
CERN

The IT Department Innovation Model

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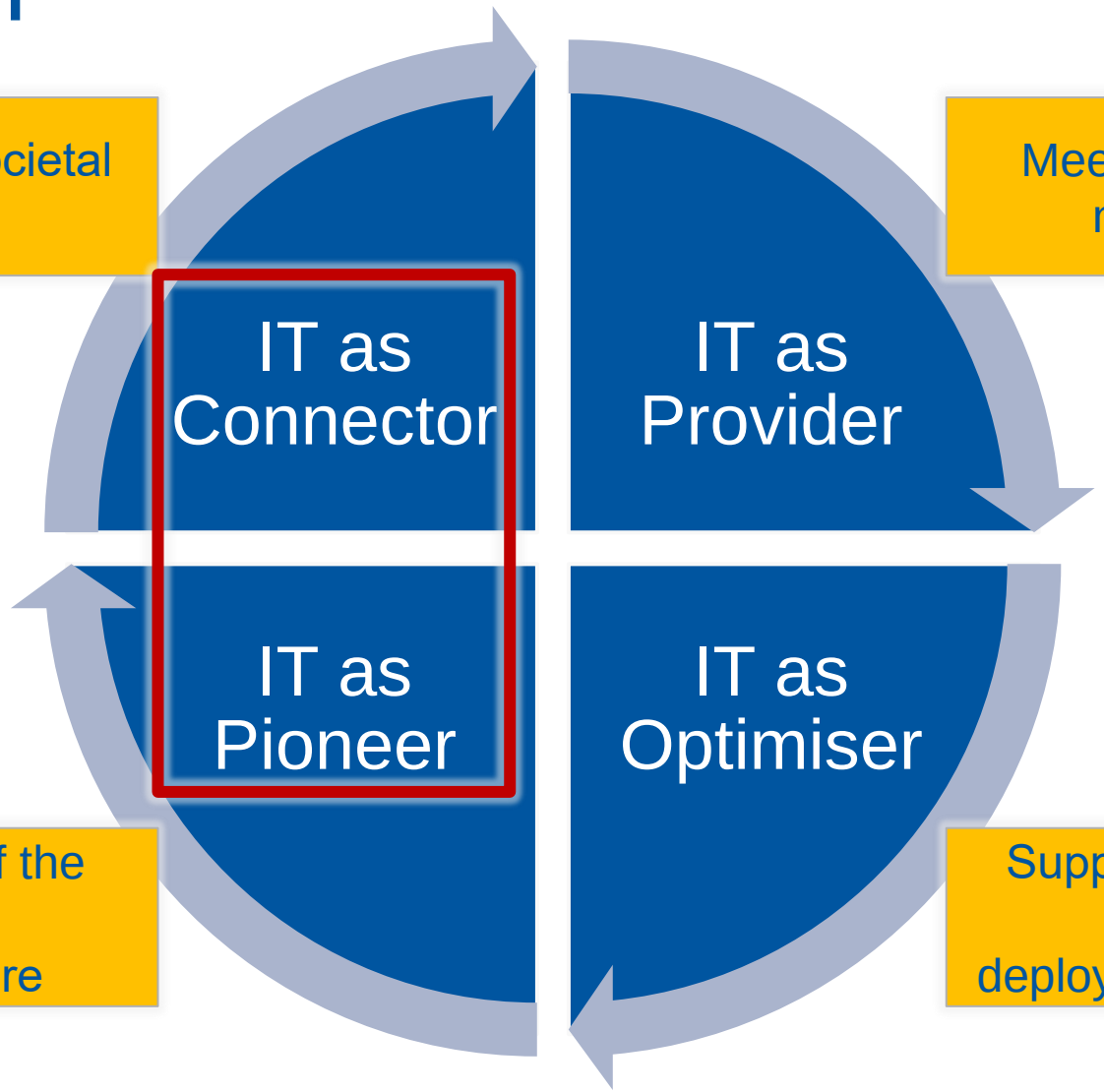
CERN IT Department Core Missions

Increase CERN's scientific, societal and economic impact

Meet the Information Technology needs of the Organization



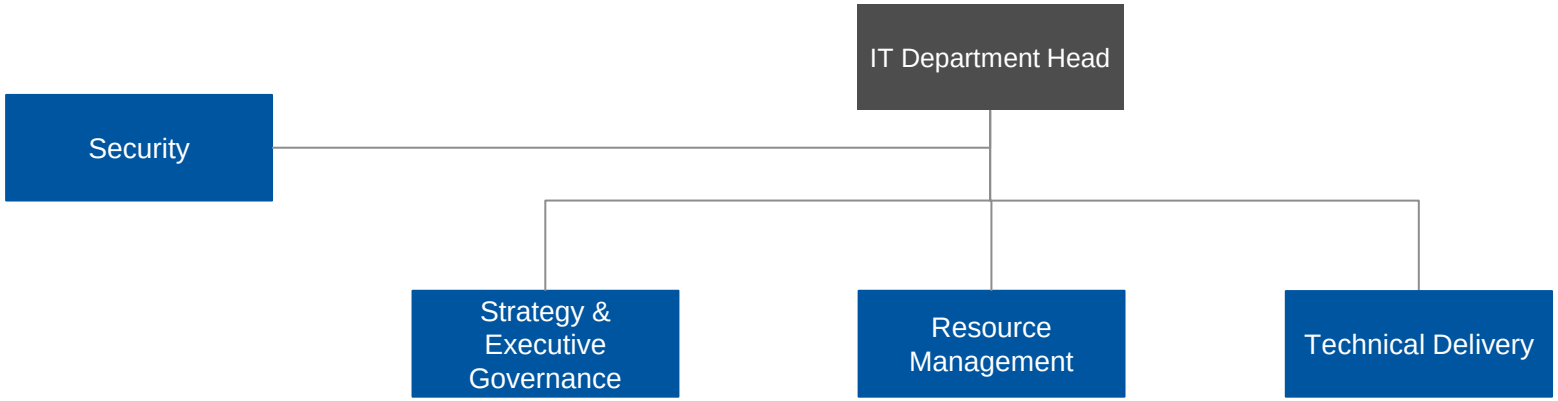
R&D Innovation

Operations Engagement

Prepare for the challenges of the scientific programmes' evolution and the lab's future

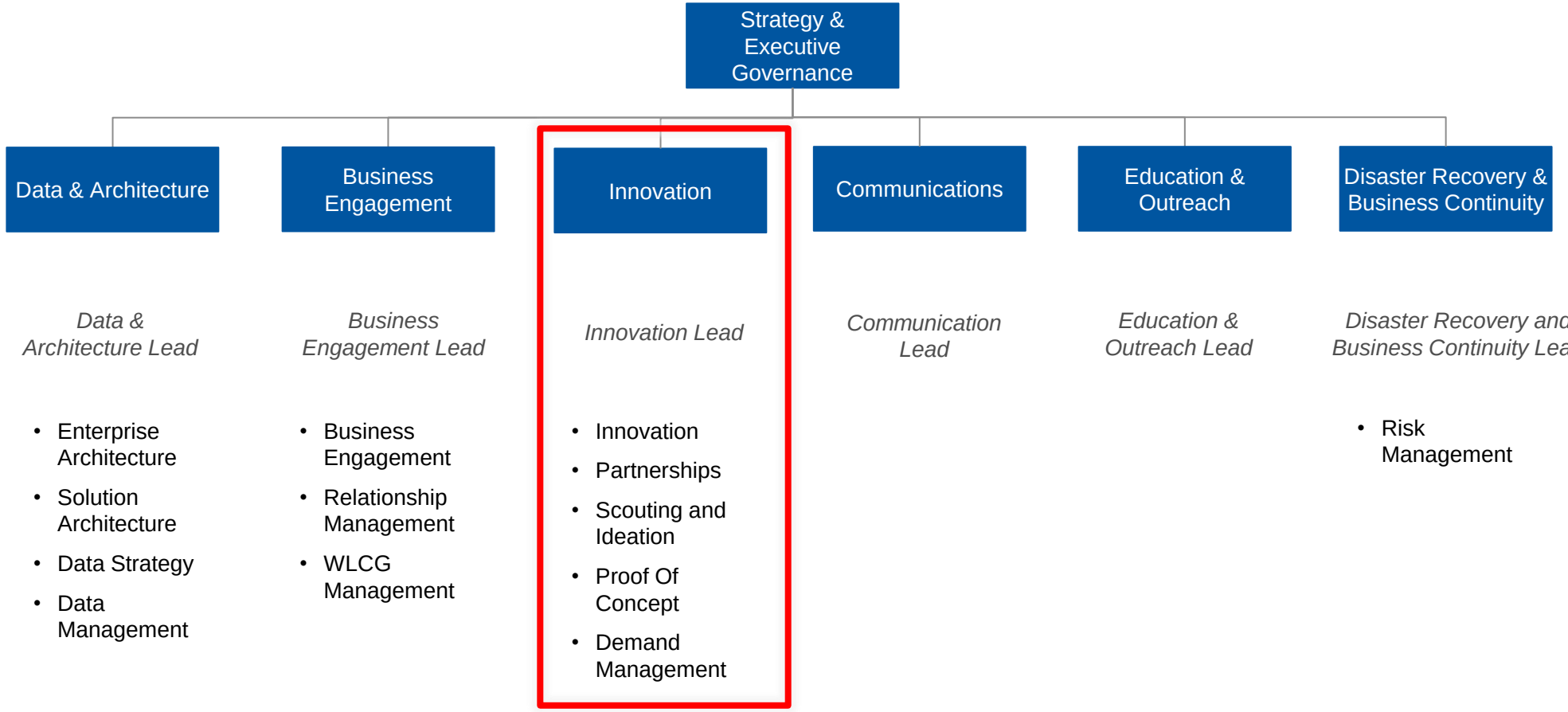
Support CERN's existing scientific programmes by deploying production quality services

IT Department organisational structure



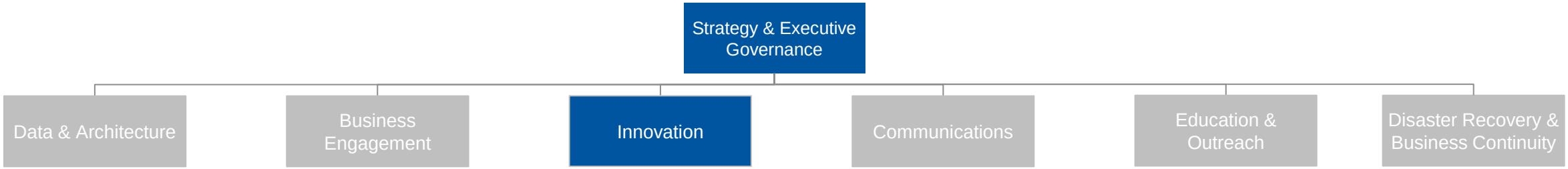
	Strategy & Exec Gov. Lead	Resource Management *Lead*	*Technical Delivery Lead*
Key Capabilities	• Data & Architecture • Business Engagement • Innovation • Education & Outreach • Communications • Risk Management • Disaster Recovery & Business Continuity	• Programme Management • Supplier & Contract Management • Talent Management • Finance & Accounting • Vendor Management • Facilities Management	• Technical Capability Delivery & Development • Technical Capacity Planning & Management • Service Management • Change Management

Strategy & Executive Governance



Innovation: Functional overview

The Innovation function will collaborate closely with Business Engagement to ensure that projects and initiatives are prioritised effectively and delivered in alignment with user needs, the IT strategy, and wider organisational objectives.



KEY ROLES & RESPONSIBILITIES

- Define and iterate the innovation roadmap in line with IT's strategy and objectives
- Ensures internal alignment and complementarity of innovation programmes and activities
- Manage the innovation process to ensure innovation projects align with the roadmap, evaluating the use case of new ideas, and monitoring the execution and results of approved projects
- Collaborate with internal and external stakeholders to progress development of innovative technologies and contribute to CERN's positive impact on society

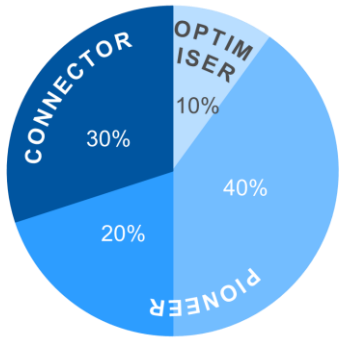
MEASURES OF SUCCESS

- Establishing a clear innovation roadmap and pipeline in line with CERN's mission, IT Strategy and user needs
- Clarity around accountability for innovation and R&D in the IT department
- Streamlined innovation lifecycle through definition of clear approach, stage gates, improved governance and accountability
- Provide a visible pipeline of scale-out opportunities for positive impact on society

KEY CAPABILITIES

Innovation	Partnerships
Scouting and Ideation	Proof Of Concept
Demand Management	Project Management

ROLES FRAMEWORK

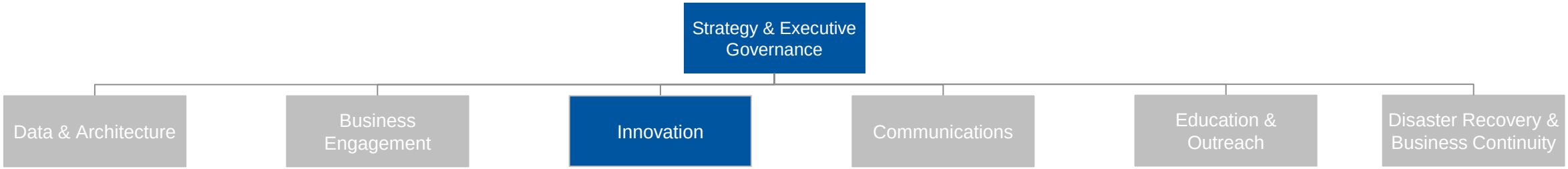


GOVERNANCE STRUCTURES

- Participation in bi-annual dept. off-site & bi-monthly IT steerco
- Chairs monthly innovation review & quarterly ideation meetings
- Participation in business engagement quarterly steerco and technical delivery review quarterly meetings
- Attends the demand management review board and the C&R management board for project proposals and scale-out

Innovation: Organisation structure

A short, medium and long-term innovation roadmap will be defined, with the Innovation Projects Sub-Lead responsible for inward facing initiatives, whilst the R&D Sub-Lead will engage with external partners to deliver outward facing initiatives.



Innovation Lead

- Collaborates with Functional Leads to define innovation roadmap in line with the IT strategy, CERN objectives and user needs
- Oversees all R&D and innovation initiatives and programmes, ensuring that the project lifecycle is implemented effectively and that the necessary demand / approval process is followed before execution and scaling-out
- Manages relationship with Knowledge Transfer and other groups / departments in the organisation, as well as with industry/academia external partners

R&D Coordination

- Responsible for technical oversight of innovation projects within IT and CERN, assigning personnel and resources
- Delegates personnel to explore innovations / solutions through proof-of-concepts to address identified user needs and strategic focus areas
- Monitors and documents on-going projects, reporting into the Innovation Lead
- Oversees project governance for R&D projects

Collaboration Frameworks Coordination

- Responsible for industrial collaborations and high-level partnerships (CERN openlab, QTI)
- Explores market innovations / solutions to solve for identified user needs and strategic focus areas
- Defines opportunities for proof-of-concept and validation projects
- Monitors and documents on-going collaborations
- Oversees project governance for industrial collaborations

EC Programmes Coordination

- Responsible for identification of opportunities for innovation and funding
- Negotiates participation in EC projects ensuring alignment with technical and strategic objectives
- Monitors and documents on-going project results, reporting into the Innovation Lead
- Manages relationships with project coordinators and partners
- Oversees project governance for EC-funded innovation projects

CHANGES FROM AS-IS

- Greater collaboration and alignment with user needs and the IT strategy
- Increases accountability and governance regarding innovation initiatives / projects pursued

IMPACT

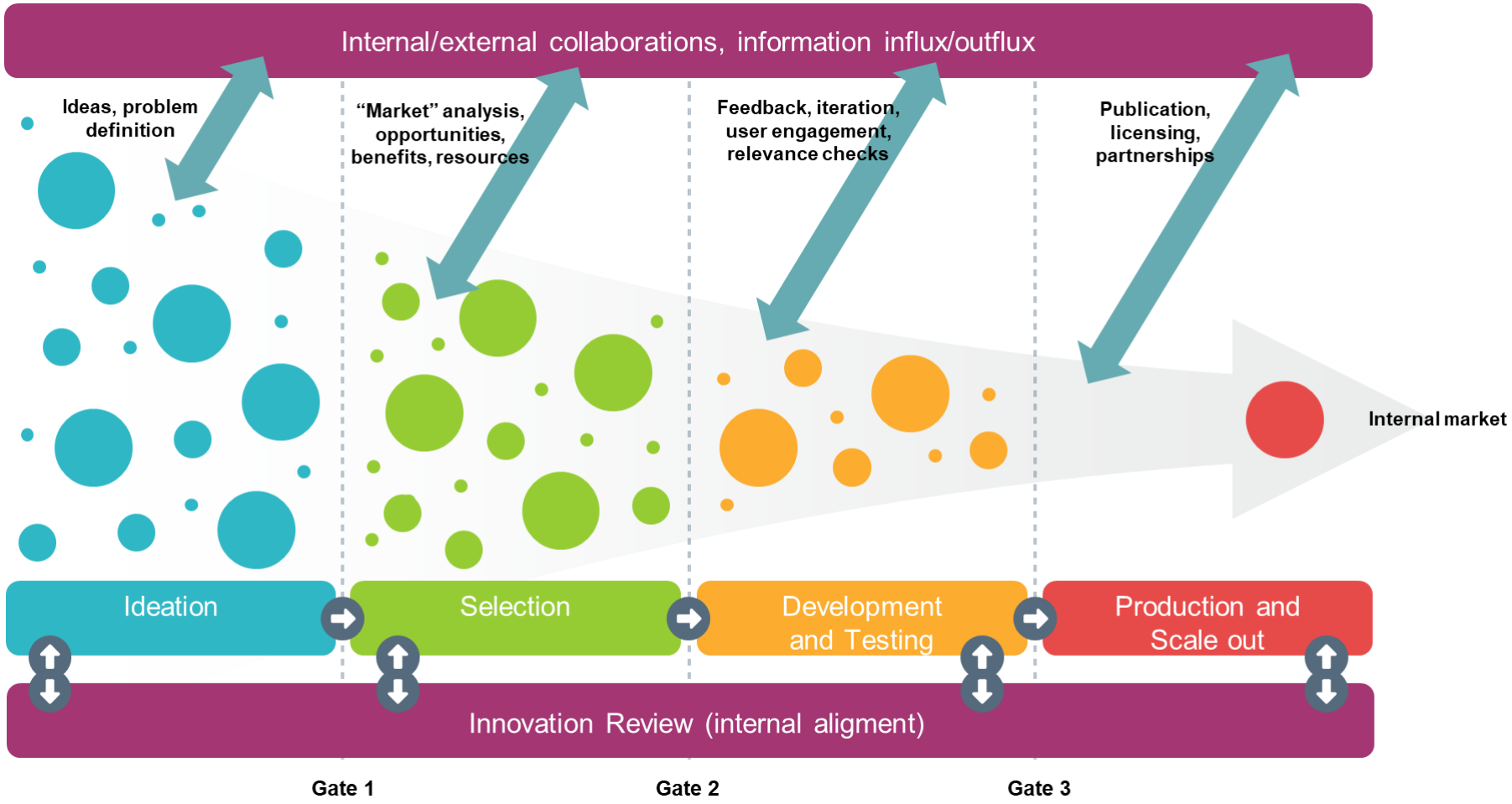
- Innovation initiatives / projects pursued are coherent and aligned to the IT strategy, with use case defined to maximise value delivered
- Enhanced resource efficiency whilst embedding agile ways of working within the organisation

Open Innovation

"Innovation is the process of turning ideas into solutions to generate value"

There are several models of Innovation developed in the past 40+ years

The one we take as base model is the **Open Innovation** framework



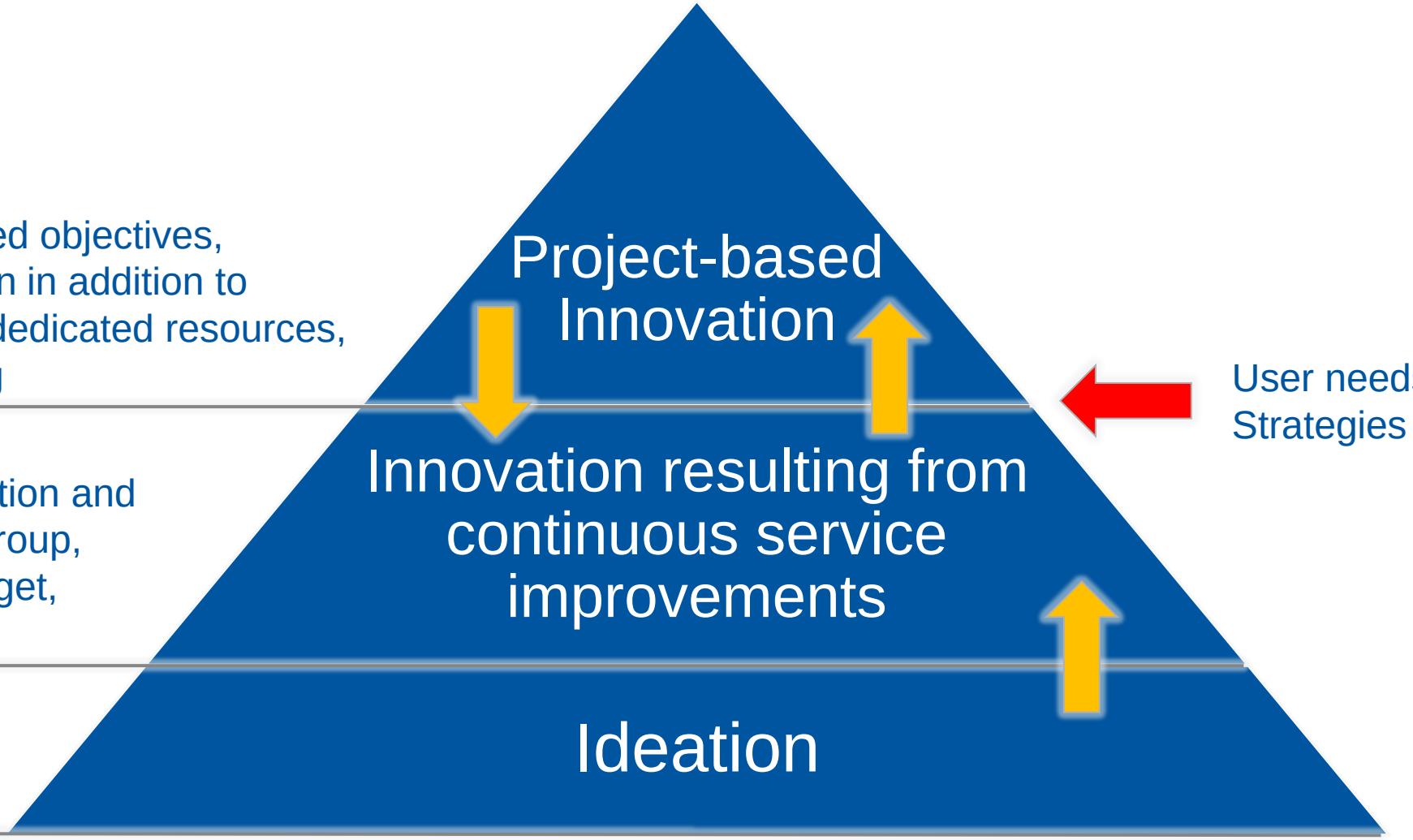
Chesbrough, Henry William (1 March 2003). *Open Innovation: The new imperative for creating and profiting from technology*. Boston: Harvard Business School Press. ISBN 978-1578518371.

Innovation scopes

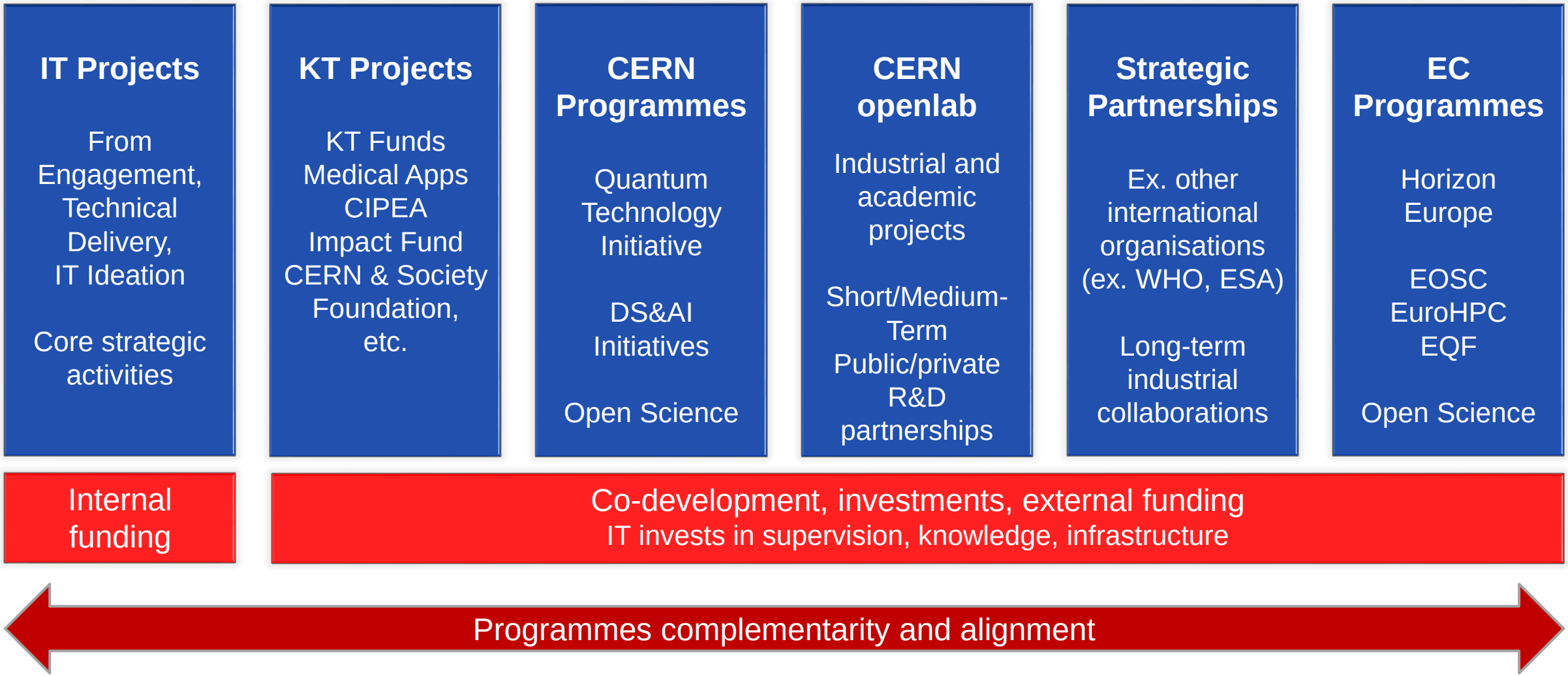
Innovation activities within stated objectives, expected results, transformation in addition to evolution, longer-term impact, dedicated resources, formal monitoring and reporting

Part of the continuous optimisation and evolution of services in each Group, within standard operations budget, standard reporting

Informal channels and discussions, multiple formats



Innovation and collaboration channels



IT Innovation Roadmap


ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE
CERN EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

IT Department

Innovation Roadmap

V. 0.1

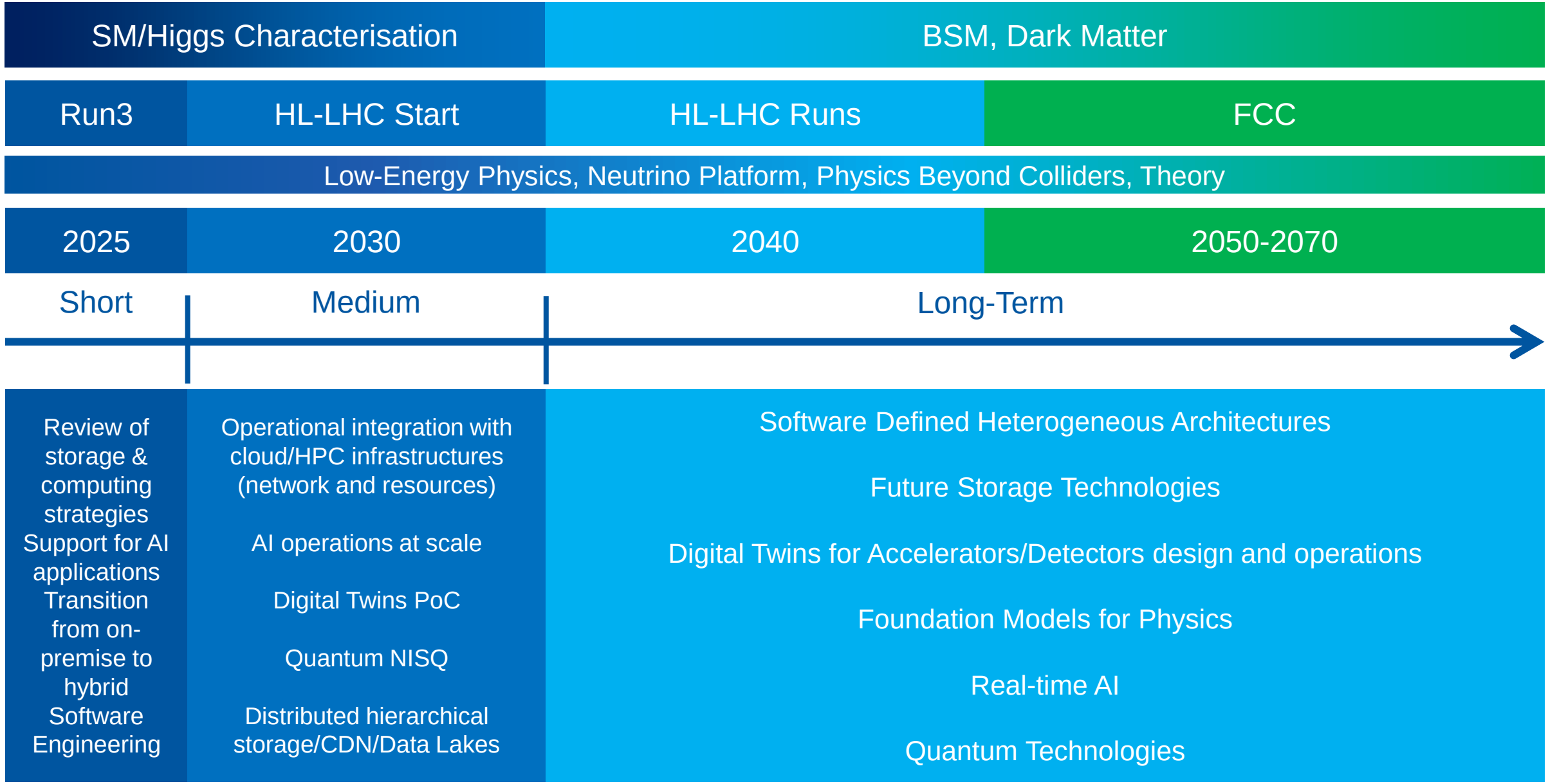
14 March 2023

Formal document describing the Innovation strategy, objectives, processes, collaboration channels, etc.

Being developed in collaboration across the the IT Department functions and technical groups and the CERN community

Internal draft being review now before broader review across the community in April-May 2023

A version of this Roadmap will also be published a white paper building on and extending the traditional CERN openlab white paper published at the beginning of each new phase


SM/Higgs Characterisation
BSM, Dark Matter
Run3
HL-LHC Start
HL-LHC Runs
FCC
Low-Energy Physics, Neutrino Platform, Physics Beyond Colliders, Theory
2025
2030
2040
2050-2070
Short
Medium
Long-Term
Review of storage & computing strategies
Support for AI applications
Transition from on-premise to hybrid
Software Engineering
Operational integration with cloud/HPC infrastructures (network and resources)
AI operations at scale
Digital Twins PoC
Quantum NISQ
Distributed hierarchical storage/CDN/Data Lakes
Software Defined Heterogeneous Architectures
Future Storage Technologies
Digital Twins for Accelerators/Detectors design and operations
Foundation Models for Physics
Real-time AI
Quantum Technologies

Objectives at a glance

Open Science and Impact
Technology and services
Scale-up, collaborations

Artificial Intelligence
Algorithms, Platforms and Services

Computing
Heterogeneous Infrastructures and Software

Data Storage and Management
Hierarchical storage and data distribution

Long-term investigation

SDIs

Digital Twins

Foundation Models

Quantum Technologies

Objective 1: Introduce heterogeneous computing infrastructures and software engineering services and tools

Why (Impact)	What (Results)	Examples (activities)
CERN and experiments computing needs are evolving towards new computing architectures and services beyond what can be provided only from on-premise	Integrate heterogeneous resources on-premise, cloud, and HPC Analysis Facilities Support development of software able to exploit such resources Performance and energy consumption	Assessment of performance and portability libraries (Intel oneAPI Intel) ML/DL development, performance benchmarks (RAISE) Partnerships and agreements with commercial Cloud providers and HPC centres for testing, validation, integration, software development (CERN openlab, EC projects, EuroHPC) Software engineering, optimisation, benchmarks with experiments (MadGraph and AdePT) Devel, test, training on GPUs, FPGAs, CUDA, C++ (E4, Nvidia, Micron, HSF)

Objective 2: Scale-up data management, data storage, databases towards HL-LHC requirements

Why (Impact)	What (Results)	Examples (activities)
HL-LHC comes with severely scaled-up requirements in terms of data volumes and analysis requirements and additional flexibility in moving data across the infrastructure but also across interactivity scopes (cold/warm/hot)	Analysis facilities Assess CDNs, Data Lakes, different topologies and architectures. Set up PoCs Interact/integrate with international data management initiatives and services	Synch&Share, ScienceMesh development (CS3MESH4EOSC) DAOS evaluation for caches and databases (Intel) Replication, cloud-enabled BC/DR (Oracle) Data archival technologies and applications (ARCHIVER)

Objective 3: Support the introduction of AI in the community

Why (Impact)	What (Results)	Examples (activities)
AI has become an essential tool in all research activities, the IT department needs to support it and provide the necessary services. AI services require close coordination of networking, computing, storage and platforms	Revise the IT services portfolio and design new services based on best-of-breed technologies on-premise, cloud and HPC. Work in close collaboration with users and technology infrastructure providers. Take part in common algorithm development and optimisation	Generative Models for detector simulation (Intel, Nvidia) AI models lifecycle, model repositories (Oracle) Data acquisition denoising (IBM, Dune) Event classification with Kubernetes (Google) Network traffic optimisation (CS) Graph networks for Reconstruction (CMS) Neural Architecture Searches, hyperparameters tuning (various collaborations with HPC centres in EU and US)

Objective 4: Keep the IT Department at the forefront of R&D

Why (Impact)	What (Results)	Examples (activities)
CERN objectives as part of the HEP community are long term. Future programmes such as HL-LHC, Physics Beyond Colliders or the FCC require technologies not yet available today. CERN and CERN IT need to keep a leading role.	Investigate and set up PoC projects in emerging technologies like advanced AI and Foundational Models, Digital Twins, quantum computing, future network and storage technologies; collaborate with other labs and industry	Quantum Computing algorithms development and characterisation for various HEP applications (experiments and theory) Long-term network & infrastructures technology co-development (classic and quantum) Digital Twins design and development for HEP detectors, robotics, industrial systems (InterTwin) Foundation models for physics Evaluation of emerging storage technologies (cristals, DNA-based storage)

Objective 5: Enable and Support Open Science and Societal Impact

Why (Impact)	What (Results)	Examples (activities)
CERN mission goes beyond HEP research, the broad objective of societal impact is an explicit part of such mission. Generating and sharing knowledge and supporting open science has a critical positive impact on CERN reputation	Engage in selected multi-disciplinary activities supporting the impact strategies defined by CERN (industry, medical, climate, aerospace/Earth observation) Advance knowledge, contribute to open tools and policies, support other scientific communities	Innovation in digital asset management, reproducibility, collaboration tools where CERN technologies have measurable impact (Invenio, Zenodo, REANA, Onboard, etc.) Digital Twins and Federated Learning for climate and social sciences, medical applications (InterTwin) Contributions to open search tools and intelligent semantic analysis of scientific text and data (OpenWebSearch, CAiMiRA) Innovative AI-based modelling and prediction of extreme whether phenomena (EMP2) Quantum-safe and post-quantum applications (Quantumacy)

Innovation and collaboration channels

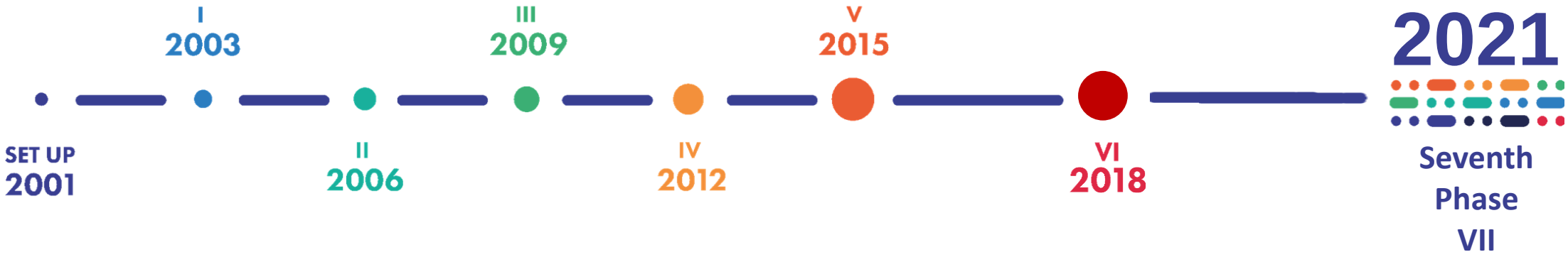
IT Projects	KT Projects	CERN Programmes	CERN openlab	Strategic Partnerships	EC Programmes
From Engagement, Technical Delivery, IT Ideation Core strategic activities	KT Funds Medical Apps CIPEA Impact Fund CERN & Society Foundation, etc.	Quantum Technology Initiative DS&AI Initiatives Open Science	Industrial and academic projects Short/Medium-Term Public/private R&D partnerships	Ex. other international organisations (ex. WHO, ESA) Long-term industrial collaborations	Horizon Europe EOSC EuroHPC EQF Open Science

Internal funding

Co-development, investments, external funding
IT invests in supervision, knowledge, infrastructure

Programmes complementarity and alignment

DRIVING INNOVATION FOR 20 YEARS

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Thanks!

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