Coordination and Support Action Special FET Flagship Call

The Human Brain Project

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Background

The industrial-scale neuroscience of the 21st century is producing a rapidly escalating volume of data and knowledge on every possible level of biological organization. The result is a data deluge. The grand challenge in the post-genomic era is to integrate this fragmented information, to find the patterns within and across different levels, and ultimately to understand the causal chain of events leading from genes to complex behavior and intelligence.

Goal

The Human Brain Simulation Project (HBSP) will build a supercomputer-based infrastructure and lead global cooperation to simulate and understand the human brain from genes to behavior, to accelerate the development of diagnostic tools and for brain disease, and to generate new brain-derived technologies.

Mission

The mission of the HBSP will be to (i) *build a European Facility for Simulation-Based Brain Research*, providing scientists throughout the world with a unique integrated re-search environment, including exascale data storage and computing capabilities, remotely accessible virtual laboratories, and other tools and infrastructure re-quired to integrate their data and knowl-edge in biologically detailed models of the brain

Neuroscience: investigation of strategic aspects of brain function, critical for brain modeling.
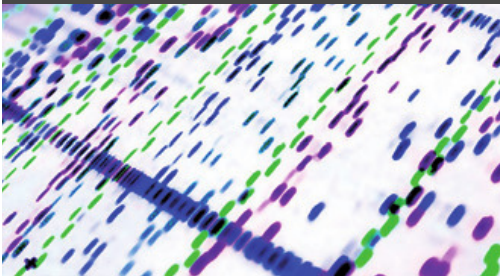
Screening: large-scale production of data by high throughput facilities in industry and at selected universities.

Neuroinformatics: analysis, standardization and databasing of past and current knowledge, development of tools and techniques for *Predictive Reverse Engineering.*
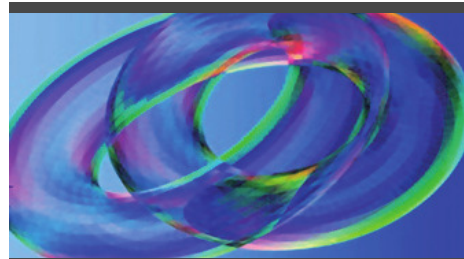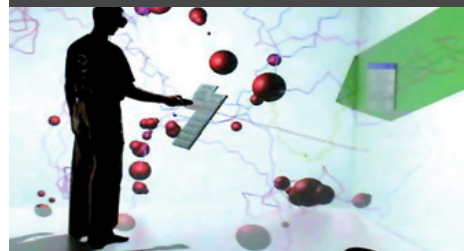

Modeling: capture of structural and functional properties and principles of the brain's operations in mathematical abstractions.

Simulation: creation of the software required for multi-scale modeling.

Supercomputing: design and optimization of a HPC facility for brain modeling and simulation.

Visualization: new techniques for interactive navigation and steering of supercomputing simulations.

Brain Probes: development of new nano, micro, genetic, optical, and electrical technologies making it possible to study an ever broader range of brain structures and functions in greater depth, and more rapidly than is currently possible.
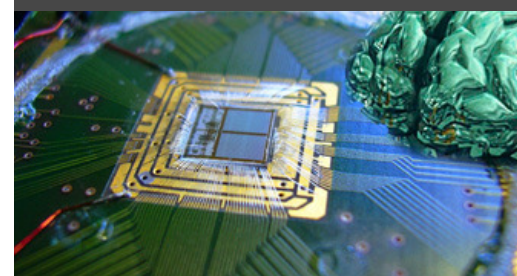

The Diseasome: exploitation of the power of ICT to study the 560 known human brain disorders as an interconnected complex system, derivation of parameter constraints for *Predictive Reverse Engineering.*

Neurorobotics: interfacing virtual and physical robots to brain models.

BrainICT: construction of neuromorphic chips based on the structural and functional organization of the brain.

Society: exploring the societal, ethical and philosophical implications of brain simulation and its application to brain disease, and future ICT.

Education: training students and educating the public about the brain, its diseases and the exploitation of knowledge about the brain in future ICT technologies.
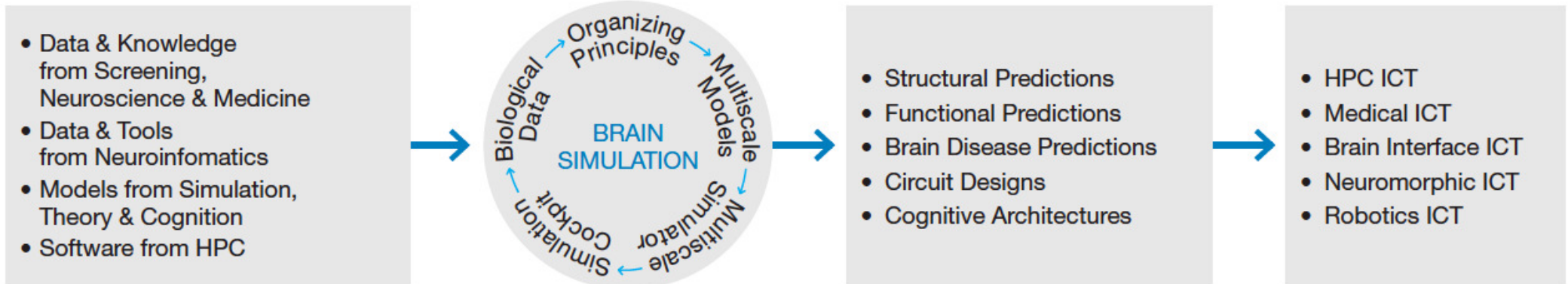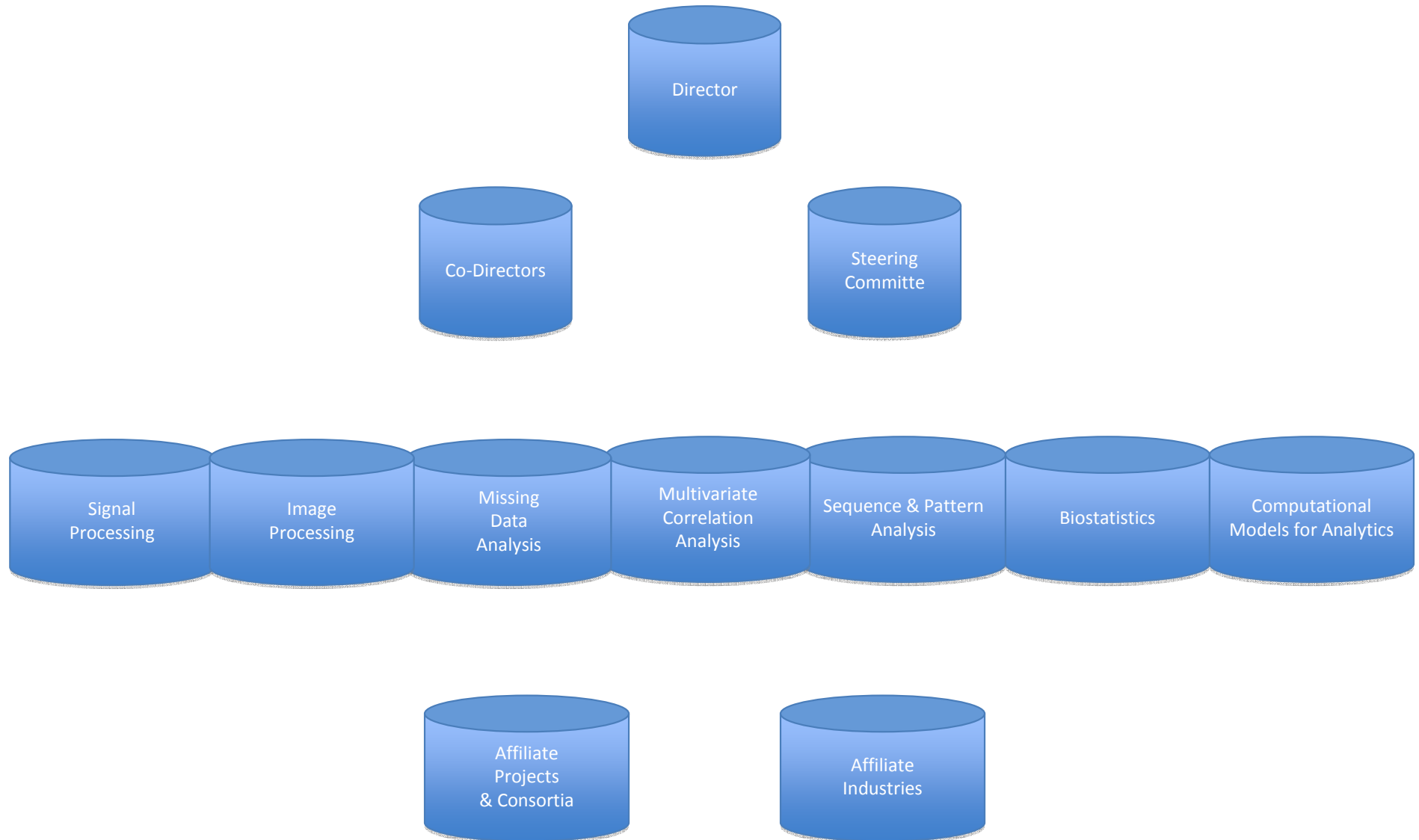
Example – Brain Simulation

Figure 1: Brain simulation in the HBP

Systems & Data Analysis

Director

Co-Directors

Steering Committe

Signal Processing

Image Processing

Missing Data Analysis

Multivariate Correlation Analysis

Sequence & Pattern Analysis

Biostatistics

Computational Models for Analytics

Affiliate Projects & Consortia

Affiliate Industries

Education

Director

Co-Directors

Steering Committee

3D Internet

Multi-Media Education Productions

Educational Website

Training Workshops

Student Programs

Affiliate Projects & Consortia

Affiliate Industries

List of Participants:

| Partner Number	Participant name	Participant short name
1	Ecole Polytechnique Fédérale de Lausanne	EPFL
2	Heidelberg University	UHEI
3	Forschungszentrum Jülich GmbH	Jülich
4	Centre Hospitalier Universitaire Vaudois	CHUV
5	Karolinska Institutet	KI
6	Universidad Politécnica de Madrid	UPM
7	Wellcome Trust Sanger Institute, Genome Research Limited – Genes to Cognition	WTSI
8	Technische Universität München – Fortiss GmbH	TUMFOR
9	IMEC	IMEC
10	Hebrew University	HUJI
11	Institut Pasteur	IP
12	Innsbruck Medical University	IMU
13	Institut National de la Santé et de la Recherche Médicale	INSERM
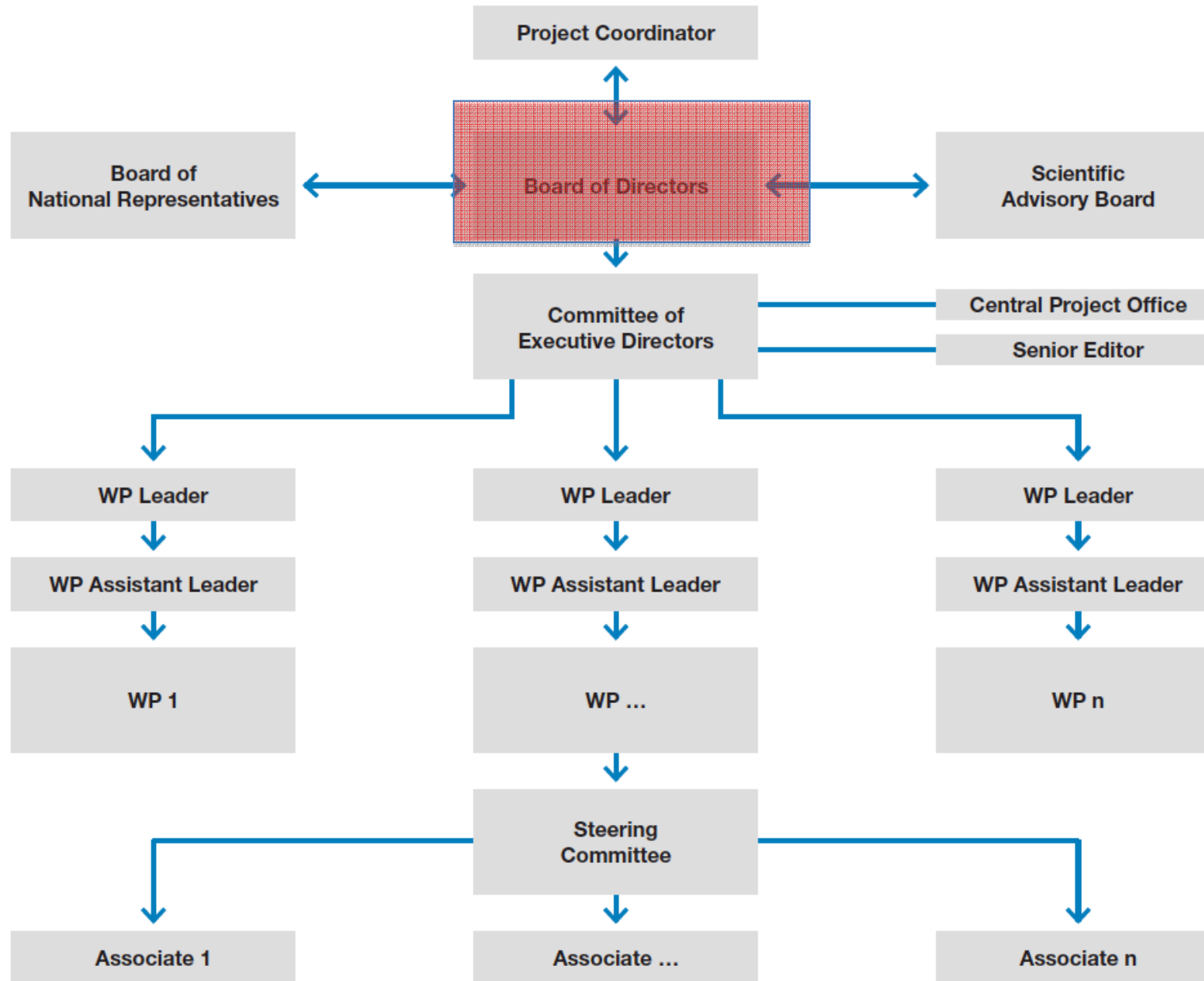
Figure 9: Organizational structure for the HBP-PS

Figure 7: The HBP – from the Roadmap to the budget

1.3.8 List of milestones for the HBP-PS

Milestone number	Milestone name	Work package(s) involved	Expected date	Means of verification
M1	Outline proposal for HBP Operational Framework	1	Month 3	Availability of document
M2	Completion of HBP Proposal Release 1	1,15	Month 3	Availability of document
M3	All Work Packages identify objectives for their Pillars of Activity	2-17	Month 4	Internal reporting
M4	Recommendations for Commission completed	1	Month 6	Availability of document
M5	Pillar teams selected	All	Month 6	Internal reporting
M6	Completion of HBP Proposal Release 2	All	Month 6	Availability of document
M7	First draft of budget completed	All	Month 6	Availability of document
M8	Publication of state of the art studies	2-14	Month 6	Availability of document
M9	Draft work plans completed	All	Month 9	Availability of documents
M10	Workshops on Operational Framework completed	1	Month 9	Internal reporting
M11	Second draft of budget completed	All	Month 9	Internal reporting
M12	Completion of HBP Proposal Release 3	All	Month 9	Availability of document
M13	Pre-final version of proposal submitted to Board of National Representatives and to Scientific Advisory Board	1,15,18	Month 11	Availability of document
M14	Completion of final HBP Proposal	All	Month 12	Availability of document

Institute for Science and Technology (Peter Jonas)

Technical University Graz (Wolfgang Maass)

Others