Luxembourg's research data
- International collaboration
 - #30) Implementing the Interoperable Europe Act for exchange of public data among administrations in the EU
 - #32) Develop a digital identity wallet
 - #33) Joining and hosting common European data spaces (e.g. Dataspace4Health)



➤ Ambitions:

- position Luxembourg as a renowned **innovation hub** with international **impact on human-centered AI**
- illustrate how AI can **benefit both citizens** and **businesses** (e.g., by helping to achieve ecological ambitions)
- create a **trusted AI ecosystem** that is **coherent, inclusive** and **collaborative** (public / private / research)
- build upon **values** of **openness, dynamism** and **reliability**

➤ National AI ecosystem (09/2024)

Private investors, incubators

Organisations and funds that provide capital, resources, mentorship and support to AI startups, technology companies and AI projects.

AI Technology solution providers

Companies creating the foundational AI models, algorithms and systems that drive intelligent functionalities in various applications and industries.

AI communities (consulting, academia & research)

Consultancy firms, academic institutions and research organisations that enable the use of AI technologies and support their adoption by end users.

AI Company, AI Developer, AI Startup / SME

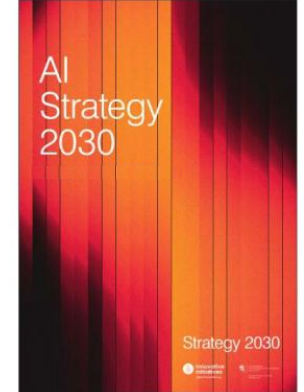
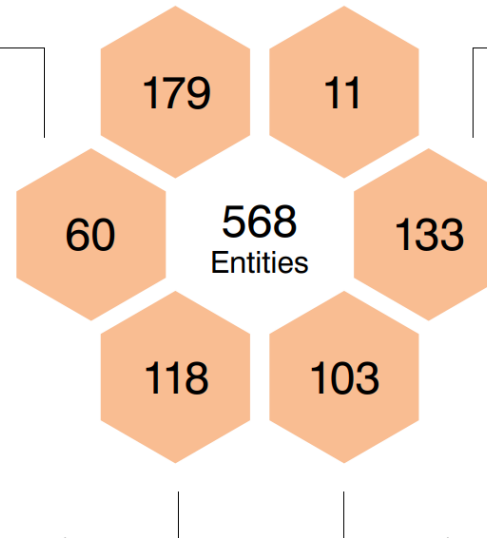
Providers using existing AI technologies to develop, customise and deploy AI-driven applications, tools and services to businesses and industries.

AI users (Early adopters)

Public and private organisations using or planning to use AI technologies and solutions in their tasks, processes and decision-making.

Potential data providers

Providers offering raw or processed data that can be used to enhance the performance and accuracy of AI algorithms.



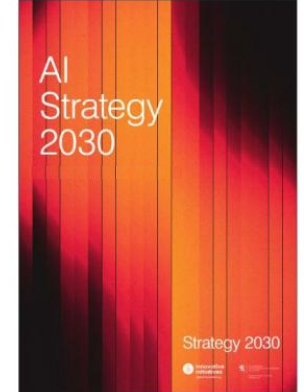
30 concrete measures such as:

- Talents and skills
 - #1) Expanding AI integration in higher education
 - #4) Building AI skills for all
 - #5) Business-driven upskilling
- Infrastructure
 - #10) Operationalizing MeluXina-AI
 - #11) Promoting sovereign Cloud resources
- Services
 - #12) Luxembourg AI Factory as one-stop-shop for AI services
 - #15) Supporting the creation and growth of AI startups (*Fit 4 Scale*)
 - #16) AI integration support for SMEs (*AI-focused SME package / Fit 4 Digital – AI*)
 - #17) AI regulatory sandboxes
- Research, development and innovation
 - #21) AI for security and security of AI
- Governance and regulations
 - #24) Fast and practical implementation of the AI Act
 - #26) Recognizing cybersecurity aspects of AI regulation
- International collaboration
 - #28) Actively participating in EU Digital Infrastructure Consortia (“EDIC”) (*ALT, Genome, CitiVerse*)
 - #29) Contributing to international standardization

MELU  INA-AI



L-AIF
LUXEMBOURG





➤ **Ambitions:**

- build a **dense and interconnected quantum ecosystem** linking research, industry and government
- develop quantum computing expertise and services around **MeluXina-Q** and hybrid workflows combining quantum computing, AI and HPC
- secure critical communications through **QKD and the transition to post-quantum cryptography**
- translate scientific excellence into **use cases, spin-offs and long-term economic impact**

➤ **Three strategic objectives**

Quantum computing	Quantum-secure communications	Economic impact
MeluXina-Q integrated with HPC as a national strategic digital infrastructure - Development of algorithms and software and hybrid use cases	Anticipating the threat of quantum computers capable of breaking current encryption systems - Terrestrial and satellite QKD - PQC migration and crypto-agility	Industry adoption, start-ups and spin-offs, quantum services, RDI and strategic partnerships



Strong engagement and alignment with EU initiatives and the EU Q-Strategy



EuroHPC
Joint Undertaking



**QUANTUM
INTERNET
ALLIANCE**



18 concrete measures such as:

- Governance and regulations
 - #1) Creating a National Quantum Coordination Office
- Talents and skills
 - #3) Strengthening quantum education, training and workforce development
- Infrastructure
 - #4) Implementing and driving adoption of MeluXina-Q
 - #5) Building expertise and partnerships to harness the full potential of quantum computing
 - #7) Developing first-generation terrestrial and space-based QKD applications
 - #9) Advancing quantum network components, photonic chips and sensing
 - #10) Preparing the transition to post-quantum cryptography
- Services ecosystem
 - #13) Building service hubs for computing, communications and PQC
- Research, development and innovation
 - #14) Defining focused quantum research priorities (National Research and Innovation Strategy)
 - #15) Strengthening strategic funding for the quantum research ecosystem
 - #17) Valorizing quantum R&D through Luxembourg's Deep Tech Lab
- International collaboration
 - #18) Strengthening Luxembourg's role in the European and global ecosystem



MELU  INA-Q



 EuroQCI



EuroHPC
Joint Undertaking

 QUANTERA

Role of standardization across the three pillars



PILLAR	Where standardization is important	Strategic contribution
DATA Implement now	Metadata and catalogues; common definitions and vocabularies; data quality; APIs and formats; access and reuse conditions; interoperability between data spaces	Makes data findable, comparable and reusable across public and private sectors; interoperable data spaces; reliable inputs for AI
AI Immediate priority	Data governance; risk and quality management; transparency and documentation; robustness, accuracy and cybersecurity; human oversight; testing and conformity assessment	Turns principles such as “trustworthy AI” into measurable and auditable requirements; conformity with relevant AI Act requirement; lower compliance uncertainty; trust and EU market access
QUANTUM Shape early	Common terminology; performance metrics and benchmarking; interfaces between quantum computers, HPC and software; QKD and quantum-network protocols; post-quantum cryptography; security testing and certification	Prevents fragmented proprietary ecosystems; enables credible procurement and investment decisions; supports interoperability with EU initiatives such as EuroHPC and EuroQCI

Standardization makes digital sovereignty operational: data can circulate, AI can be trusted, and quantum technologies can interoperate and reach the market

Quantum standardization and the European opportunity



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Ministère de l'Économie

➤ Why timing matters

For an emerging technology, standards do not simply serve to consolidate an established market, they can actively contribute to creating it.

Luxembourg's Quantum Strategy gives ILNAS/NSC 03 a role in monitoring and contributing to emerging standards

➤ European direction

The EU's 2026 ICT Standardization Rolling Plan calls for standardization strategies from the start of higher-TRL projects, including EuroHPC, EuroQCI and Chips JU activities. Priority topics include modular quantum computing, programming frameworks, QKD networks, metrology and certification.

➤ Opportunities for Luxembourg

Leverage the national Quantum Technologies standardisation commission (ILNAS/NSC 03) to place national experts in EU groups like CEN-CENELEC JTC 22 and ETSI and connect at international level to ISO/IEC JTC 3.

EU policy window

Quantum Europe Strategy

- Coordinated infrastructure hubs
- Industrialisation and secure supply chains
- Competence clusters, skills and shared facilities

Forthcoming EU Quantum Act

- Boost research and innovation
- Scale industrial capacity, including pilot lines and a design facility
- Reinforce supply chain resilience and governance

Priority for Luxembourg: Link MeluXina-Q, LuxQCI/EuroQCI testbeds and future quantum competence centers to standards development and validation. Position national actors for future EU consortia, shared infrastructures and pilot facilities.

The role of standardization in ADS2030 can be described at three levels:

1. Standardization as an implementation tool

Translates strategic principles into interoperable technical solutions that organizations can deploy across data, AI and quantum technologies

2. Standardization as a competitiveness tool

Supports Luxembourg companies in accessing the European market, reduces uncertainties in procurement, demonstrates compliance and brings innovative solutions to scale

3. Standardization as a sovereignty tool

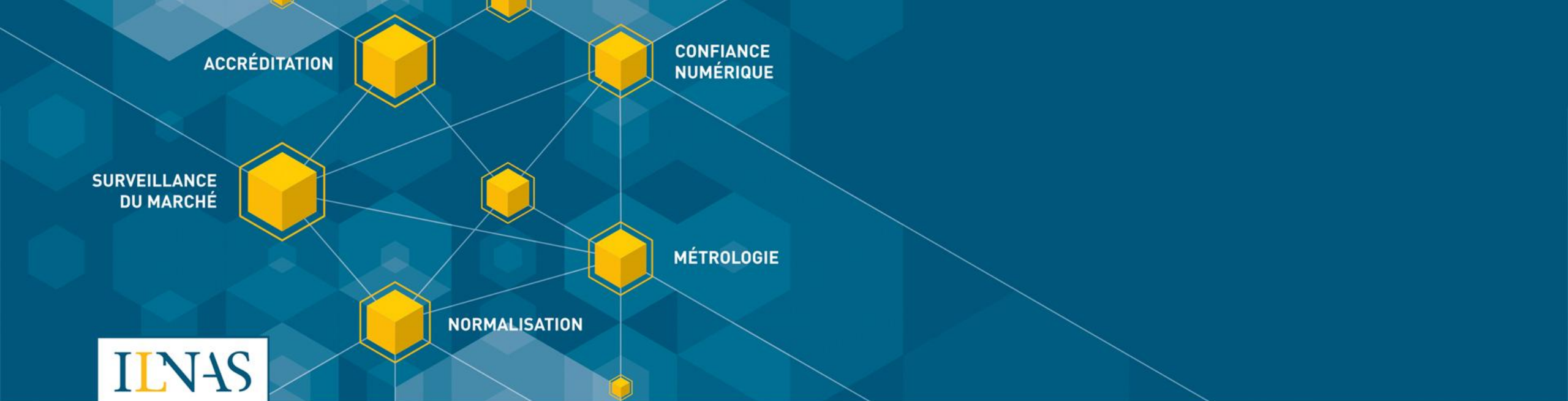
Reduces unwanted technological dependencies and gives Luxembourg actors a voice in defining the technical rules on which future digital markets will operate

From standard taker to standard maker

Mobilize national expertise at the right time

- Anticipate technical requirements
- Ensure Luxembourg use cases are recognized
- Build partnerships and access European markets

Strategic lever: ILNAS/NSC 04 (AI), ILNAS/NSC 05 (Cloud and Data) and ILNAS/NSC 03 (Quantum Technologies) connect national experts to European and international standardization work.



ISO/IEC JTC 1 at the forefront of ICT technical standardization

“ONE JOURNEY IN APPLYING AND SHAPING ISO/IEC JTC 1 STANDARDS”

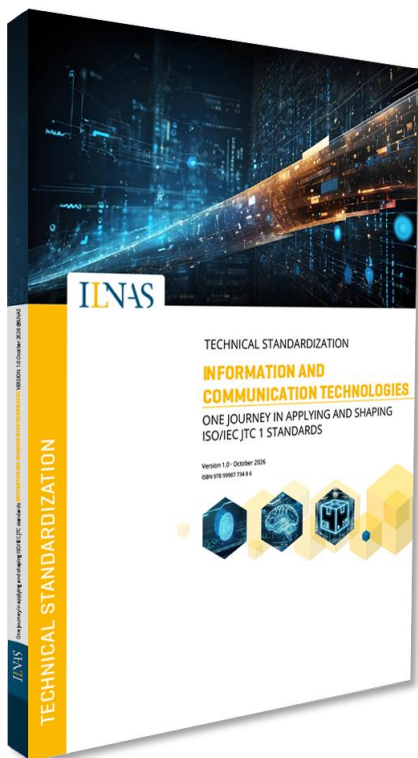
13th October 2026

Mr. Nicolas Domenjoud

Responsible “ICT & Technical Standardization” – ILNAS/OLN



New ILNAS
publication!



<https://gd.lu/9ss47v>



INFORMATION AND COMMUNICATION TECHNOLOGIES

ONE JOURNEY IN APPLYING AND SHAPING ISO/IEC JTC 1 STANDARDS

Version 1.0 - October 2026

*The technical committee ISO/IEC JTC 1 “Information Technology” is one of the most important for providing standards covering various Information and Communication Technology (ICT) areas. Discover, through a series of **imaginary interviews**, the many advantages of being involved in the development and use of ISO/IEC JTC 1 technical standards from different organizations’ perspectives.*



INTERVIEWS

- ☐ ILNAS – The Luxembourg’s National Standards Body
- ☐ Standardization as a strategic tool to support policymakers – Interview with a Public Policy consultant
- ☐ How standardization strengthens supply chain management – Interview with a Luxembourg SME
- ☐ Advancing Brain-Computer Interface innovation through standardization – Interview with a Luxembourg Researcher
- ☐ Why international standardization matters for data management innovation – Interview with the CEO of a Luxembourg Startup

FACT BOXES for more information

- ☐ Standardization organizations
- ☐ ISO/IEC JTC 1 Structure and Luxembourg’s memberships
- ☐ Luxembourg’s involvement in ISO/IEC JTC 1 and its subgroups
- ☐ How standards can support regulation
- ☐ Funding for participation in standardization
- ☐ Links between research, innovation and standardization
- ☐ And discover many of the ISO/IEC JTC 1 subcommittees throughout the report...

ILNAS

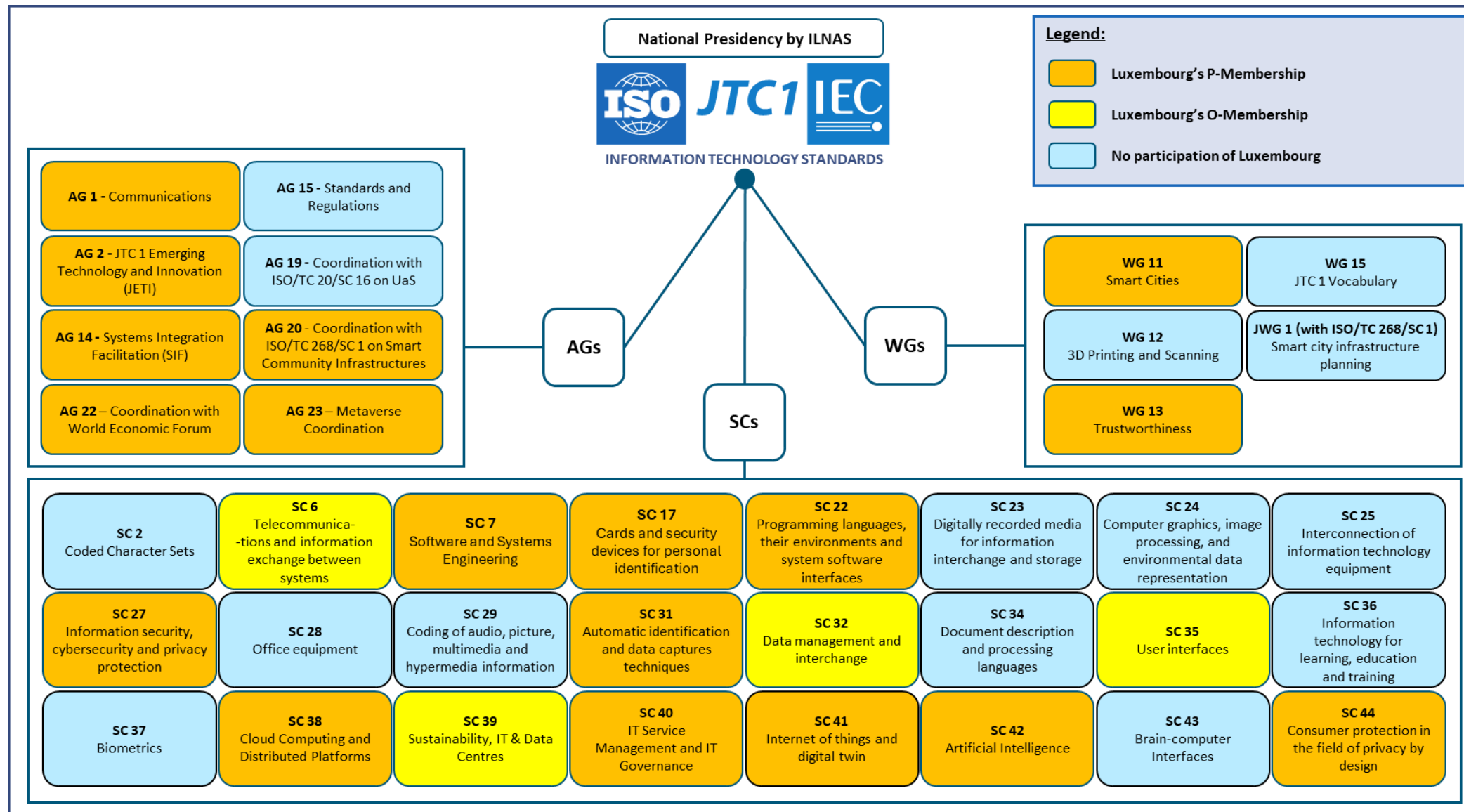
NATIONAL STANDARDS BODY

- ✓ Member of INT and EU SDOs (ISO, IEC, ITU, CEN, CENELEC, ETSI)
- ✓ Implement the National Standardization Strategy 2024-2030 (ICT being one priority)
- ✓ Holds the presidency of the National Mirror Committee ISO/IEC JTC 1
- ✓ Facilitate the participation of national experts in the development of standards

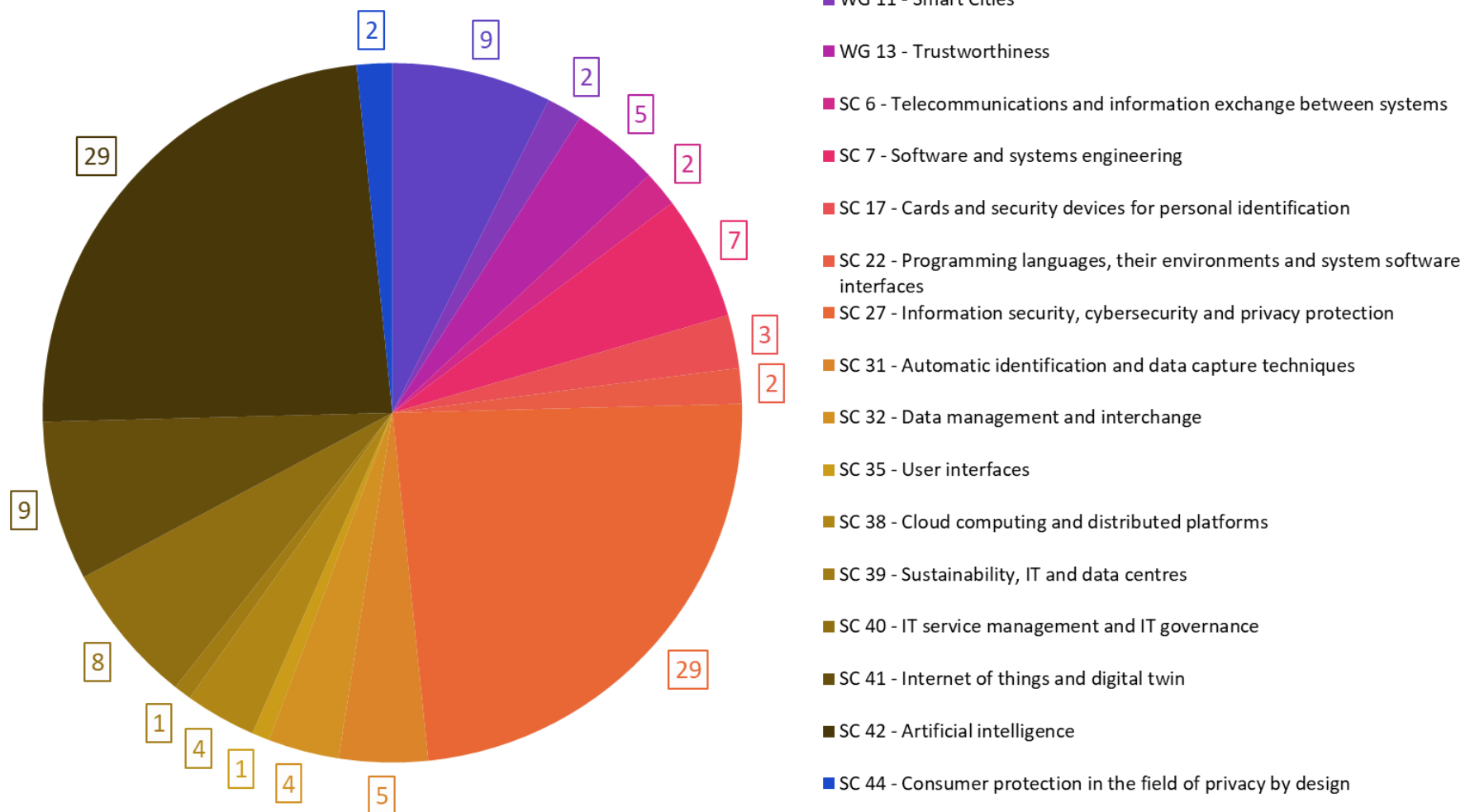
- **Key takeaways**

- ISO/IEC JTC 1 “Information technology”
 - One of the world's leading international committees for the development of ICT standards
 - Composed of many subcommittees and working groups, covering a wide range of ICT areas
- Why international standards matter?
 - Interoperability of systems, secure data exchange, trust, ...
- Involvement in standardization efforts allows experts from Luxembourg to contribute to defining the technical content of standards prior to their publication
 - National interests and expertise are taken into account in future standards
- Around 100 national delegates are currently involved in ICT standardization (including 65 in ISO/IEC JTC1)

“ISO/IEC JTC 1 has a great importance for establishing and maintaining the interoperability, security and reliability of ICT worldwide. In this frame, we encourage national stakeholders to participate in standardization efforts. Involvement is not just a way to keep up with technological advancements, but also an opportunity to shape the future of international ICT standards, and to meet the related community.”



ISO/IEC JTC 1 NATIONAL DELEGATES



- Key takeaways

- Being engaged in international standardization committees allows to better understand how technologies evolve and how regulatory frameworks can make use of standards for ensuring compliance
 - From a regulatory perspective, standards can offer useful tools to assist with legal obligations
- Citizens need to be assured that systems are secure, transparent, fair and that they are safeguarding their rights
 - International standards help in reaching this goal by offering shared technical methods for assessing performance, managing risks, enhancing interoperability, and addressing security and privacy issues
- Participation in ISO/IEC JTC 1/SC 42 “AI” and ISO/IEC JTC 1/SC 37 “Biometrics”
 - Engagement in SC 42 offers knowledge about AI governance and reliable AI systems, whereas involvement in SC 37 delivers expertise on biometric performance, interoperability, accuracy evaluation, and security standards

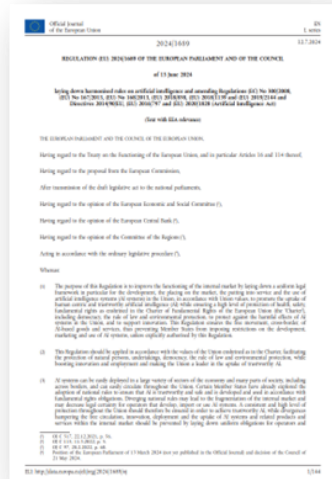
“From a regulatory point of view, international standards also help in establishing a common language among policymakers, technology providers, conformity assessment bodies, and users. It facilitates the understanding between all the parties and promote consistency across jurisdictions, reducing uncertainty for both citizens and organizations.”



PRIVATE CONSULTING FIRM

- ✓ Specialized in international standardization (AI and Biometrics in particular)
- ✓ Advise public authorities for ICT-related decisions and represent their interest in technical committees
- ✓ Participation in:
 - ☐ ISO/IEC JTC 1/SC 27
 - ☐ ISO/IEC JTC 1/SC 37
 - ☐ ISO/IEC JTC 1/SC 42
 - ☐ ISO/IEC JTC 1/SC 44

Regulation (EU) 2024/1689 (AI Act)



Standardization Request M/613



European Standardization Organizations (ESOs)



CEN/CLC JTC 21
Artificial Intelligence

Joint
Work

ETSI TC Securing
AI

Vienna / Frankfurt
Agreements

ISO/IEC JTC 1/SC 42
Artificial Intelligence



International Standards Development Organizations (SDOs)

Fictive interview with Ms. Carole Nanjenn - Public Policy consultant at a private consulting firm



SC 42 "Artificial Intelligence"

Scope:

Standardization in the area of Artificial Intelligence

- ☐ Serve as the focus and proponent for JTC 1's standardization program on Artificial Intelligence
- ☐ Provide guidance to JTC 1, IEC, and ISO committees developing Artificial Intelligence applications

Structure:

- ☐ WG 1 - Foundational standards
- ☐ WG 2 - Data
- ☐ WG 3 - Trustworthiness
- ☐ WG 4 - Use cases and applications
- ☐ WG 5 - Computational approaches and computational characteristics of AI systems
- ☐ JAG - AI and sustainability
- ☐ JWG 2 - Testing of AI-based systems
- ☐ JWG 3 - AI enabled health informatics
- ☐ JWG 4 - Functional safety and AI systems
- ☐ JWG 5 - Natural language processing systems
- ☐ JWG 6 - Conformity assessment schemes for AI systems
- ☐ JWG 7 - Artificial intelligence (Financial Services)

44 standards published
49 projects

Luxembourg's involvement:

- ☐ P-Membership
- ☐ 29 national delegates



SC 44 "Consumer protection in the field of privacy by design"

Scope:

Standardization of consumer protection in the field of privacy by design for products, goods and services, including their data lifecycles.

Structure:

- ☐ AG 2 - Communication group
- ☐ CAG - Advisory group
- ☐ WG 1 - High level requirements and foundational concepts

2 standards published
3 projects

Luxembourg's involvement:

- ☐ P-Membership
- ☐ 2 national delegates



SC 37 "Biometrics"

Scope (extract):

Standardization of generic biometric technologies pertaining to human beings to support interoperability and data interchange among applications and systems.

Structure:

- ☐ WG 1 - Harmonized biometric vocabulary
- ☐ WG 2 - Biometric technical interfaces
- ☐ WG 3 - Biometric data interchange formats
- ☐ WG 4 - Technical Implementation of Biometric Systems
- ☐ WG 5 - Biometric testing and reporting
- ☐ WG 6 - Cross-Jurisdictional and Societal Aspects of Biometrics
- ☐ JWG 7 - Cybersecurity testing and evaluation of biometrics

142 standards published
28 projects

Luxembourg's involvement:

- ☐ Not yet member

- Key takeaways

- Standards are important for compliance but the advantages extend far beyond that:
 - Standards establish common technical specifications and shared good practices that minimize confusion and integration expenses
- SMEs frequently gain significant advantages from engaging in standardization
 - Standardization offers an open and widely recognized technical frameworks that limit market fragmentation
 - Offers important entry to worldwide networks of specialists, clients, vendors, authorities, and technology providers
 - Enables SMEs to anticipate upcoming market trends and impact standards that could directly relate to their operations
- When participating, organizations can influence the content of standards from the beginning and ensure their business is in line with the upcoming publications instead of having to adapt their practices after they have been delivered



LUXEMBOURG SME

- ✓ SME active in the supply chain and logistics management
- ✓ Benefits from European fundings for participation in standardization
- ✓ Participation in:
 - ❑ ISO/IEC JTC 1/SC 31
 - ❑ ISO/IEC JTC 1/SC 41

"Resources are frequently constrained for SMEs. We cannot bear the expense of creating tailored solutions for each customer or supplier. Standardized methods enable us to create scalable systems that function across various organizations and countries."

StandICT.eu

Open Call 4
10/2026 – 12/2026

Open Call 5
02/2027 – 04/2027

Open Call 6
06/2027 – 08/2027

Types of open calls

Short-term (ST)

Contributions of up to three months, focusing on specific deliverables such as comments on drafts or liaison activities.

Max. € 5 000

Long-term (LT)

Sustained participation in standardization activities (e.g.: chairing or convening working groups) for up to nine months.

Max. € 10 000

Standardization Meetings (SM)

Supports the organization of international standardization meetings in Europe, endorsed by recognized SDOs or global fora.

Max. € 50 000

An individual may be selected for multiple awards, up to a cumulative maximum of €50,000 across the 3-year lifetime of the project

- Key takeaways

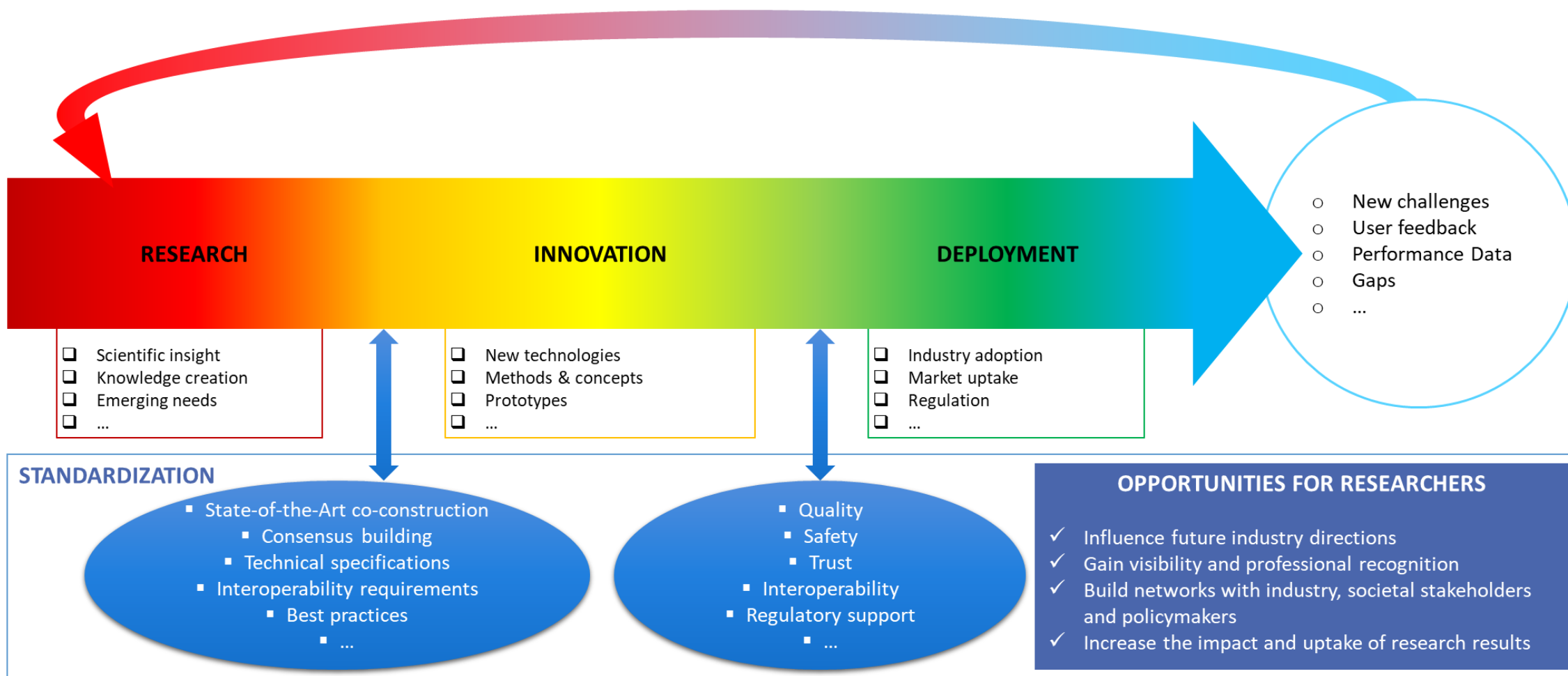
- Research and standardization can benefit from each other
 - Researchers provide scientific proof and practical insights obtained from extensive experimental efforts, performance metrics, evaluation methods, interoperability needs, terminology, etc. → upcoming international standards are grounded in solid scientific principles and represent the current state of the art
 - Standardization helps researchers in gaining a clearer insight into the practical requirements of industries, healthcare providers, regulatory bodies, and end users
- Participation in ISO/IEC JTC 43 “Brain-Computer Interfaces”
 - The subcommittee gathers specialists from academia, industry, government, and global research institutions to create shared frameworks that facilitate innovation and implementation

“Engaging in committees like ISO/IEC JTC 1/SC 43 provides an additional chance to turn research findings into real-world benefits for society. Through involvement in standards, researchers can influence the future technologies while fostering innovation, trust, and global cooperation.”



RESEARCH CENTER

- ✓ Researcher working on brain-computer interfaces (BCIs) in the frame of a Horizon Europe research project
- ✓ Participation in:
 - ❑ ISO/IEC JTC 1/SC 43



- Key takeaways

- Sustained success relies on interoperability, trust, security, and scalability. This is the reason why the startup decided to participate in international standardization from the very beginning of their business. It helps in guaranteeing that the solutions created can fit with worldwide digital networks
- Engagement in multiple subcommittees
 - SC 32 assists the startup in organizing and managing data
 - SC 38 focuses on the management of data within cloud environments
 - SC 42 provides sophisticated insights powered by AI
 - SC 39 assists them in reducing environmental consequences, and SC 27 guarantees safety and confidentiality across the whole ecosystem
 - Collectively, these committees offer an extensive perspective on the upcoming digital environment

“For startups, obtaining global knowledge and international connections is crucial. Being part of ISO/IEC JTC 1 standardization enables us to connect directly with recognized experts globally. It provides us with early insight into technological trends, enhances our credibility with customers and investors, and allows us to contribute to standards that could shape future markets.”



STARTUP

- ✓ Luxembourg-based startup creating data management solutions for organizations
- ✓ Participation in:
 - ☐ ISO/IEC JTC 1/SC 27
 - ☐ ISO/IEC JTC 1/SC 32
 - ☐ ISO/IEC JTC 1/SC 38
 - ☐ ISO/IEC JTC 1/SC 39
 - ☐ ISO/IEC JTC 1/SC 42

Fictive interview with Mr. Romeo Jederhlo - CEO of a Startup



SC 39 "Sustainability, IT and data centres"

Scope (extract):

Standardization of assessment methods, design practices, operation and management aspects to support resource efficiency, resilience and environmental sustainability for and by information technology, data centres and other facilities and infrastructure necessary for service provisioning.

Structure:

- ☐ WG 1 - Resource Efficient Data Centres
- ☐ WG 3 - Sustainable facilities and infrastructures
- ☐ WG 4 - Digital Services and Software Sustainability

33 standards published
10 projects

Luxembourg's involvement:

- ☐ O-Membership
- ☐ 1 national delegates



SC 38 "Cloud computing and distributed platforms"

Scope (extract):

Standardization in the areas of Cloud Computing and Distributed Platforms including:

- ☐ Foundational concepts and technologies,
- ☐ Operational issues, and
- ☐ Interactions among Cloud Computing systems and with other distributed systems

Structure:

- ☐ CG 1 - Liaison coordination group for JTC 1/SC 27
- ☐ CG 2 - Liaison coordination group for JTC 1/SC 41
- ☐ CG 3 - Liaison coordination group for JTC 1/SC 42
- ☐ CG 4 - Liaison coordination group for JTC 1/SC 7
- ☐ CG 5 - Liaison coordination group for JTC 1/WG 13
- ☐ WG 3 - Fundamentals
- ☐ WG 5 - Stakeholders considerations
- ☐ WG 6 - Data, interoperability and portability

33 standards published
18 projects

Luxembourg's involvement:

- ☐ P-Membership
- ☐ 7 national delegates



SC 32 "Data management and interchange"

Scope (extract):

Standards for data management within and among local and distributed information systems environments. SC 32 provides enabling technologies to promote harmonization of data management facilities across sector-specific areas.

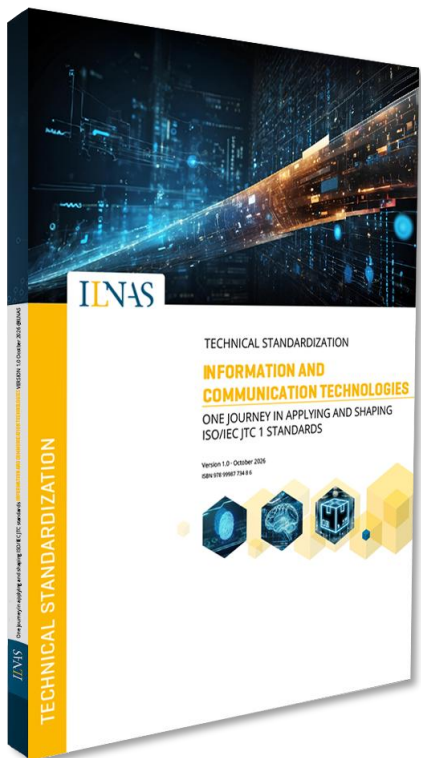
Structure:

- ☐ WG 1 - eBusiness
- ☐ WG 2 - MetaData
- ☐ WG 3 - Database language
- ☐ WG 6 - Data usage

130 standards published
31 projects

Luxembourg's involvement:

- ☐ O-Member
- ☐ 4 national delegates



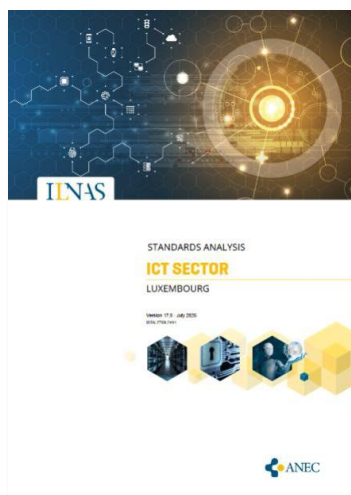
<https://gd.lu/9ss47v>



We hope that this publication will:

- ✓ Give you a deeper understanding of ICT standardization, its strategic importance, and the many opportunities that participation in standardization activities can offer, regardless of your field of activity or the type of organization to which you belong
- ✓ Inspire you to join this international community and to contribute, in your own way, to the development of the standards of tomorrow

PARTICIPATION IN STANDARDIZATION IS FREE OF CHARGE IN LUXEMBOURG – JOIN THE COMMUNITY NOW!



FURTHER DETAILS ON ICT STANDARDIZATION

The Standards Analysis “ICT Sector - Luxembourg” reflects the main standardization activities of recognized Standards Development Organizations (SDOs) within the ICT landscape. This analysis serves as a practical tool dedicated to national organizations, allowing them to identify technical standardization activities supporting their business.

→ <https://gd.lu/8nKCgh>



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www.portail-qualite.lu

Session 2 – Recherche, education et normalisation technique



INTERVENANTS



Dr. Lucas CICERO
Responsable
« Space, Conformity,
Education about Standardization »
ILNAS/OLN



Pr. Grégoire DANOY
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Université du Luxembourg



Dr. Cansu AGRALI
Chercheuse postdoctorale
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M. Guilhem HONORÉ
Doctorant
Université du Luxembourg



M. Hakan HASAN
Doctorant
Université du Luxembourg





Education, recherche et innovation dans le cadre de la normalisation technique

13 octobre 2026

Dr. Lucas Cicero

Chargé de projets - ILNAS



EDUCATION À LA NORMALISATION, RECHERCHE ET INNOVATION

INTRODUCTION

EDUCATION À LA NORMALISATION

ACTIONS ET RÉSULTATS

RECHERCHE ET INNOVATION

ACTIONS ET RÉSULTATS

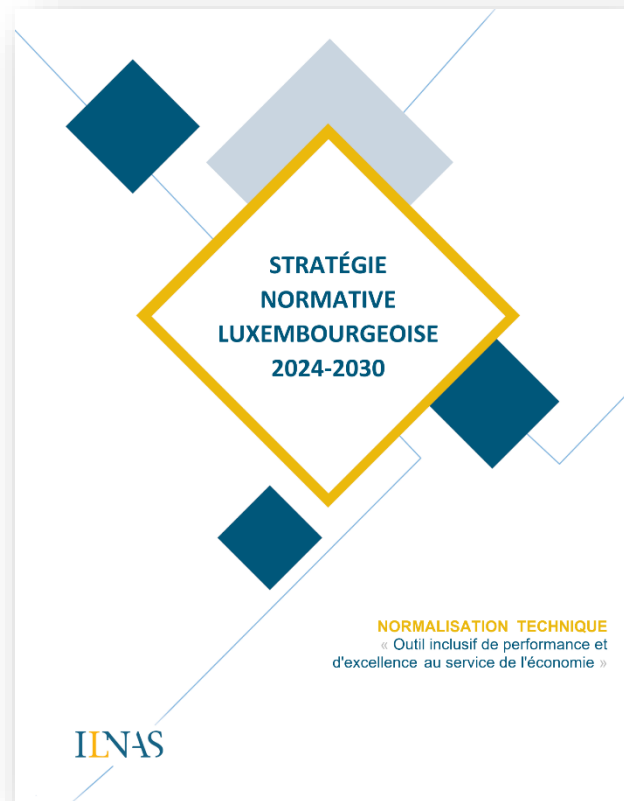
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ACTIONS ET RÉSULTATS





VERS L'EXCELLENCE

PILIER IV

Organiser et participer au développement des axes de recherche et d'éducation normatifs en regard des secteurs économiques identifiés comme « porteurs » et des domaines pertinents au plan national

EDUCATION À LA NORMALISATION



BÉNÉFICES DE LA NORMALISATION POUR LE GRAND-DUCHÉ DE LUXEMBOURG

« Un outil inclusif de performance et d'excellence au service de l'économie »

Langage commun
INTEROPÉRABILITÉ
COMMERCE INTERNATIONAL

Vision inclusive
ACCEPTATION PAR LE
MARCHÉ

Etat de l'art
EFFICACITÉ – QUALITÉ
SECURITÉ - INNOVATION

BÉNÉFICES DE L'ÉDUCATION À LA NORMALISATION POUR LE MARCHÉ LUXEMBOURGEOIS



La **sensibilisation** à la normalisation facilite l'utilisation des normes une fois l'étudiant intégré dans le milieu professionnel

→ VERS LA PERFORMANCE

L'**éducation** à la normalisation prépare les étudiants à une participation à la normalisation pour défendre les intérêts du Grand-Duché de Luxembourg

→ VERS L'EXCELLENCE

RECHERCHE ET INNOVATION



LA NORMALISATION EN SOUTIEN A LA RECHERCHE ET L'INNOVATION

Fondations

CONTRIBUTION À L'ÉTAT DE L'ARTAlignement de la recherche
avec le marché**COMPATIBILITÉ ET COMPARABILITÉ**

Dissémination

**RÉDUCTION DU
*TIME-TO-MARKET***

Confiance

**INNOVATION ET NOUVELLES
TECHNOLOGIES**

PARTICIPER ACTIVEMENT À LA NORMALISATION EN TANT QUE CHERCHEUR(SE) : QUELS BÉNÉFICES ?

De chercheur à



... normalisateur

**L'intégration de la normalisation dans un plan de valorisation d'un(e) chercheur(se) permet de :**

- Disséminer ses travaux de recherche auprès d'une communauté élargie
- Se tenir informé des orientations du marché et les comparer avec ses travaux
- Contribuer plus largement à l'économie nationale
- Bénéficier de financements européens (projets Horizon Europe)
- Faciliter l'appropriation (confiance) d'une nouvelle technologie par le marché



Politique pour l'éducation et la recherche
dans le cadre de la normalisation
technique (2025-2030)



I DÉVELOPPEMENT DU CHAMP DE CONNAISSANCE GLOBALE DE L'ÉDUCATION À LA NORMALISATION TECHNIQUE

- Participer aux initiatives pertinentes en matière d'éducation à la normalisation
- Former les futures générations à la normalisation technique
- Renforcer le rayonnement luxembourgeois en termes d'éducation à la normalisation technique

II DÉVELOPPEMENT DU CHAMP DE CONNAISSANCE GLOBALE DE LA RECHERCHE DANS LE CADRE DE LA NORMALISATION TECHNIQUE

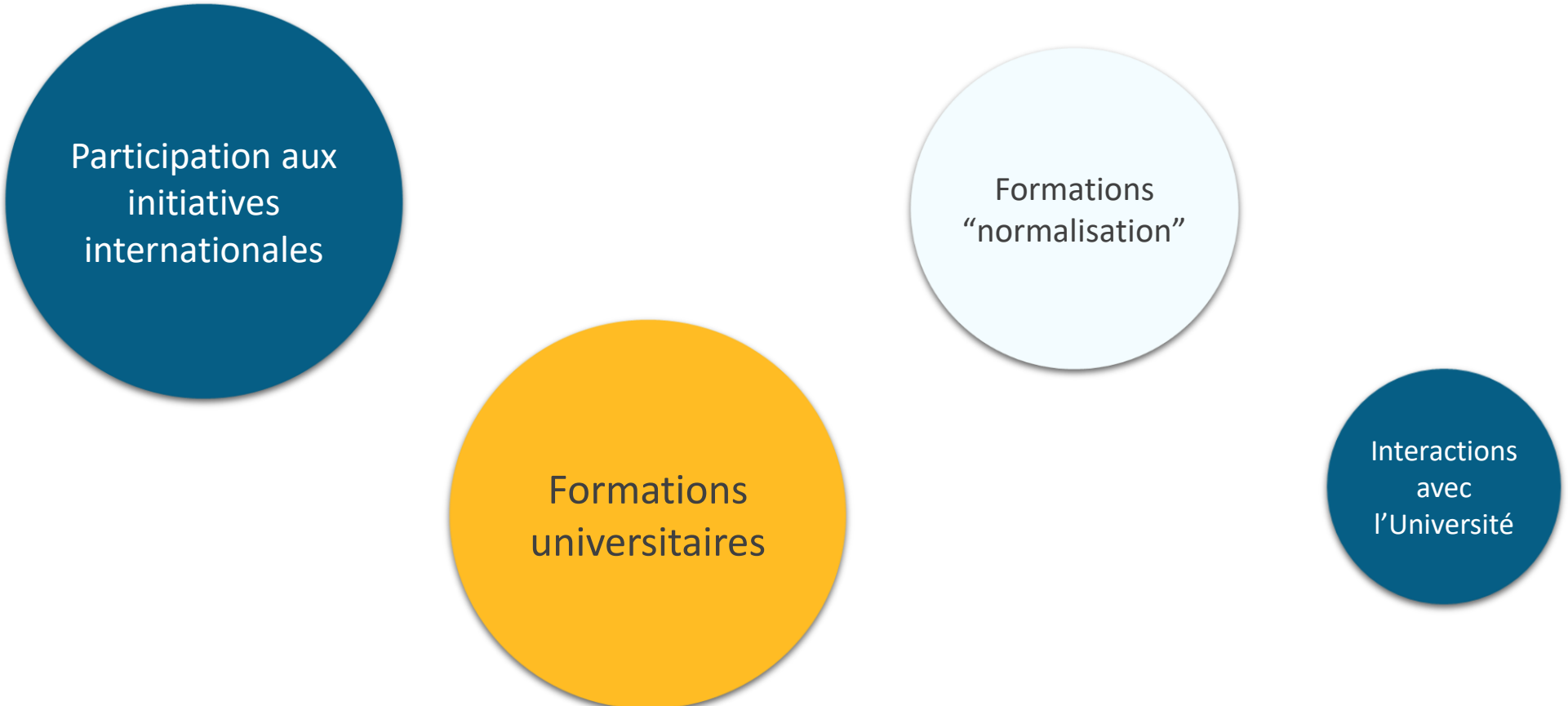
- Participer aux initiatives pertinentes en matière de recherche pour la normalisation
- Sensibiliser les acteurs nationaux de la recherche et de l'innovation
- Mettre en œuvre des programmes/projets conjoints de recherche

EDUCATION À LA NORMALISATION, RECHERCHE ET INNOVATION
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ACTIONS ET RÉSULTATS



DÉVELOPPEMENT DU CHAMP DE CONNAISSANCE GLOBALE DE **L'ÉDUCATION À LA NORMALISATION TECHNIQUE**

Participation aux
initiatives
internationales

Formations
“normalisation”

Formations
universitaires

Interactions
avec
l'Université

« Participation aux initiatives pertinentes en matière de normalisation »
« Renforcer le rayonnement luxembourgeois en termes d'éducation à la normalisation technique »

- **Participations et présentations**

- *High-Level Forum on European Standardisation*
 - *Workstream 2/2026 "Education & Skills on standards"*
- *CEN/CENELEC Advisory Committee – Research and Innovation*
 - **Valorisation des activités du Grand-Duché de Luxembourg en matière d'éducation à la normalisation et recherche lors de la réunion de lancement le 30 octobre 2025**
- *ISO Education on Standardization*
- *ANSI Committee on Education*
 - **Présentation des activités du Grand-Duché de Luxembourg en matière d'éducation à la normalisation lors de la réunion du 30 octobre 2025**
- *CWA "Guideline for education and training on standards and standardization"*

« Former les futures générations à la normalisation technique »

- **Formation continue - Master MTECH**

- Créé en 2021, et fait suite au certificat universitaire «Smart ICT for Business Innovation »
- Conjointement développé et encadré par l'Université du Luxembourg et l'ILNAS
- **Partenaire** : Chambre des Salariés
- Adresse les thématiques Smart ICT, confiance numérique, technopreneuriat et normalisation technique
- **Objectif** : équiper les étudiants de connaissances en Smart Secure ICT et leur permettre de les transporter en innovations techniques en s'appuyant sur la normalisation technique

332 heures
d'ensei-
nement

60 ECTS

2 ans de
formation
continue

11 Modules

Stage
(750 hours)



CHAMBRE DES SALARIES
LUXEMBOURG



LUXEMBOURG LIFELONG
LEARNING CENTER



GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Économie



CENELEC



« Former les futures générations à la normalisation technique »

- Formation continue - Master MTECH

3^{ème} promotion (2024-2026)



Succès : 100% de réussite (actuellement)

4^{ème} promotion (2027-2029)



<https://gd.lu/7dK2P2>

Inscriptions ouvertes !
Lancement : février 2027

« Former les futures générations à la normalisation technique »

- **Certificat « *Certificate in Standardisation for Sustainable Development* »**
 - Développement conjoint entre l'ILNAS et l'Université du Luxembourg
 - **Objectifs** : préparer les participants à traduire les objectifs de développement durable en actions concrètes grâce à la normalisation, et fournir les éléments clé pour comprendre les bénéfices de la participation active à la normalisation
 - **Public cible** : étudiants en Master et professionnels
 - **Date de début** : février-mars 2027

75 heures

3 ECTS

16 semaines
de
formation

4 Modules

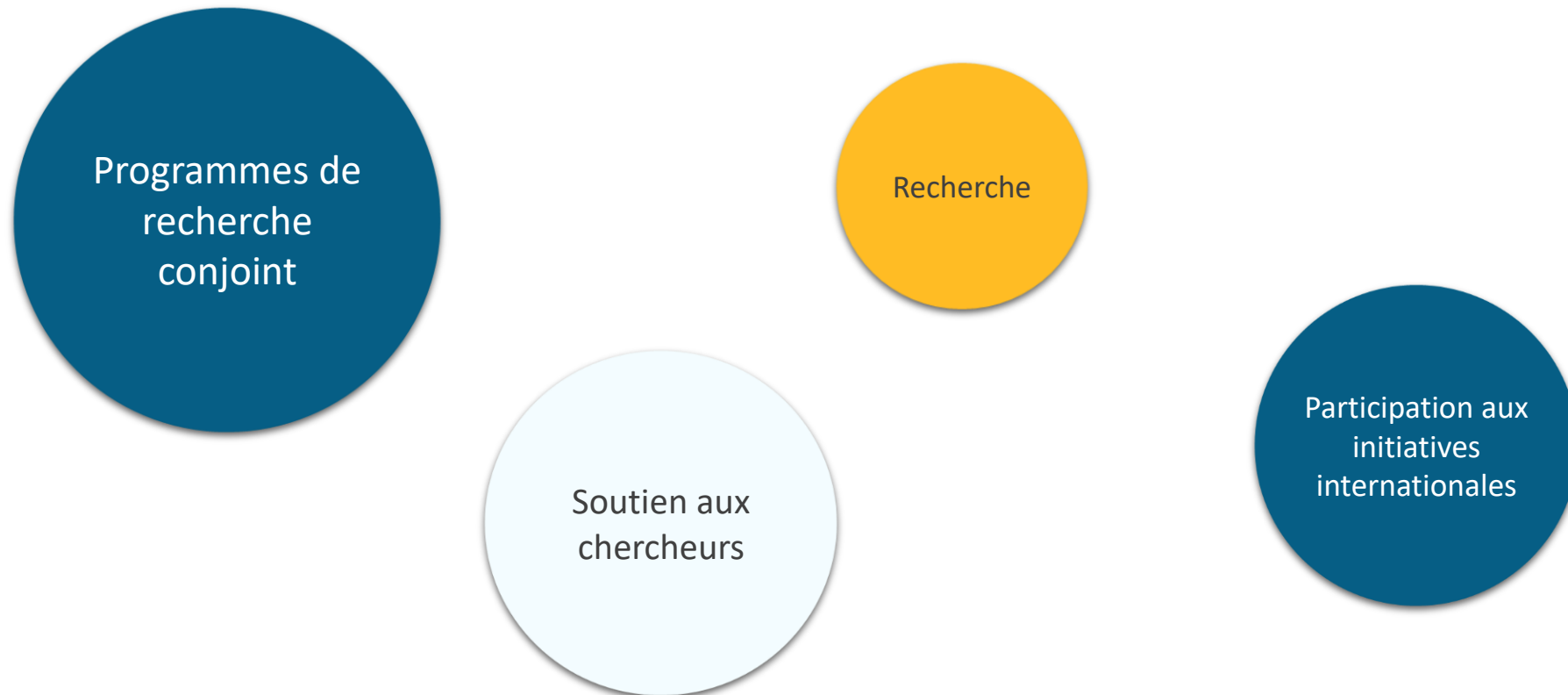
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RECHERCHE ET INNOVATION
ACTIONS ET RÉSULTATS



DÉVELOPPEMENT DU CHAMP DE CONNAISSANCE GLOBALE DE LA RECHERCHE DANS LE CADRE DE LA NORMALISATION TECHNIQUE



« *Participer aux initiatives pertinentes en matière de recherche pour la normalisation* »

- **Participations et présentations**
 - *CEN/CENELEC Advisory Committee – Research and Innovation*
 - **Valorisation des activités du Grand-Duché de Luxembourg en matière d'éducation à la normalisation et recherche lors de la réunion de lancement le 30 octobre 2025**
 - *Conférence EURAS – 24-26 juin 2026*
 - Publication et présentation d'un article de recherche conjointement entre l'Université du Luxembourg et l'ILNAS

« *Sensibiliser les acteurs nationaux de la recherche et de l'innovation* »

- **Soutien aux chercheurs du Grand-Duché de Luxembourg**
 - Service de veille normative permettant aux chercheurs d'identifier plus rapidement les normes afférentes à leurs projets
 - Mise à disposition des normes à un prix préférentiel :
 - Réduction de 80% pour les établissements d'enseignement publics
 - Réduction de 50% pour les établissements de recherche publics
 - Réduction de 50% pour les start-ups
 - Participation de l'ILNAS aux comités consultatifs de *consortium* luxembourgeois répondant aux projets Horizon Europe
 - L'ILNAS a **supporté 4 projets Horizon Europe** au cours de l'année passée

« Mettre en œuvre des programmes/projets conjoints de recherche »

- Programme de recherche ILNAS/UL-SnT 2021-2024

« Technical Standardisation for Trustworthy ICT, Aerospace, and Construction »

- Alignement avec la « Stratégie normative luxembourgeoise 2020-2030 »
- Clôture avec succès !



Soutenance du Dr. Maria Hartman
9 janvier 2026



Soutenance du Dr. Hedieh Haddad
17 mars 2026



Soutenance du Dr. Manuel Combarro Simón
12 juin 2026

« Mettre en œuvre des programmes/projets conjoints de recherche »

- Programme de recherche ILNAS/UL-SnT 2021-2024

« Technical Standardisation for Trustworthy ICT, Aerospace, and Construction »

- Valorisation via plusieurs publications, liant la normalisation à la recherche



Pushing the frontier: Standardization of emerging technologies in the space domain

Maria Hartmann¹, Lucas Cicero², Grégoire Danoy¹, Jean-Philippe Humbert², Pascal Bouvry¹

¹University of Luxembourg, ²Institut luxembourgeois de la normalisation, de l'accréditation, de la sécurité et qualité des produits et services (ILNAS)

¹{firstname.lastname}@uni.lu, ²{firstname.lastname}@ilnas.etat.lu

Abstract: The standardization of emerging technologies presents a unique challenge, even more so in rapidly developing niche markets such as the space domain. This paper analyses problems that may arise in this setting from the perspective of a technical researcher, using a concrete use case example related to a specific AI technology, Federated Learning, to derive more general recommendations on efficiently tackling standardization in such a context.

Conférence EURAS
24-26 juin 2026

« Mettre en œuvre des programmes/projets conjoints de recherche »

- Programme de recherche ILNAS/UL-SnT 2025-2028

« Technical Standardisation for Sustainable and Trustworthy ICT, Aerospace, and Construction »

- Alignement avec la « Stratégie normative luxembourgeoise 2024-2030 »

ICT

Construction

Aerospace

TRUSTWORTHINESS AND SUSTAINABILITY

« Mettre en œuvre des programmes/projets conjoints de recherche »

- Programme de recherche ILNAS/UL-SnT 2025-2028

« Technical Standardisation for Sustainable and Trustworthy ICT, Aerospace, and Construction »



Cérémonie de signature – 17 décembre 2024



Réunion de lancement – 17 décembre 2025

Recherche

- **Confiance économique**
 - **Confiance** = notion complexe, aux multiples dimensions et aux impacts significatifs
 - **Confiance dans le domaine économique** = levier des performances de l'économie
 - Acteurs et mécanismes existent (*e.g.* ILNAS), mais une grande diversité (complexité) est présente
- Les connaissances relatives au concept de confiance économique, ainsi que les notions sous-jacentes, sont actuellement peu connus du marché luxembourgeois.

POURSUITE DE L'EXÉCUTION DE LA POLITIQUE AFIN DE...

SENSIBILISER LES ACTEURS DE LA RECHERCHE LUXEMBOURGEOISE À LA NORMALISATION

CONTRIBUER À LA CONNAISSANCE GLOBALE EN MATIÈRE DE NORMALISATION

ADAPTER ET IMPLÉMENTER LES INITIATIVES EUROPÉENNES ET INTERNATIONALES AU GRAND-DUCHÉ DE LUXEMBOURG

CONTRIBUER À L'ECONOMIE LUXEMBOURGEOISE EN NOURISSANT LE MARCHÉ NATIONAL DE CONNAISSANCES RELATIVE À LA NORMALISATION





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www.portail-qualite.lu

Le *Workstream on Education & Skills on Standardisation* du *High-Level Forum on Standardization* souhaite connaître vos pratiques actuelles et vos besoins en matière d'éducation à la normalisation.

N'hésitez pas à prendre 5min pour compléter le questionnaire !



L'ILNAS vous remercie de votre participation.

World Standards Day 2026

ILNAS-SnT Research Programmes

Prof. Grégoire Danoy

Head of PCO Group
University of Luxembourg

SnT

About the University of Luxembourg

We are a **young, research-driven** university embracing **interdisciplinarity** to shape solutions for tomorrow's societal challenges.

Founded in 2003, we offer a **welcoming, multilingual environment** where students and researchers from around the world feel at home.

Our compact size fosters close interaction between students and lecturers, creating a personal and collaborative academic community.



At a glance



Ranked

A Top 250 University

worldwide in the Times Higher Education (THE) World University Rankings 2025

7,200

Students*



305

Professors



1000+

Doctoral candidates



148

Nationalities

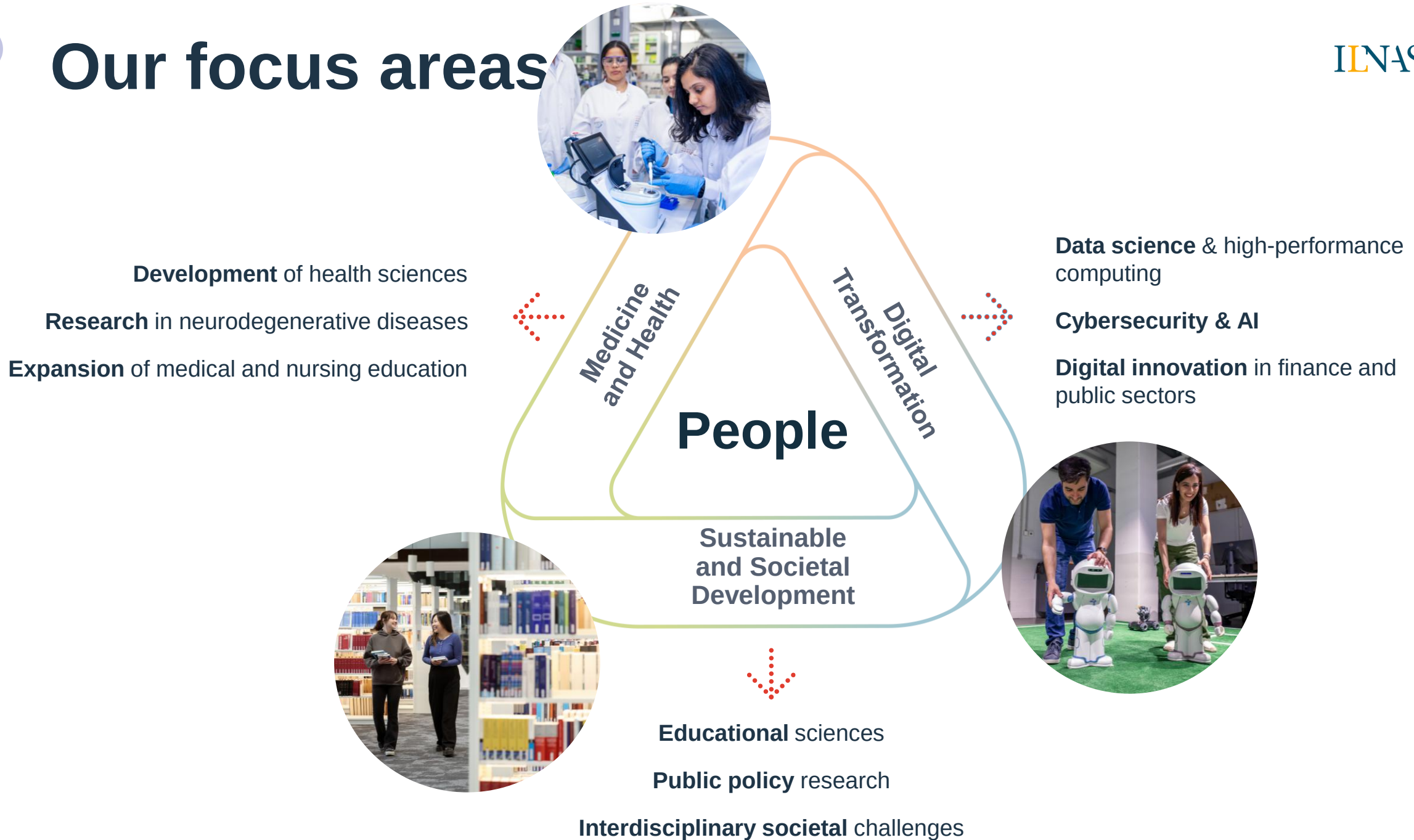


56%

International students



Our focus areas



Parallel Computing and Optimisation Group

<http://pcog.uni.lu>



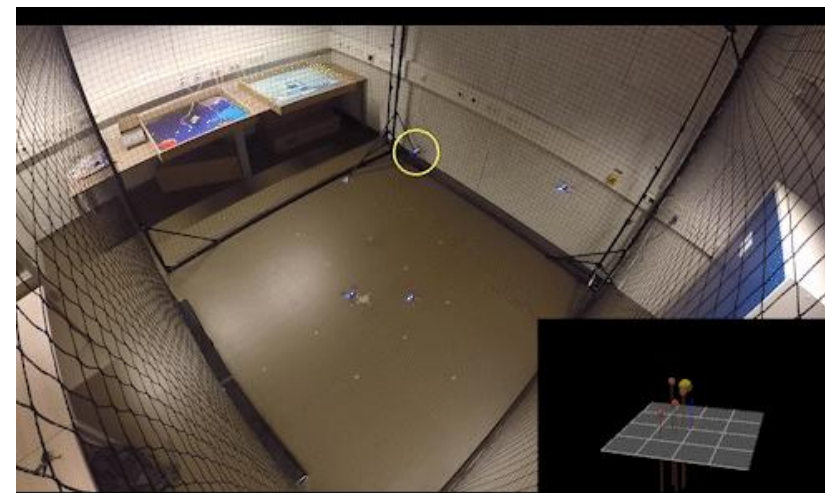
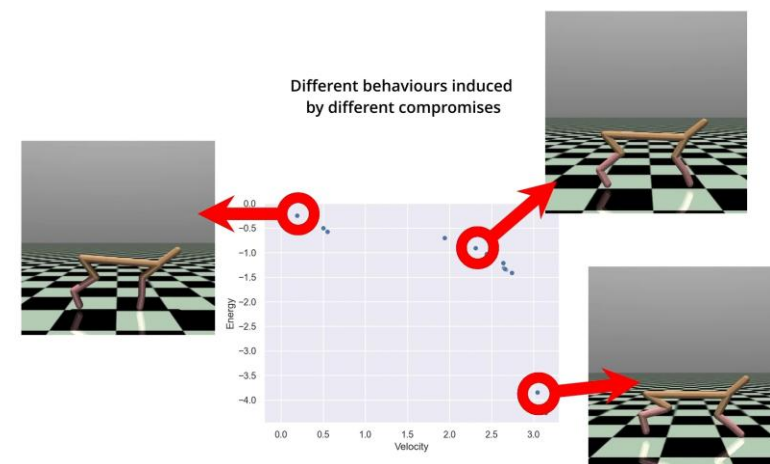
18+
researchers

1
Professor

8
Postdocs

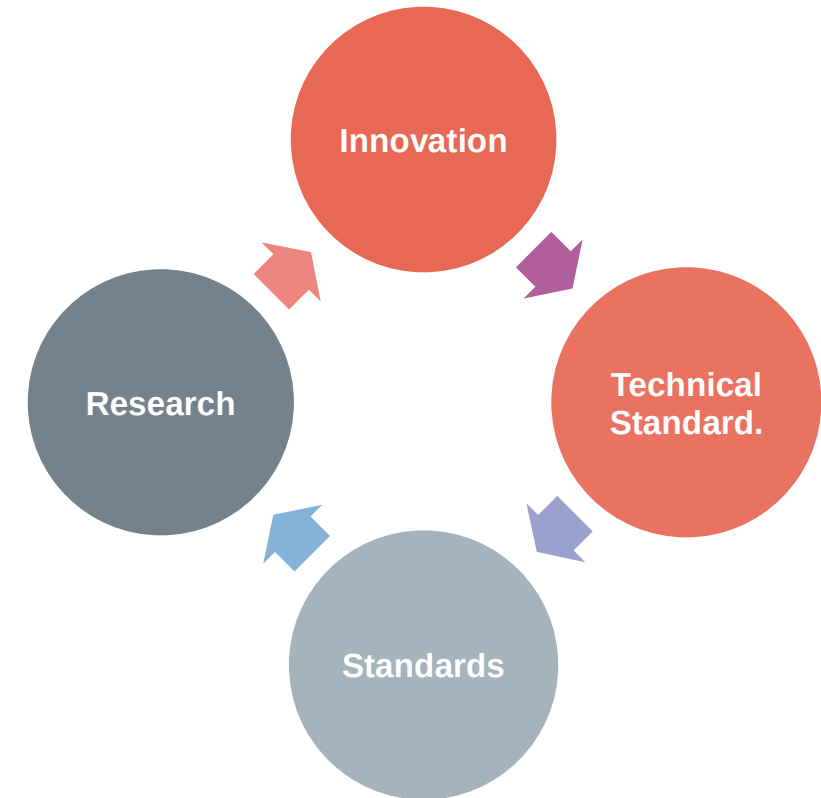
9
PhD students

13
nationalities

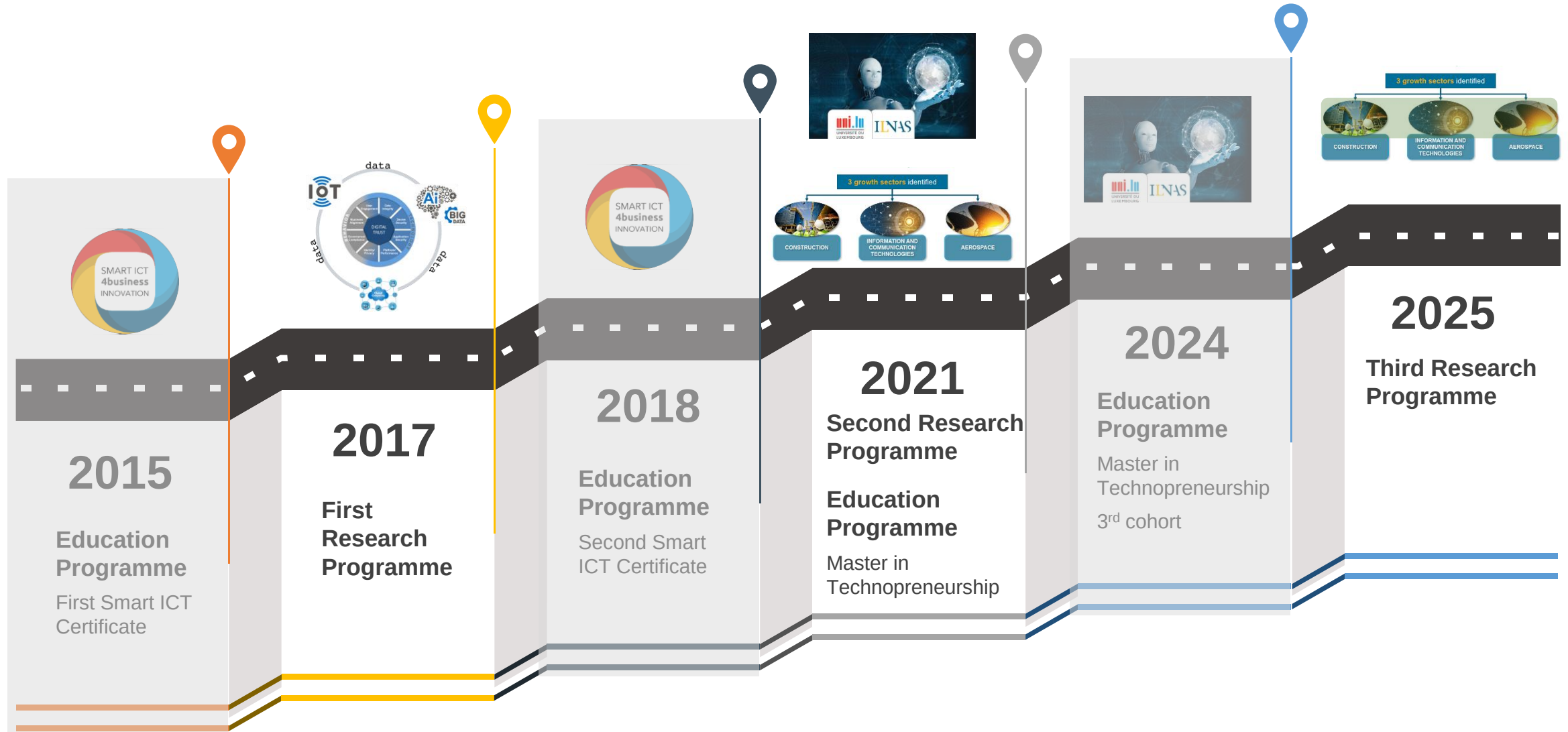


A Partnership Anchored in Standards

- **Objective**
 - Strengthen the interface between research and standardisation
- **Outcomes**
 - Help researchers amplify their impact through standards
 - Detect standardisation needs early, based on research results
 - Accelerate translation of research into practical, trusted standards



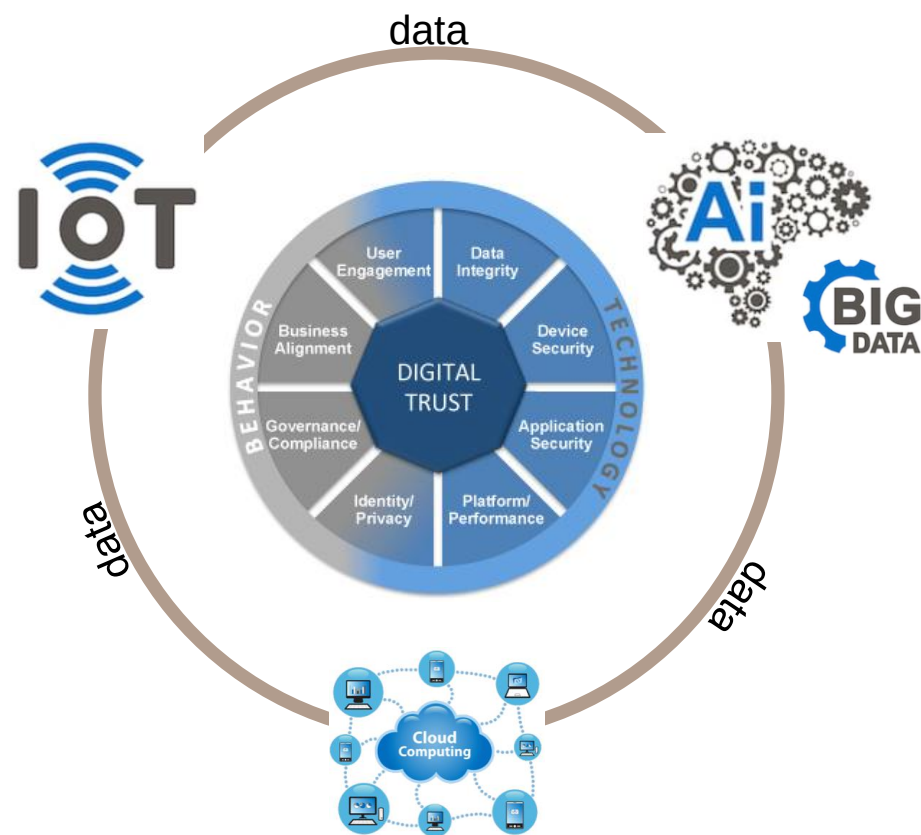
Research & Education Collaboration



First Research Programme (2017–2020)

“Technical Standardisation for Trusted Use in the Field of Smart ICT”

NATIONAL STANDARDISATION STRATEGY 2010-2020 & POLICY ON ICT



Core research pillars

- Internet-Of-Things
- AI/Big Data
- Cloud Computing

Connecting layer

- Data

Transversal component

- Digital Trust and Security across all domains

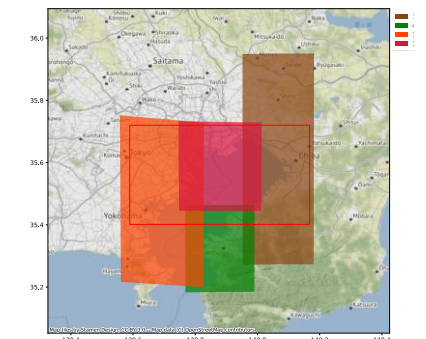
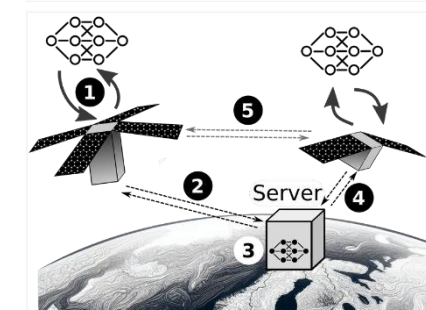
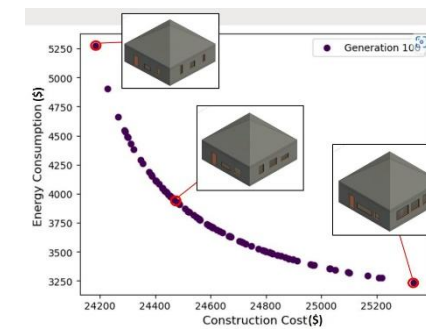
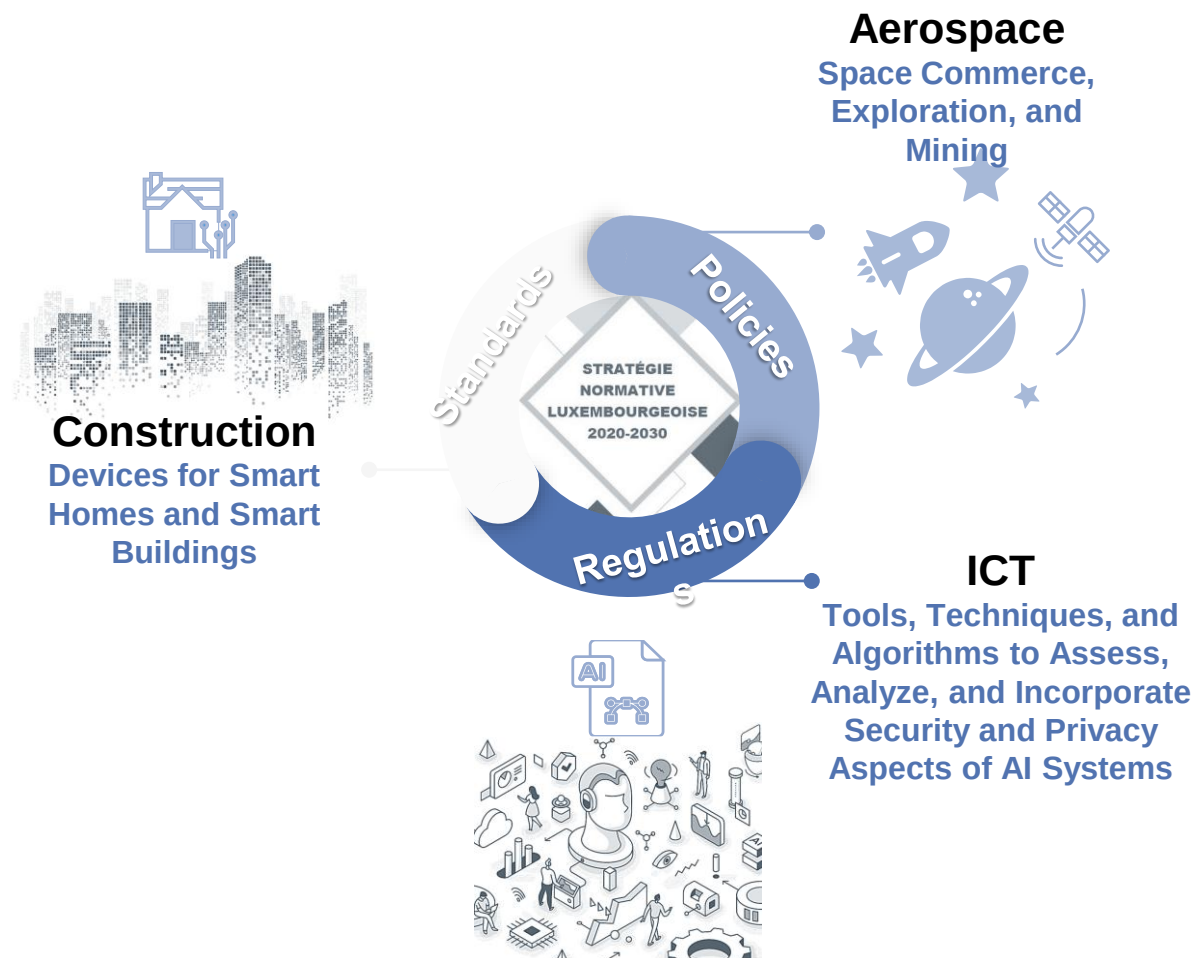
Objective

An innovative environment on digital trust for Smart ICT and related standardisation

The Second Research Programme (2021–2024)

Technical Standardisation for Trustworthy ICT, Aerospace, and Construction

NATIONAL STANDARDISATION STRATEGY 2020-2030



An Impactful Collaboration



Continuing the Journey

Third Research Programme (2025-2028)

<https://ilnas-snt.uni.lu/>



Standardisation for Trustworthy and Sustainable ICT, Construction and Aerospace

Construction



Sustainable and people-centred design

ICT



(Hybrid-)Quantum Optimisation

Space



AI for Sustainable Satellite Fleets

Contact

Parallel Computing and Optimisation Group



Prof. Grégoire Danoy
Head of PCOG
gregoire.danoy@uni.lu

World Standards Day 2026

**Technical Standardisation for Trustworthy and
Sustainable ICT, Construction and Aerospace**

Dr. Cansu Agrali

Research Associate

The Third Research Programme

Standardisation for Trustworthy and Sustainable ICT, Construction and Aerospace

Impact

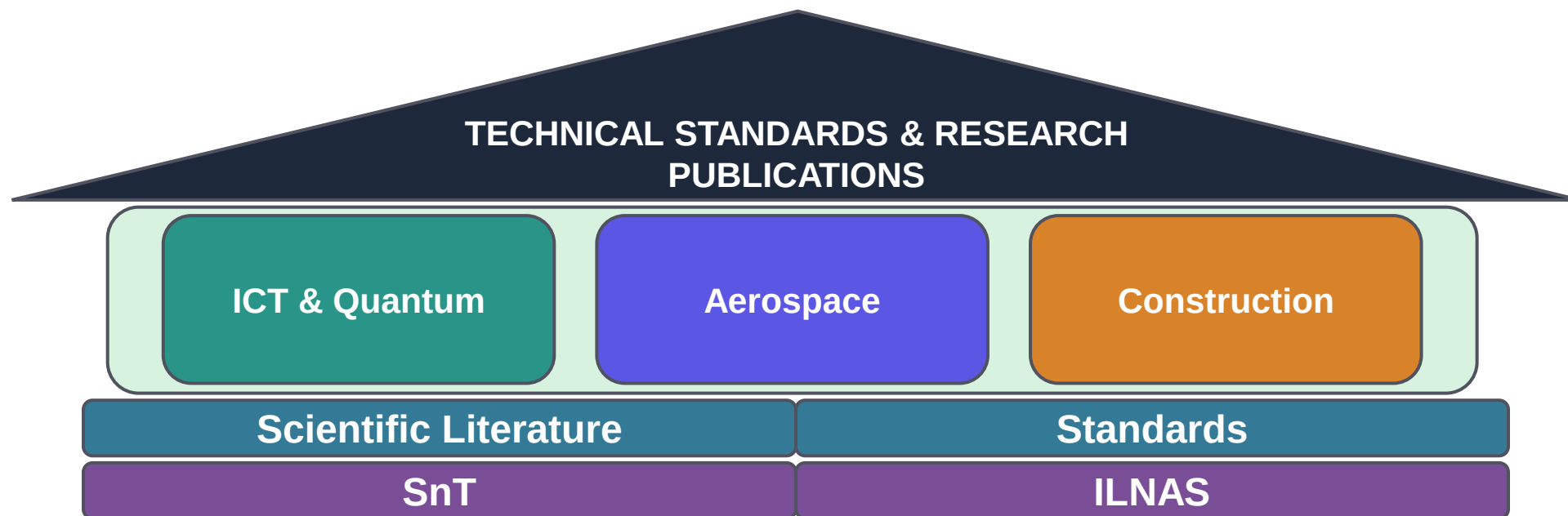
Integrating University research into Technical Committees' activities to shape future standards and contribute to national competitiveness.

Trust

Developing the technical basis for Trustworthy and Sustainable ICT, Space, and Construction systems.

Excellence

Empowering Luxembourg's voice in European and International standardisation using the scientific outcomes of the program researchers.



SnT Team



Prof. Grégoire Danoy

Assistant professor
Principal Investigator
PhD supervision



Prof. Pascal Bouvry

Dean of the Faculty of Science,
Technology and Medicine
PhD supervision



Dr. Cansu Agrali

Research Associate
Project Manager



Simao Cortinhal

Doctoral Researcher on
ICT



Guilhem Honore

Doctoral Researcher on
Aerospace

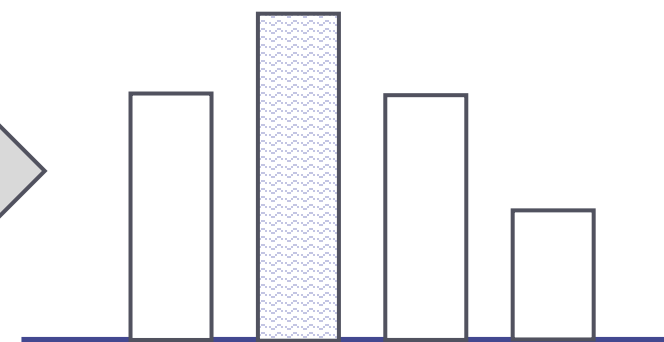
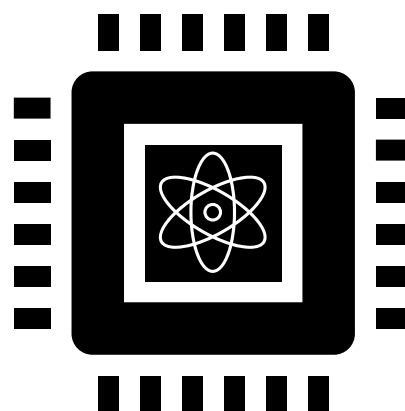
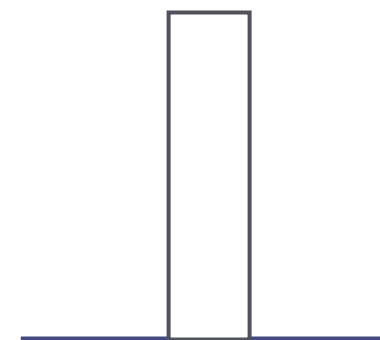
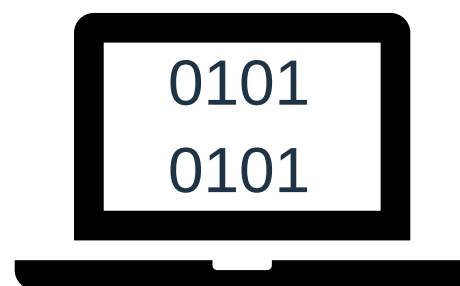
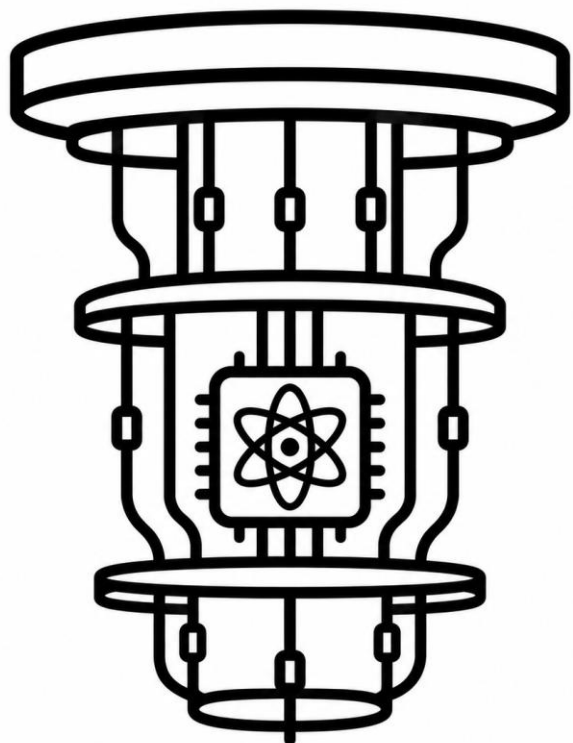


Hakan Hasan

Doctoral Researcher on
Construction

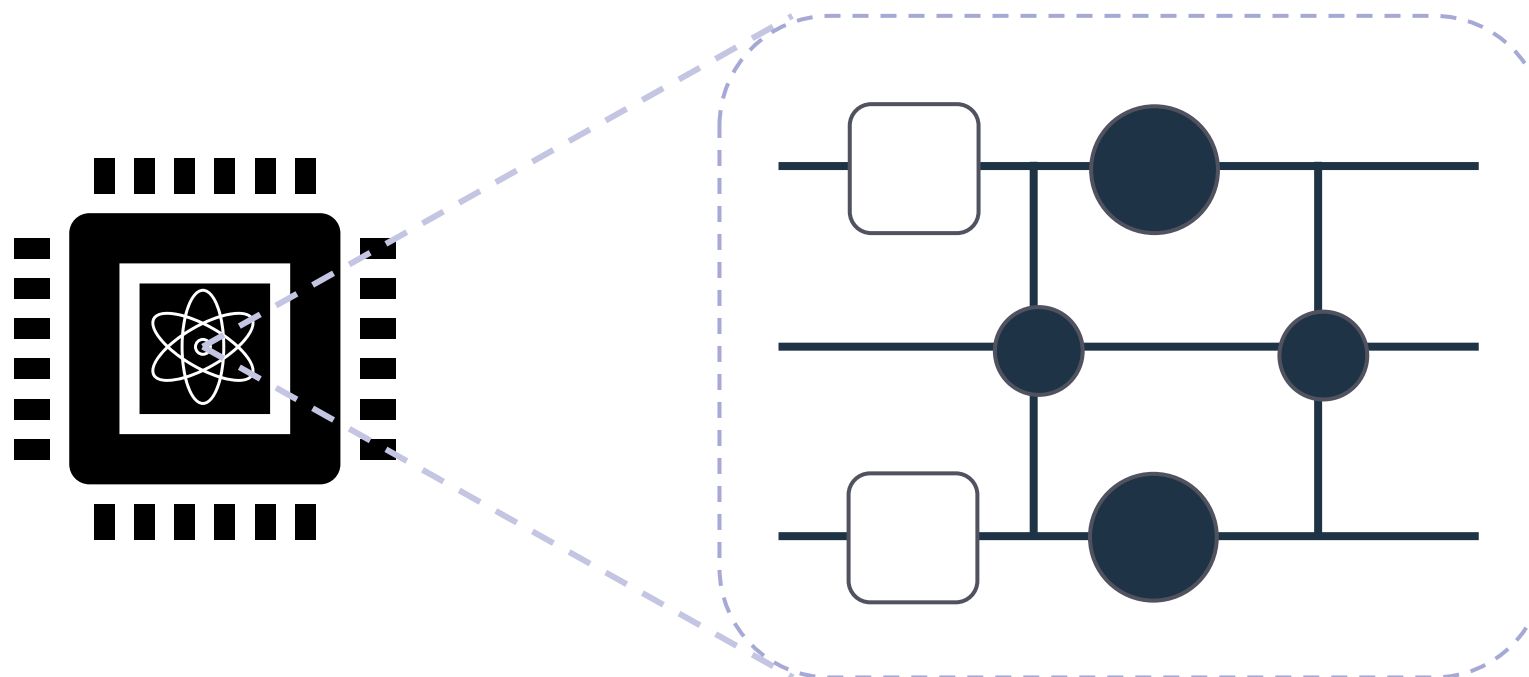
ICT

Quantum Circuit Optimisation



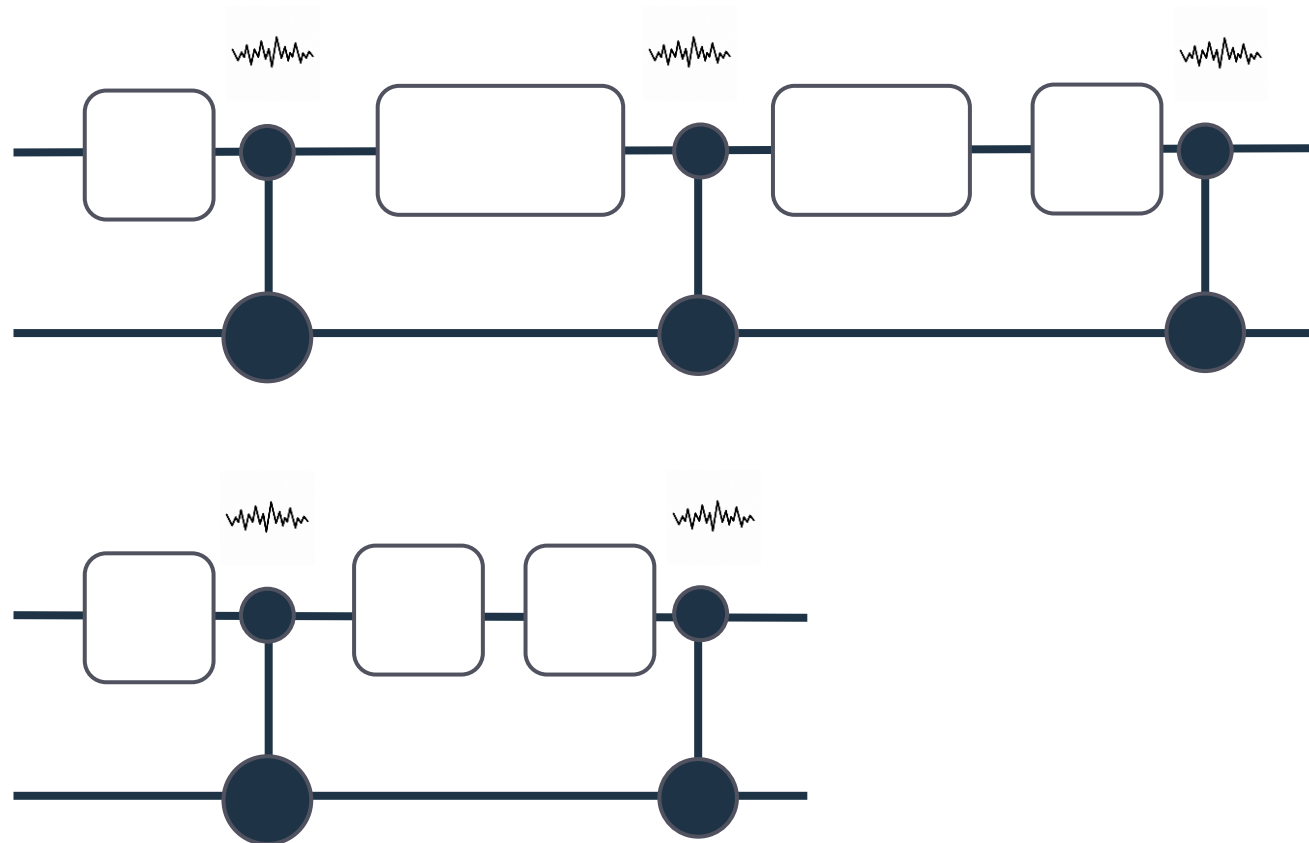
ICT

Quantum Circuit Optimisation



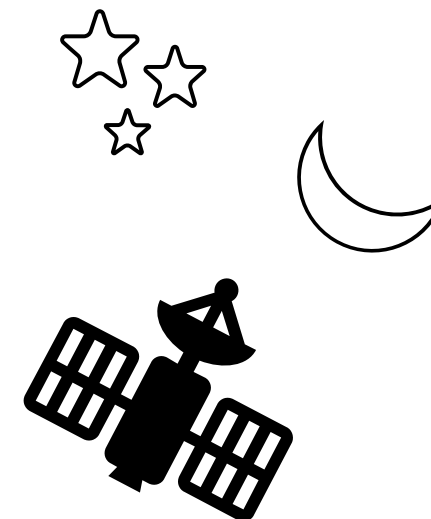
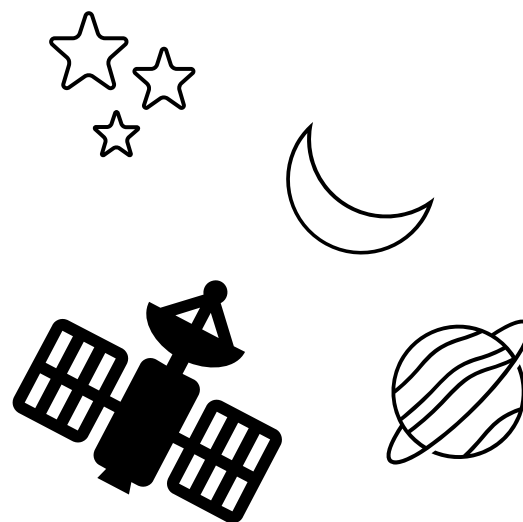
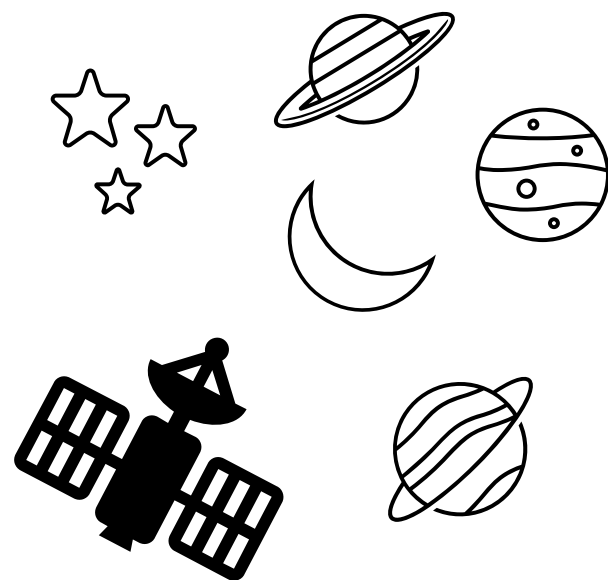
ICT

Quantum Circuit Optimisation



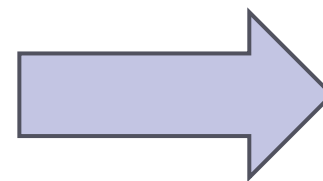
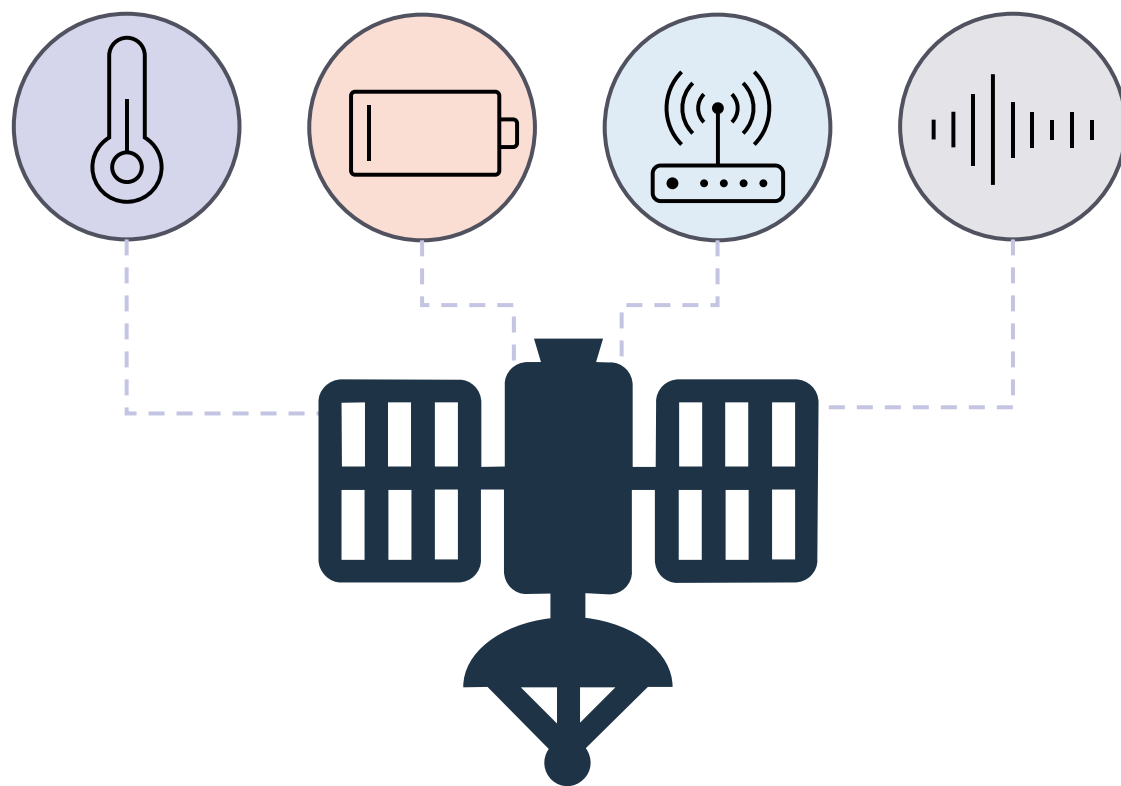
Aerospace

Reinforcement Learning for Satellites



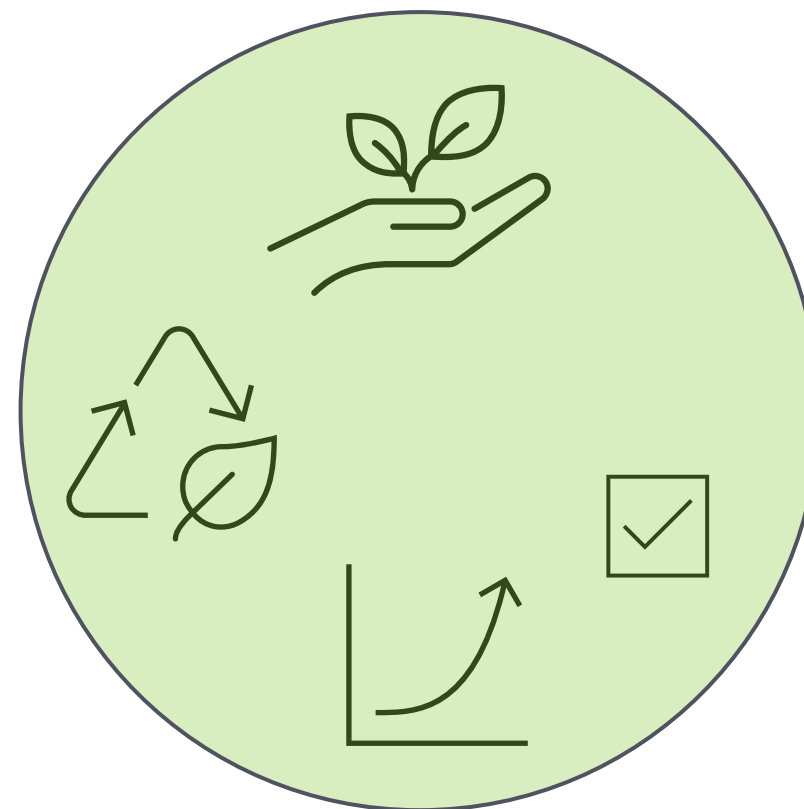
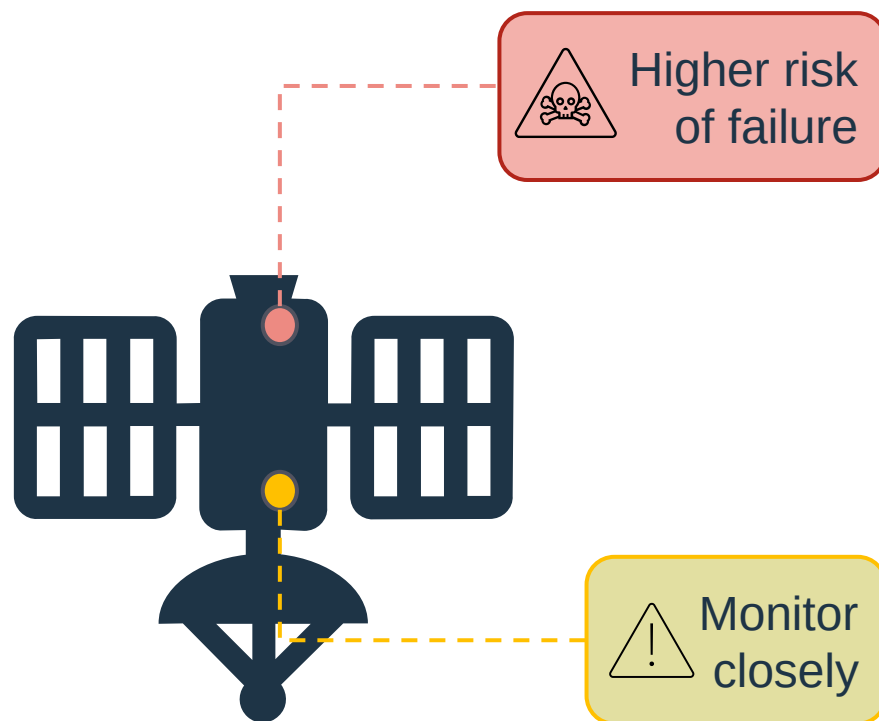
Aerospace

Reinforcement Learning for Satellites



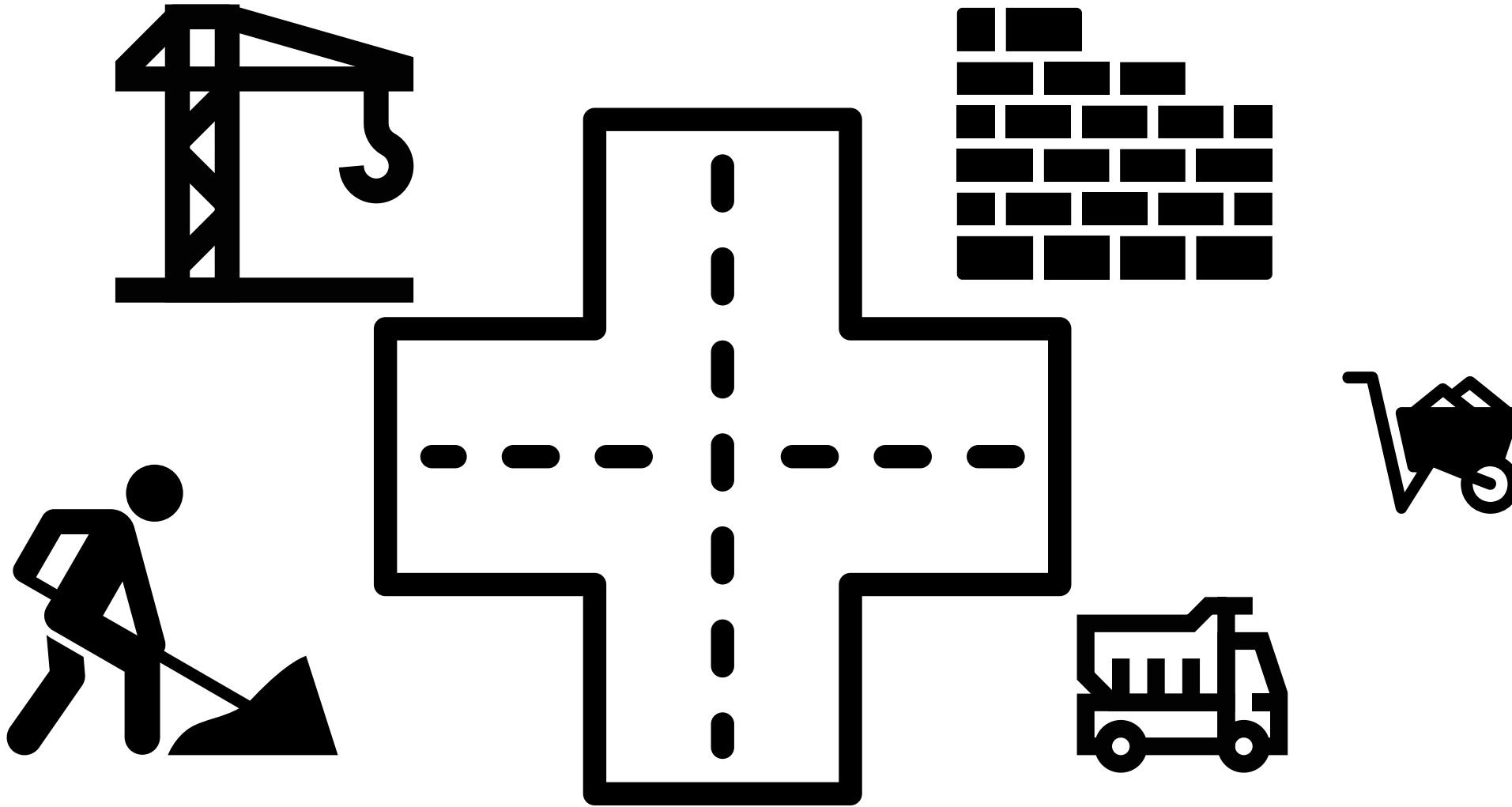
Aerospace

Reinforcement Learning for Satellites



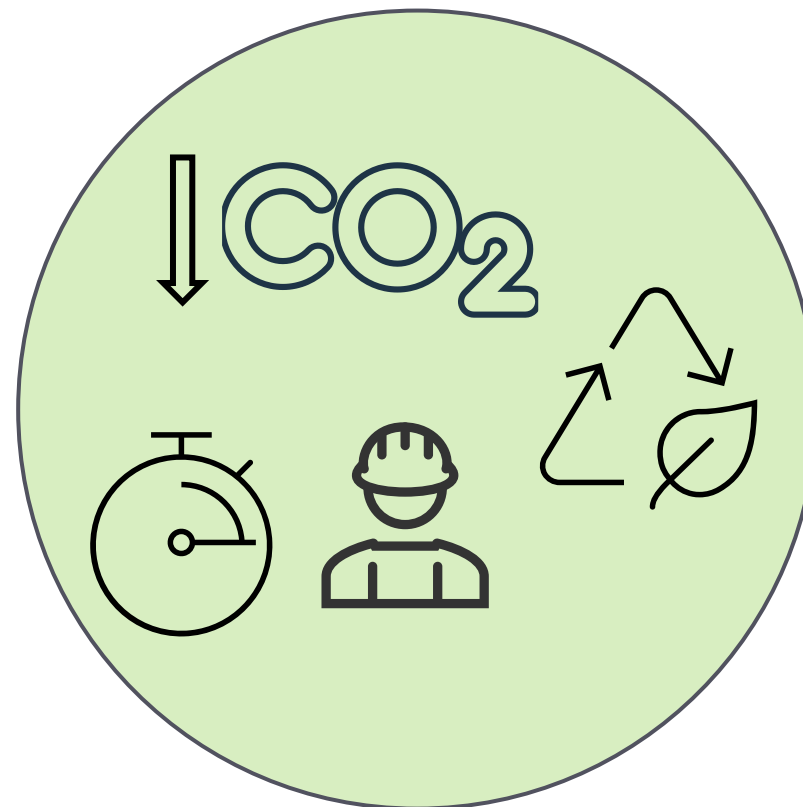
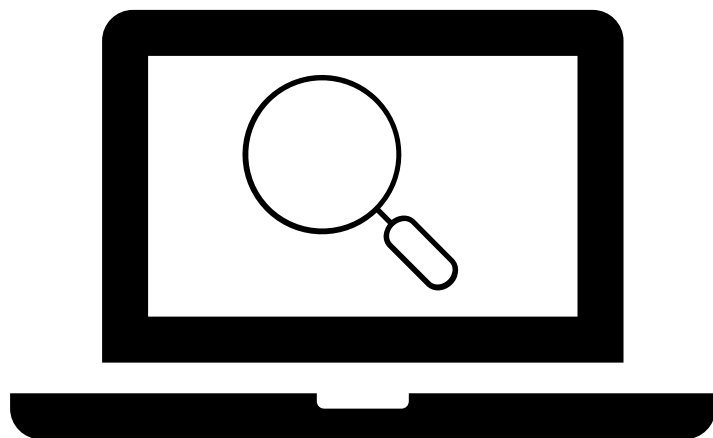
Construction

Construction logistics optimisation



Construction

Construction logistics optimisation



Standardisation Impact

Research expertise translated into active participation in standardisation



3

Domains



3

Researchers



10

Committees

ICT

Simao Cortinhal

- ILNAS/NSC 03 – Quantum Technologies
- CEN/CLC JTC 22 – Quantum Technologies
- IEC/ISO JTC 3 – Quantum Technologies

Aerospace

Guilhem Honore

- ILNAS/NSC 06 – Space
- CEN/CLC/JTC 5 – Space
- ISO/TC 20/SC 14 – Space systems and operations

Construction

Hakan Hasan

- ISO/TC 59/SC 13 – Organization and digitization of information about buildings and civil engineering works, including building information modelling

ILNAS/NSC 04 – Artificial Intelligence
CEN/CLC JTC 21 – Artificial Intelligence
ISO/IEC JTC 1/SC 42 – Artificial Intelligence

Thanks!

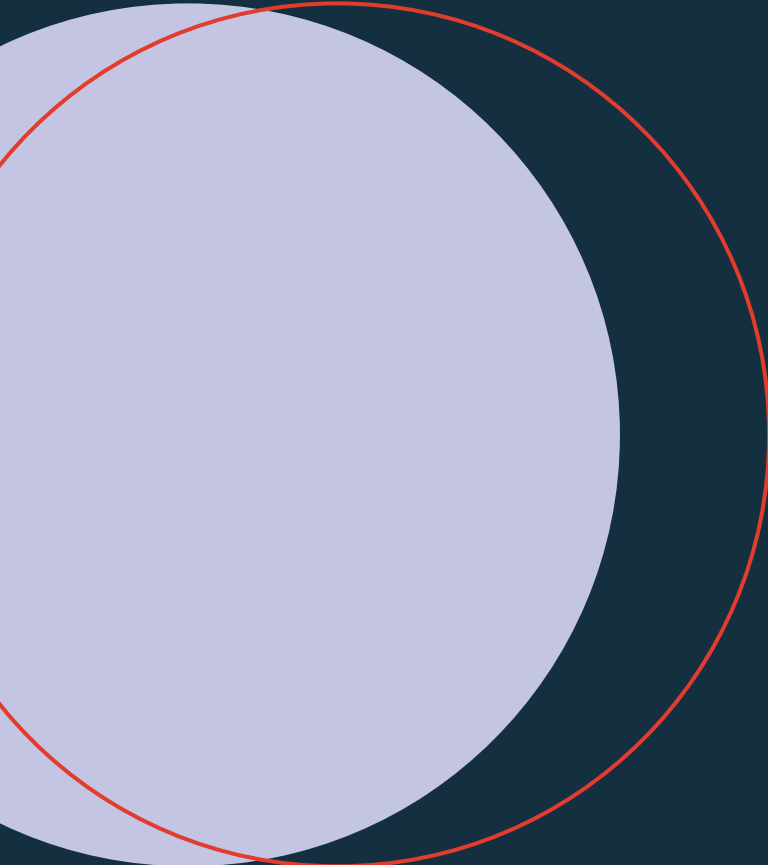
Contact



Cansu Agrali
Research Associate
cansu.agrali@uni.lu

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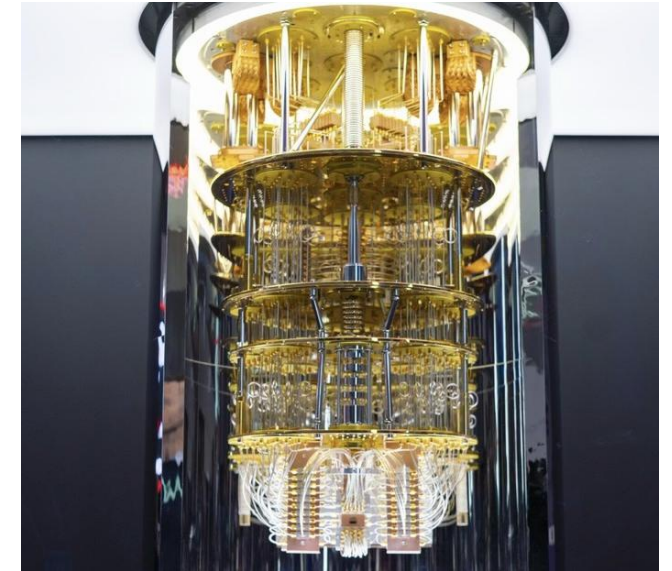
Quantum circuit optimisation with evolutionary algorithms

Simao CORTINHAL

PhD Student (ILNAS/SnT - ICT & Quantum)
University of Luxembourg

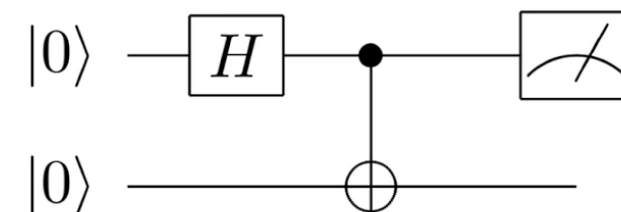
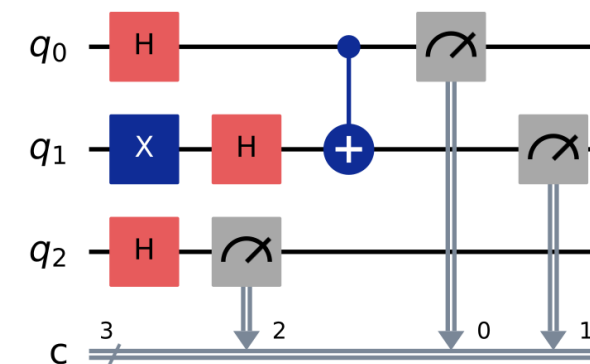
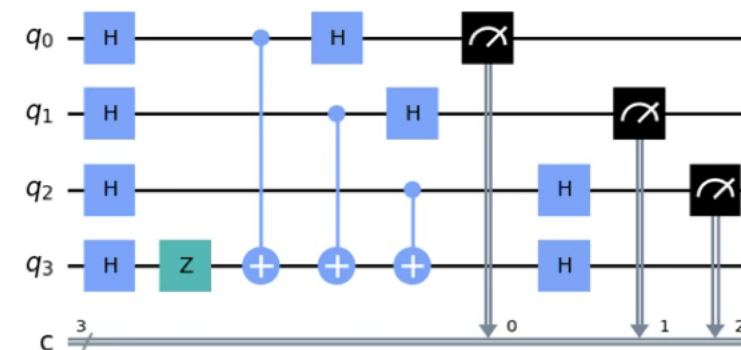
Foundations of Quantum computing

- A new **computational paradigm**
- Rules of classical physics break down:
 - **Superposition**
 - **Entanglement**
- Computational resources
- Solve **specific problems**
 - Molecular & material simulation
 - Cryptography
 - Optimisation, machine learning, chemistry
- Algorithm → **Quantum circuit**



Quantum circuits

- Standard visual formalism
- Qubit timeline
- Symbols across wires → **Gates**
- **Metrics :**
 - Depth
 - Gate count
 - 2-qubit gate count



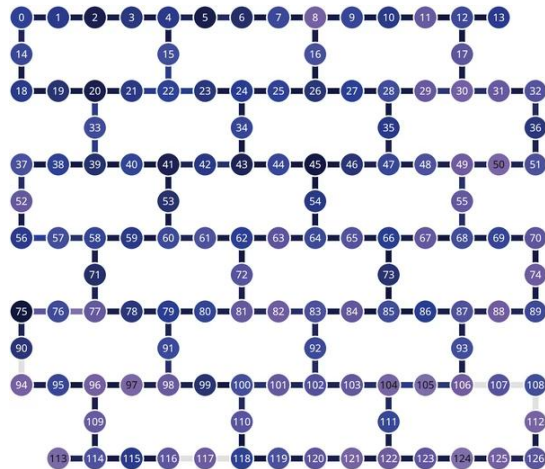
Limitations

Noisy Intermediate-Scale Quantum

- Sensitive to external disturbances
 - Decoherence
 - Gate errors
- Hardware
 - Grid
 - Qubit count

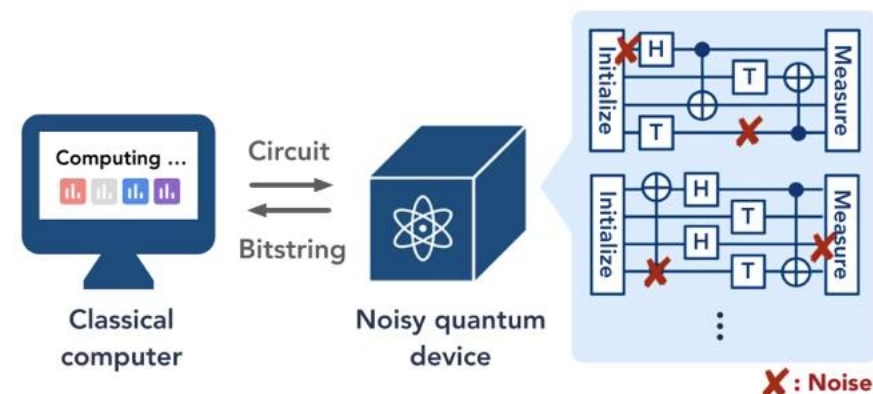
Consequences

- Incorrect output
- Depth Limit
- Exponential Fidelity Decay



Towards Trustworthy Quantum Computing

- Quantum computers are **noisy**
→ results can be wrong
- **Outputs are** probabilistic
→ same circuit - different answers
- Large circuits can't be checked classically
→ **hard to verify**
- Trust requires: **reliable, verifiable, reproducible**

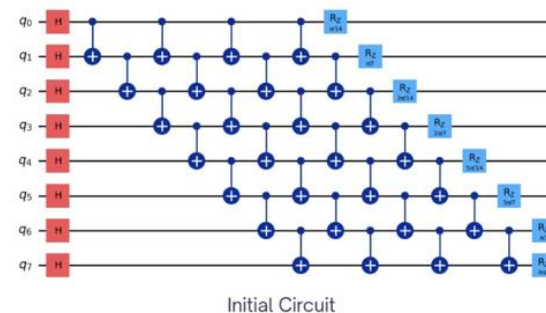


Optimisation

- **Reduce depth**
 - Shorter execution
 - Less time for decoherence
- **Reduce gate count**
 - Every gate adds error
 - 2-qubit gates (more error-prone)
- **Preserve fidelity**
 - Must produce the correct result

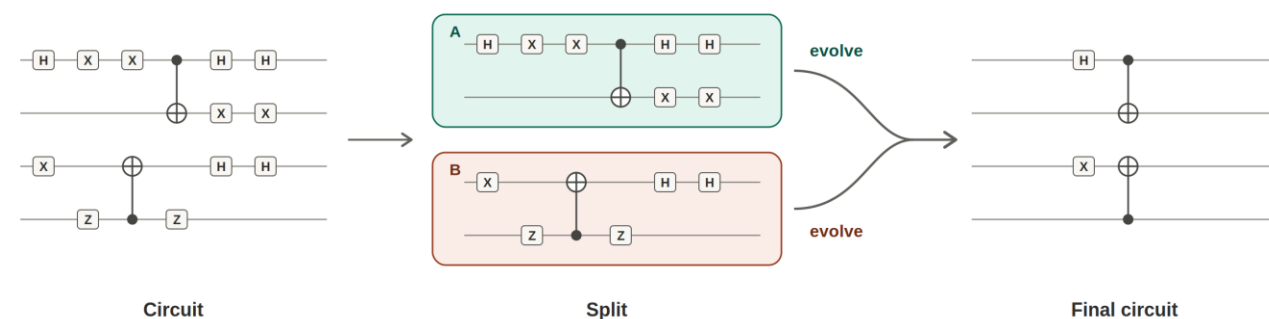
Evolutionary Algorithms

- Inspired by **natural evolution**
- Generate many different circuits
- Keep the **best ones**
- **Combine** and slightly **modify** them
- **Repeat** → circuits improve generation after generation



Decomposition

- **Problem:** large circuits
→ **too costly to evaluate**
 - **Split** the circuit into **smaller pieces**
 - Each piece evolves with its **own population**
 - **Pieces cooperate** to build the full circuit
- **Scales to larger circuits**

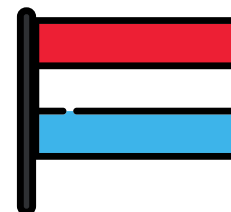


Standardisation committees



European & International Level

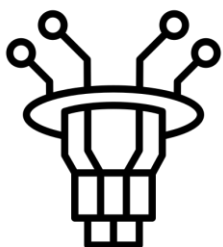
- **CEN/CLC JTC 22** – Quantum Technologies
- **CEN/CLC JTC 22 /WG 3** – Quantum Computing and Simulation
- **IEC/ISO JTC 3** – Quantum Technologies
- **IEC/ISO JTC 1/SC 42** – Artificial Intelligence



National Level

- **ILNAS/NSC 03** – Quantum Technologies
- **ILNAS/NSC 04** – Artificial Intelligence

Standardisation documents



- **CEN/CLC/JTC 22/WG 3** – prEN 16470 – *Hybridization of Quantum Computing* (Draft, v7 - 2026-09-03)
 - Hybrid quantum-classical **architecture & interfaces**
- **CEN/CLC/JTC 22/WG 3** – EAS 18433:2026 *Quantum Computing – High-Level Programming Language* (2026-05-30)
 - **High-level QC language** for hybrid algorithms & portability
- **CEN/CLC JTC 22** – *Standardization Roadmap on Quantum Technologies* (1.1 - June 2025)



Interdisciplinary Centre
for Security, Reliability
and Trust



Thanks!

Contact



Simao CORTINHAL

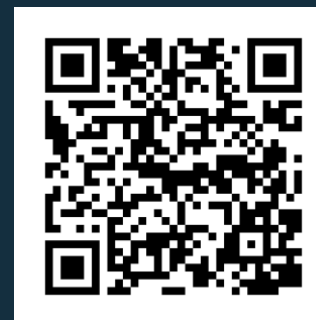
PhD Student

simao.cortinhal@uni.lu

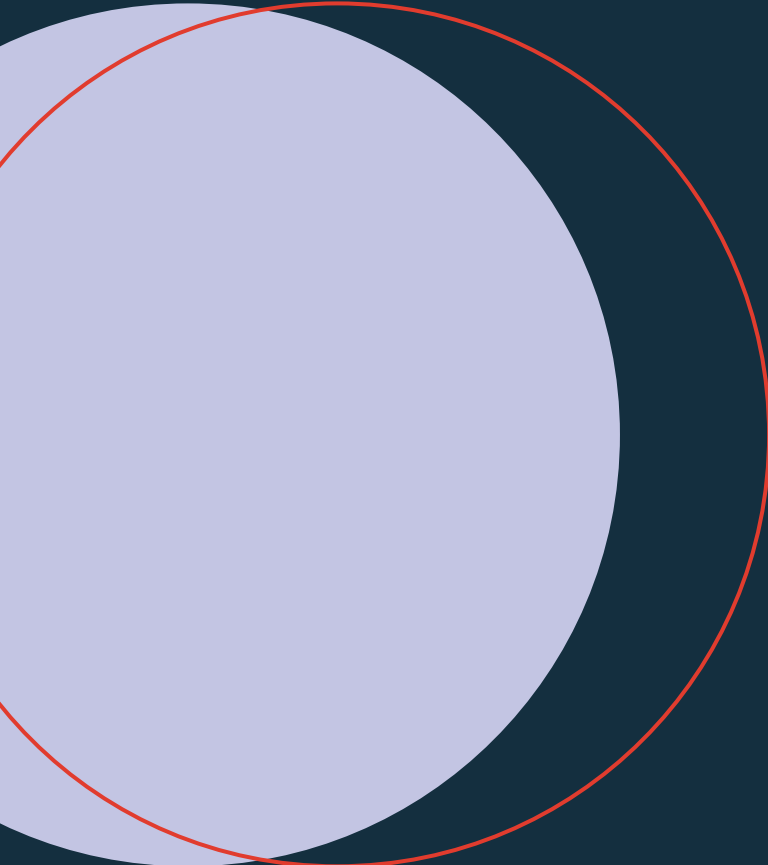
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IILNAS



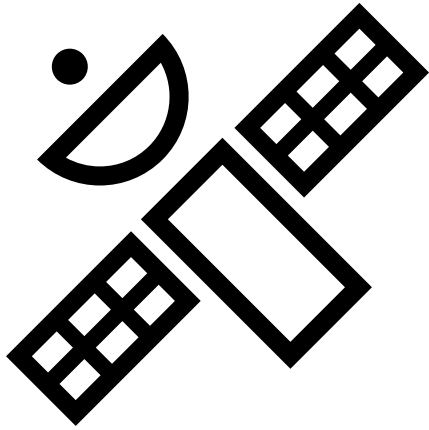
Continual reinforcement learning for satellites

Guilhem HONORE

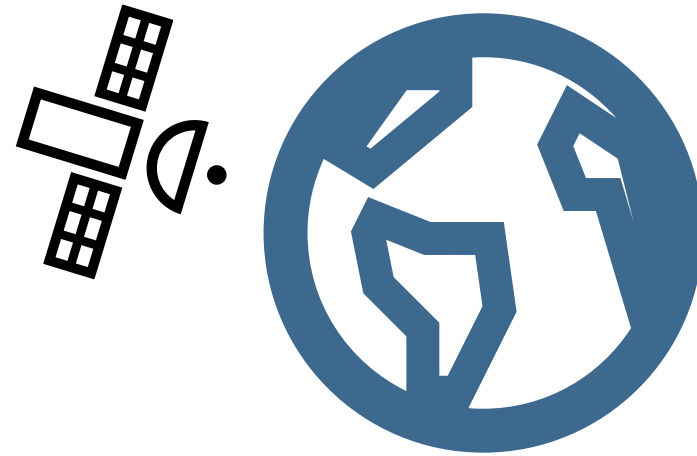
PhD Student (ILNAS/SnT - Aerospace)
University of Luxembourg

The software in a satellite

2 types of in-space operations



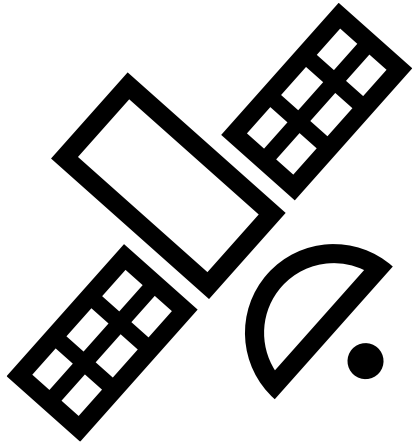
Guidance, Control &
Navigation



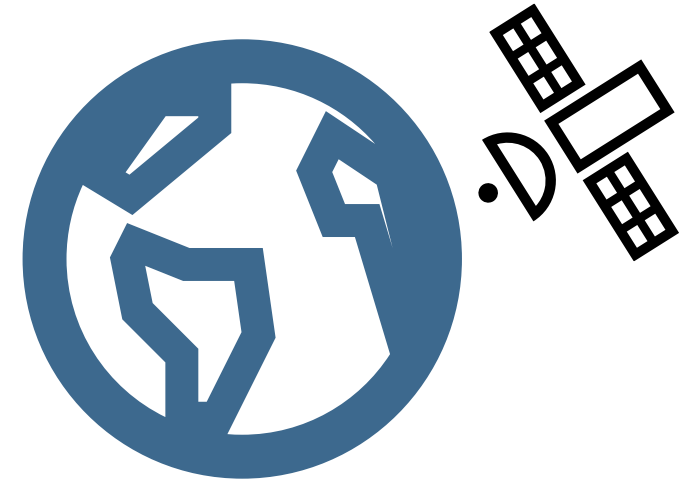
Mission Specific Task

The software in a satellite

2 types of in-space operations

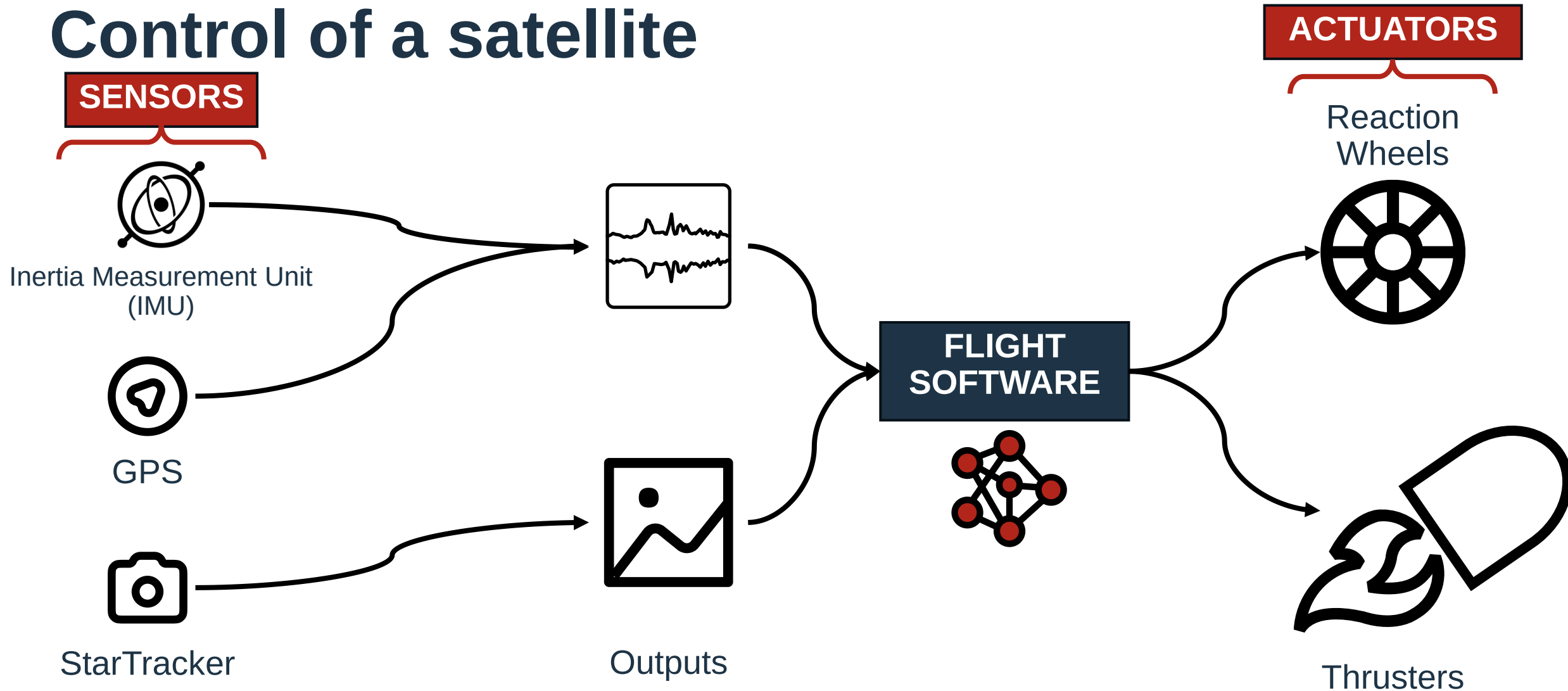


Guidance, Control &
Navigation

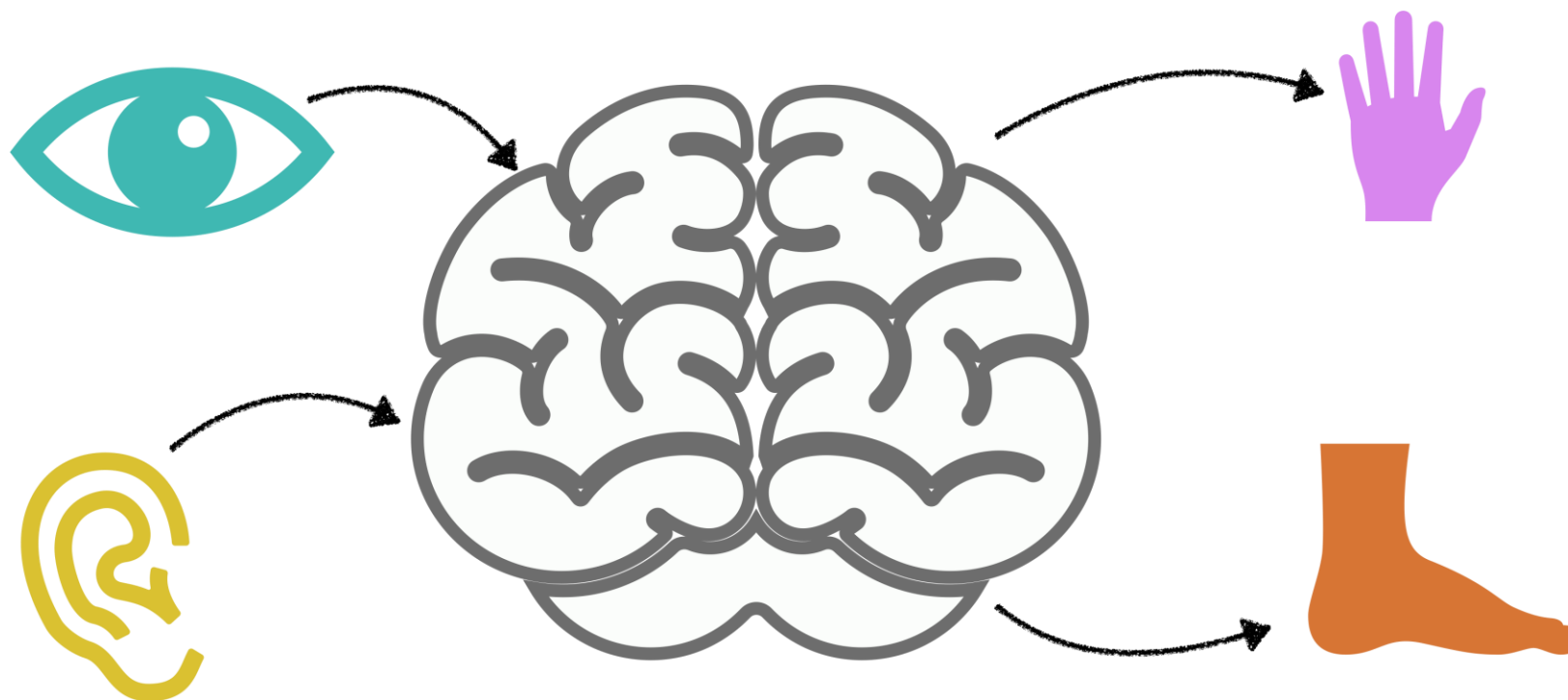


Mission Specific Task

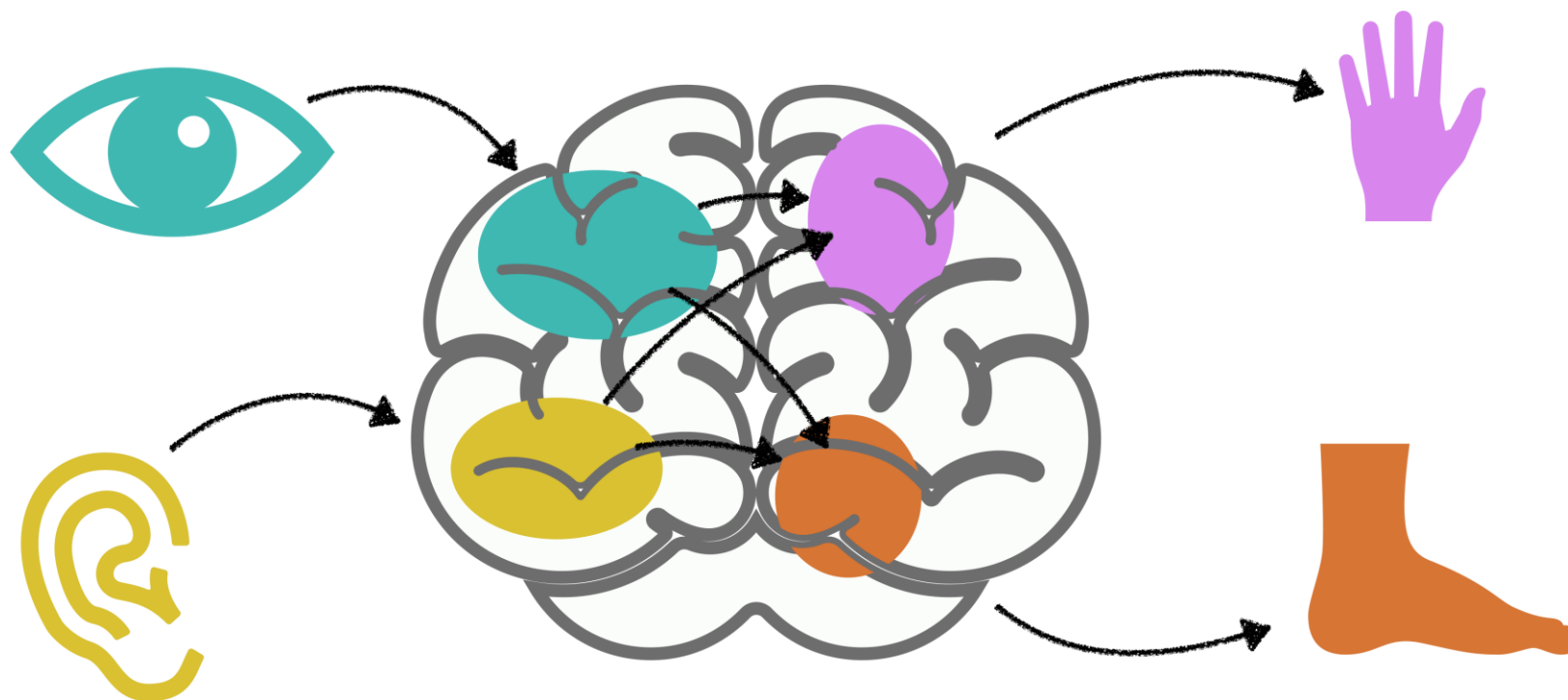
Control of a satellite



Introducing modularity for machine learning

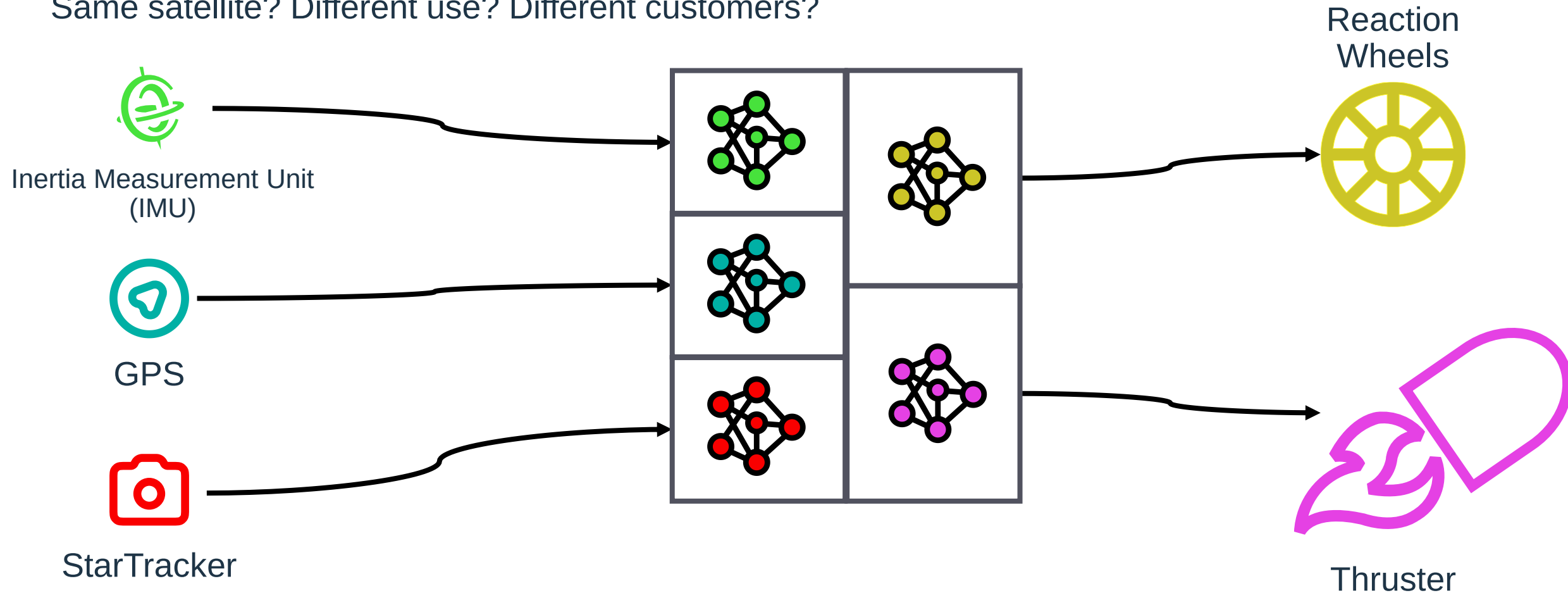


Introducing modularity for machine learning



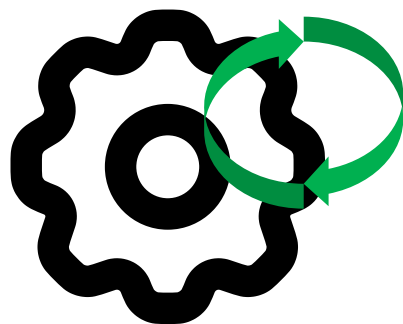
Control of a satellite

Same satellite? Different use? Different customers?

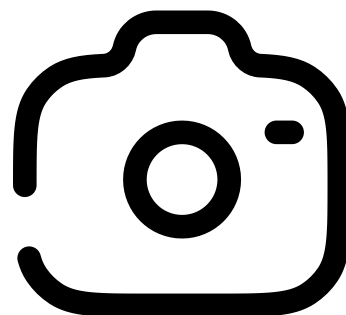


Use cases

From an experimental framework to tackling the real challenges of the space industry



**Spacecraft attitude
determination and control**



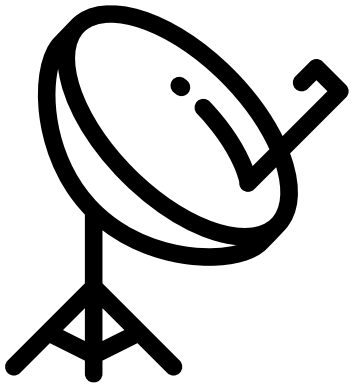
Earth Observation



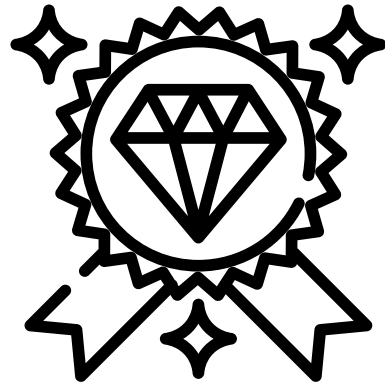
Satellites Radio Networks

Machine learning in outer space

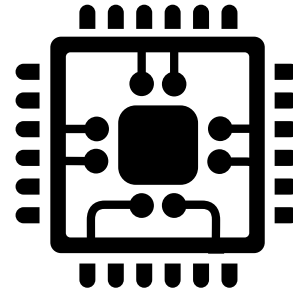
The main challenges of onboard and life-long learning



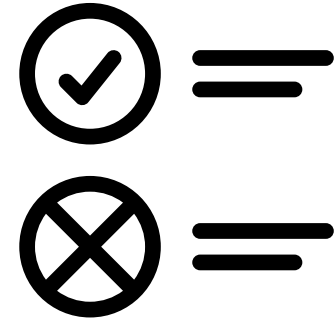
Data Availability



Data Quality



Hardware
Acceleration



Standardisation &
Quality

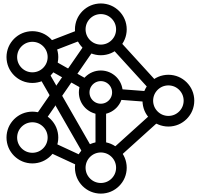
Standardisation committees

Bringing my research into the standardisation world



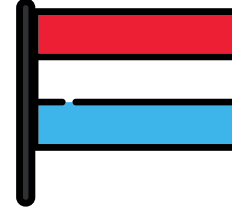
Space standardisation committee

- ISO/TC 20/SC 14 – Space systems and operations
- CEN/CLC JTC 5 – Space



AI standardisation committee

- ISO/IEC JTC 1/SC 42 – Artificial intelligence



National commission

- ILNAS/NSC 06 – Space

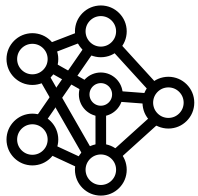
Standards

Bringing my research into the standardisation world



Space standards

- ISO 21442:2022 – *Space systems* – General requirements for control engineering
- ECSS-E-HB-40-02A – Machine learning handbook



AI standardisation committee

- ISO/IEC 25059 – *Software engineering* — Systems and software Quality Requirements and Evaluation (SQuaRE) — Quality model for AI systems



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Thanks!

Contact



Guilhem Honore

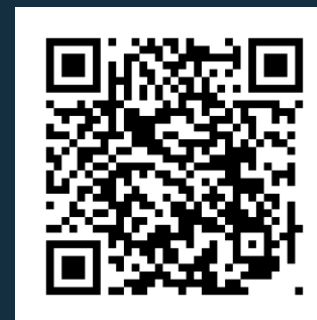
PhD Student

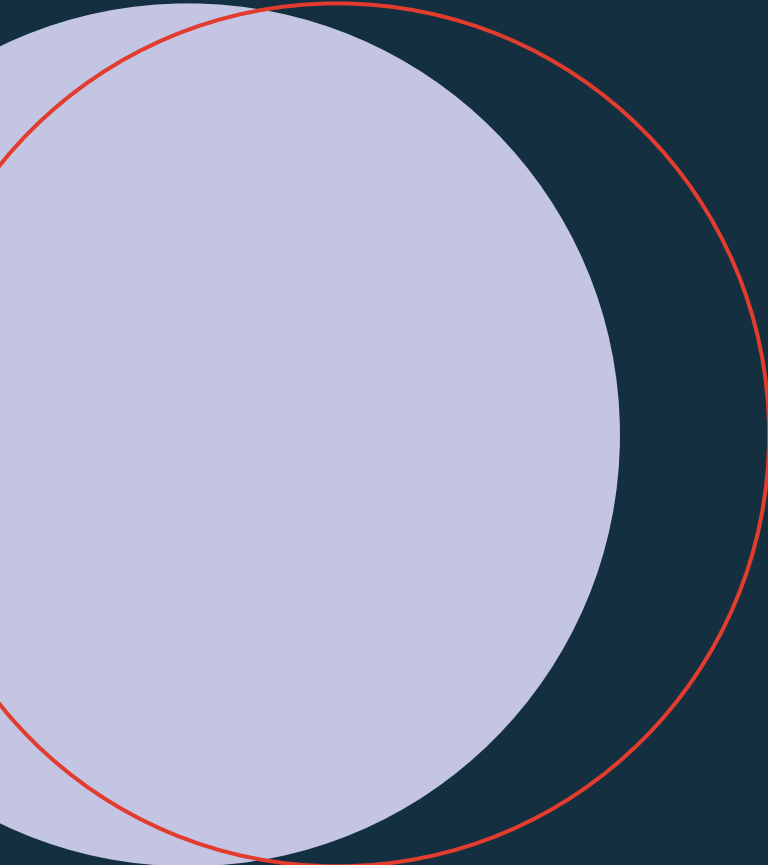
guilhem.honore@uni.lu

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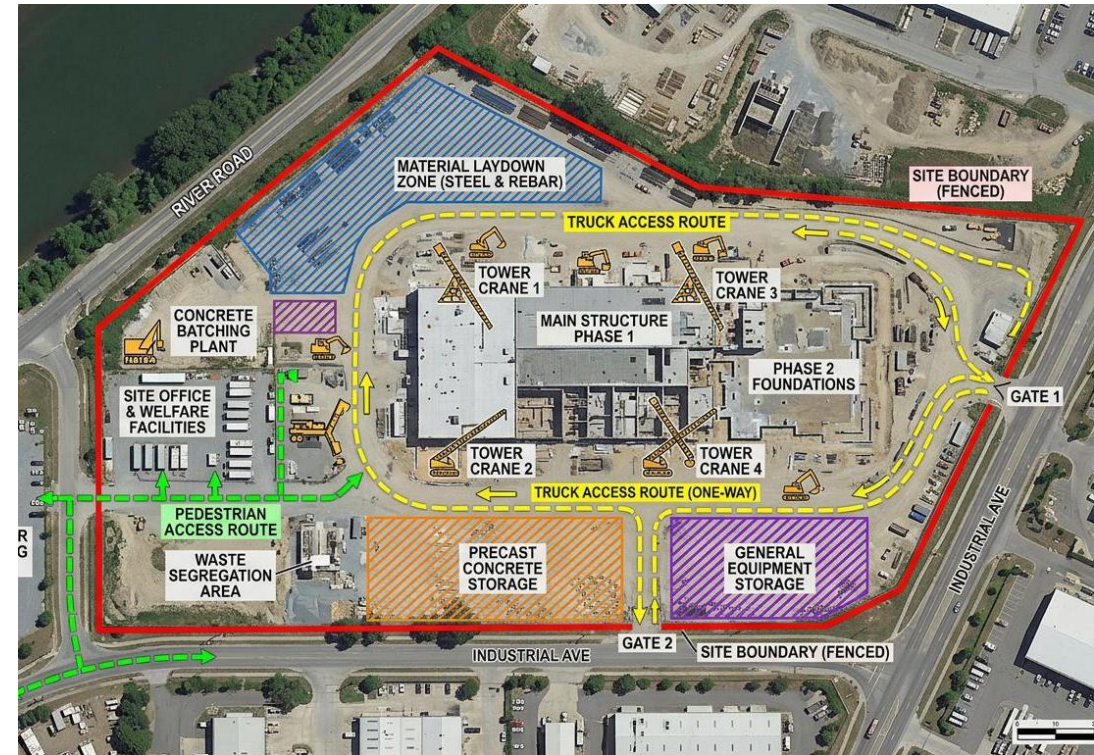
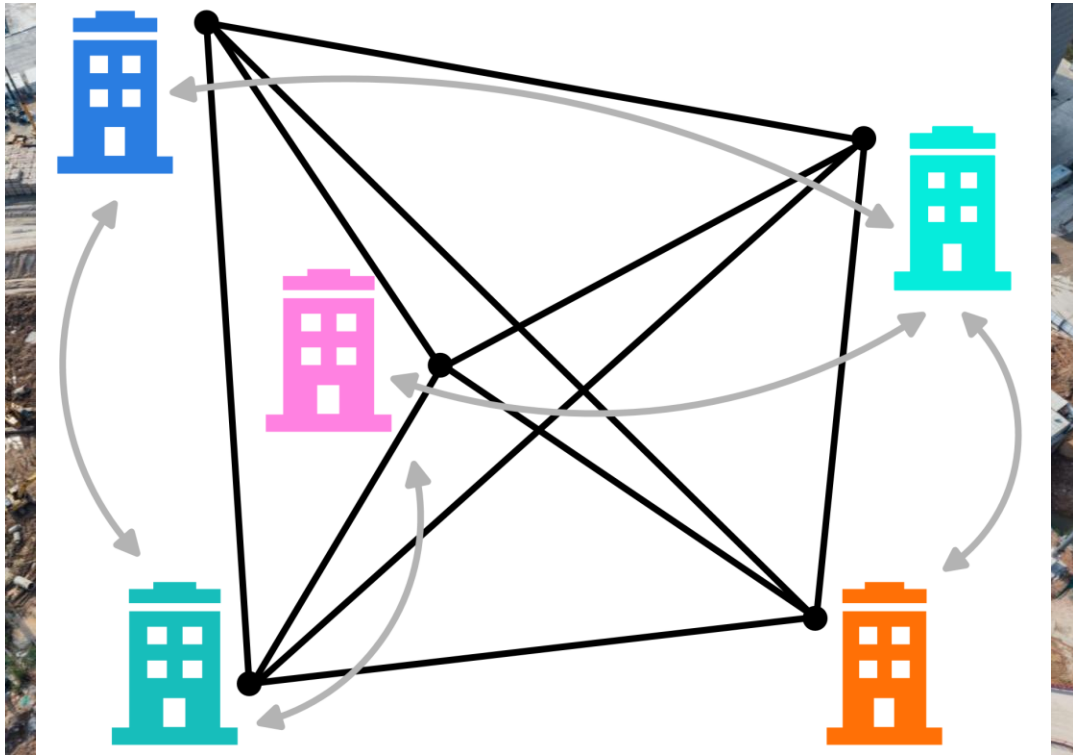
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Construction logistics optimisation with constraint programming

Hakan HASAN

PhD Student (ILNAS/SnT – Construction)
University of Luxembourg

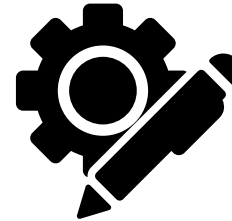
A building site is a logistics system



Challenges



- *Distance → Minimise unnecessary travel and movement.*



- *Resources → Optimise the use of space and limited resources.*

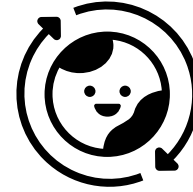


- *Cost → Reduce overall operational cost.*

Sustainability Impacts



- *Reduce environmental impact → lower fuel consumption, energy use and CO₂ emissions.*



- *Optimise resource & waste flows → less material handling, waste transport and site congestion.*

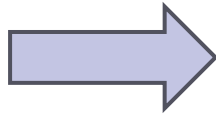


- *Improve site safety & wellbeing → reduced safety risks and exposure.*

Constraint Programming

Constraint programming (CP) is about modelling and solving problems under constraints.

Construction
site



```

australia.mzn
+
include "nvalue.nmzn";

enum REGION = { WA, NT, SA, Q, NSW, V, T };
enum COLOR = color(1..card(REGION));

% Neighboring regions
array [_] of tuple(REGION, REGION): neighbors = [
  (WA, NT),
  (WA, SA),
  (NT, SA),
  (NT, Q),
  (SA, Q),
  (SA, NSW),
  (SA, V),
  (Q, NSW),
  (NSW, V)
];

% Color of each Region
array [REGION] of var COLOR: color;
% Number of colors used
var 1..card(COLOR): n_colors :: output = nvalue(color);

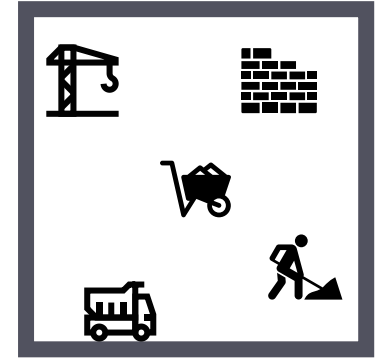
% Neighboring regions have different colours
constraint forall (pair in neighbors)
  (color[pair.1] != color[pair.2]);

% Use as few colors as possible
solve minimize n_colors;
  
```



```

▼ Running australia.mzn
color = [WA: Color(3), NT: Color(2), SA:
Color(1), Q: Color(3), NSW: Color(2), V:
Color(3), T: Color(1)];
n_colors = 3;
=====
Finished in 177msec.
  
```



Define
the problem

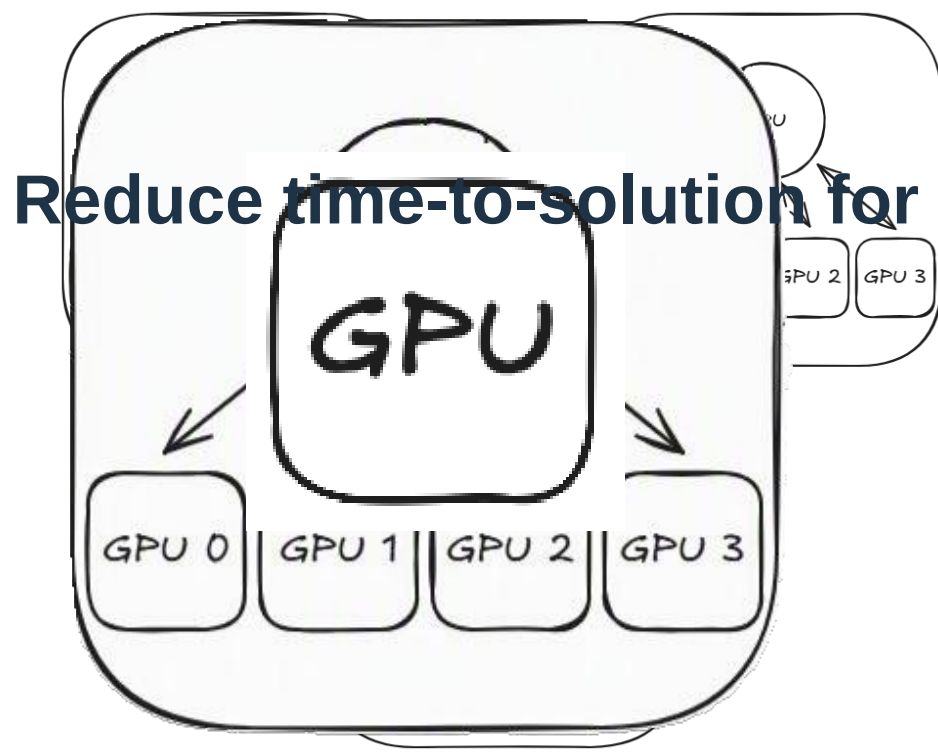
Build
the model

Solve the model

Apply the solution

Distributed Constraint Solving

Reduce time-to-solution for large optimisation problems

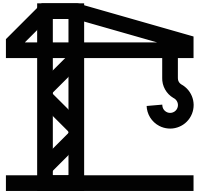


Implementation of the first multi-GPU constraint solver.

One optimisation problem → multiple parallel search processes.

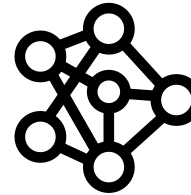
Share solutions to guide the search.

Standardisation committees



Construction standardisation committee

- **ISO/TC 59/SC 13** – Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)



AI standardisation committee

- **ISO/IEC JTC 1/SC 42** – *Artificial intelligence*

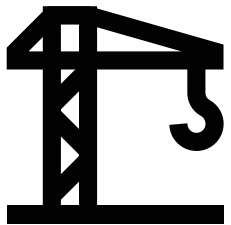
Standardisation documents

Bringing my research into the standardisation world



Sustainability standards

- **ISO/TS 12720:2024** – Sustainability in buildings and civil engineering works — Guidelines on the application of the general principles in ISO 15392
- **ISO 14083:2023** – Greenhouse gases — Quantification and reporting of greenhouse gas emissions arising from transport chain operations



Construction standards

- **ISO 16739-1:2024** – Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries



Thanks!

Contact



Hakan Hasan

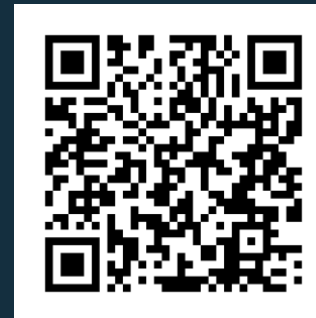
PhD Student

hakan.hasan@uni.lu

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Remise du trophée
« **Délégué(e) National(e) en Normalisation 2026** »



Lauréat(e) 2026

Quelques indices...

PhD in
Chemistry

**Free University
Berlin**
Germany

Head of Quality
Management

**Clinical Research
Organisation**
France

GCP, GLP

Head of Quality
Management

**Luxembourg
Institute of Health**
Luxembourg

ISO 9001, ISO 17025,
ISO 20387, GCP...

Head of Incoming Goods
Quality Control

Diagnostics Industrie
Germany

GMP, ISO 9001

Head of Quality
Management

**Integrated BioBank
of Luxembourg**
Luxembourg

ISO 9001, ISO 17025

Project co-leader

**ISO/TC 276/WG 2
Creation & Revision
of ISO 20387**

*Biobanking – General
Requirements for
Biobanks*

Lauréate 2026

Quelques indices...

Elle a travaillé dans l'unité d'assurance qualité de BRAHMS Diagnostica en Allemagne où **elle a contribué à la certification initiale ISO 9001 en 1992**

Entre 2000 et 2010, elle a travaillé chez PAREXEL en France dans une organisation soumise aux « **Bonnes Pratiques Clinique (GCP)** » et « **Bonnes Pratiques Laboratoires (GLP)** ».

Elle est venue s'installer au Luxembourg en 2010. En tant que responsable qualité de l'IBBL (Integrated Biobank of Luxembourg) **elle a mis en place le système de qualité selon les normes ISO 9001 et ISO 17025. Les certifications et accréditations correspondantes ont été obtenues en 2014 et 2016.** Depuis 2015, l'IBBL fait partie du LIH (Luxembourg Institute of Health). **En 2026, l'accréditation selon ISO 20387 a été atteinte.**

Son implication dans la normalisation technique en tant qu'experte luxembourgeoise débute en 2013. Parmi ses réalisations majeures figure sa contribution active, en qualité de co-responsable de projet, à l'élaboration et à la mise à jour de la **norme ISO 20387 « Biotechnologie – Biobanking – Exigences générales relatives au biobanking »**.

Aujourd'hui, elle apporte son expertise et suit les travaux de différents comités techniques de normalisation :

- ISO/TC 276 – Biotechnology - WG2 Biobanking and bioresources & WG4 Bioprocessing for cells and related entities
- ISO/TC 212 – Medical laboratories and in vitro diagnostic systems
- ILNAS/NSC 02 – Conformity [linked to ISO/CASCO – Committee on conformity assessment]
- ILNAS/TC 107 – Sécurité SI laboratoires

Lauréate 2026

Dr. Sabine LEHMANN

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LUXEMBOURG
INSTITUTE
OF HEALTH



Félicitations !

Merci à tou(te)s les expert(e)s impliqué(e)s dans la normalisation technique.

