

# BUSINESS PLAN 2021



CZECH BIOIMAGING

Imaging principles of life



EUROPEAN UNION  
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Operational Programme Research,  
Development and Education



MINISTRY OF EDUCATION,  
YOUTH AND SPORTS

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This document is a collective work developed based on many discussions of the Czech-Biolmaging Steering, Advisory and Supervisory Boards, and collected information from a wide user community. Some principles were modified and further developed from Euro-Biolmaging ERIC.

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## Vision

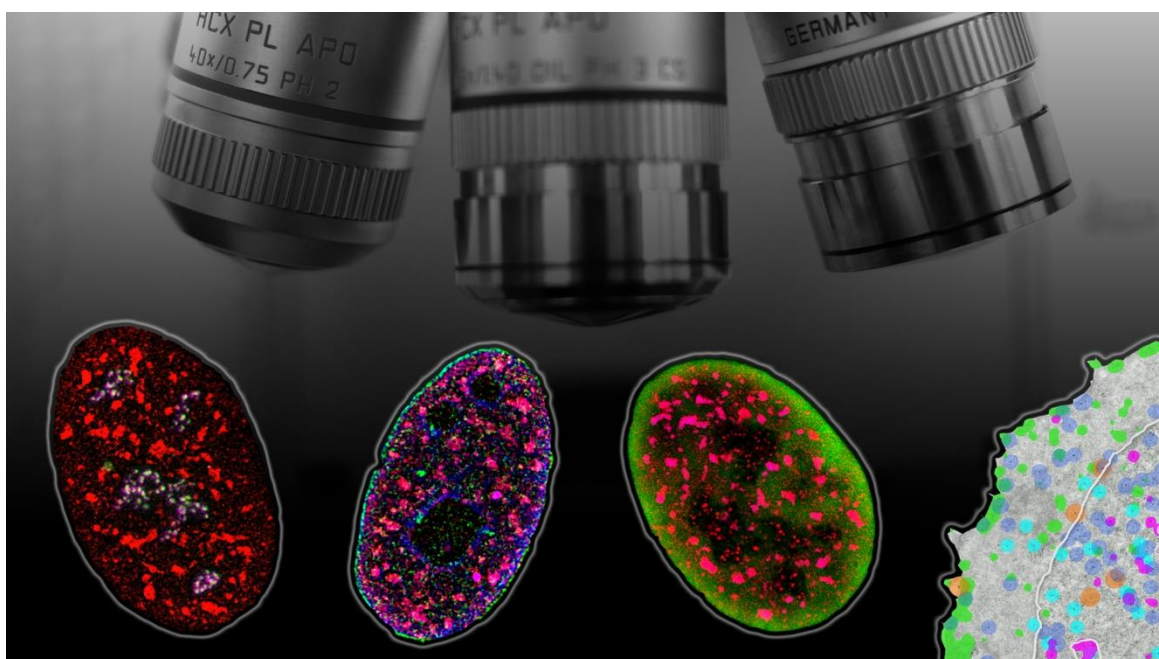
To create a sustainable research infrastructure embedded in European scientific landscape in the field of biomedical imaging that empowers scientists to improve existing imaging methods or to develop new methods and data processing strategies for the study of animate as well as inanimate matter, thus establishing a bridge between life and material sciences. This allows life science researchers to deliver solutions that address grand societal challenges in health and quality of life, bio-economy, and sustainability.

## Mission

By connecting Czech bioimaging facilities and making their collective expertise, resources, and services easily accessible to national/international researchers, Czech-Biolmaging will bring cutting-edge imaging technologies within easy reach of scientists.

Assembling the best teams in imaging (composing of experts in biology, medicine, physics, mathematics, informatics, computer science) in the Czech Republic will stimulate the interdisciplinary cooperation and contribute to higher competitiveness of the Czech research.

Through Czech-Biolmaging, researchers will be able to gain efficient access to the best biomedical imaging expertise, resources, and services, including state-of-the-art facilities, data, tools, and training.



# Czech-BioImaging Business Plan

Version: 2021-5

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# Abbreviations

BC	Biology Centre CAS
BIOCEV	Biotechnology and Biomedicine Center of the CAS and Charles University in Vestec
BUT	Brno University of Technology
CAPI	Center of Advanced Preclinical Imaging CUNI
CAS	Czech Academy of Science
CARS	Coherent Anti Stokes Raman Scattering
CBIA	Centre for Biomedical Image Analysis
CEITEC MU	Central European Institute of Technology at Masaryk University
CELLIM	Cellular Imaging Core Facility of CEITEC MU
CESNET	Czech Education and Scientific NETwork
CF	Core facility
CIISB	Czech Infrastructure for Integrative Structural Biology
CLEM	Correlative light and electron microscopy
COST	European Cooperation in Science and Technology
CR	Czech Republic
CSIRT	Cyber Security Response Team
CUNI	Charles University
CzBI	Czech-BioImaging
EATRIS	European Infrastructure on Translational Medicine
ELIXIR	European Life-Science Infrastructure for Biological Information
ELMI	European light microscopy initiative
EM	Electron microscopy
ERDF	European Regional Development Fund
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EuBI	Euro-BioImaging
FAIR	Findable, Accessible, Interoperable and Reusable
FCS	Fluorescence Correlation Spectroscopy
FIB-SEM	Focused ion beam scanning electron microscopy
FLIM	Fluorescence Lifetime Imaging Microscopy
FRAP	Fluorescence recovery after photobleaching
FTE	Full-time equivalent
GDPR	General Data Protection Regulation
GMO	Genetically modified organisms
GPU	Graphics processing unit
IEB	Institute of Experimental Botany of the Czech Academy of Sciences
IMCF BIOCEV	Imaging Methods Core Facility at BIOCEV CUNI
IMG	Institute of Molecular Genetics CAS (the hub)
IMG EM	Electron Microscopy Core Facility at IMG CAS
IMG LM	Light Microscopy Core Facility at IMG CAS

IMTM UPOL	The Institute of Molecular and Translational Medicine at UPOL
IPHYS	Institute of Physiology CAS
ISI	Institute of Scientific Instruments CAS
ISILMR	Laboratory of Magnetic Resonance at Institute of Scientific Instruments
IT	Information technology
LEM BC	Laboratory of Electron Microscopy at Biology Centre CAS
MAFIL	Multimodal and Functional Imaging Laboratory at CEITEC MU
MEYS	Ministry of Education, Youth and Sport of the Czech Republic
MPI	Magnetic Particle Imager
MR	Magnetic Resonance
MRI	Magnetic Resonance Imaging
NAS	Network Attached Storage
PACS	Picture Archiving and Communication System
PALM	Photoactivated Localization microscopy
RI	Research Infrastructure
R&D	Research and development
SBF SEM	Serial Block Face Scanning Electron Microscopy
SEM	Scanning electron microscope
SHG	Second Harmonic Generation
SMLM	Single Molecule Localization Microscopy
SPECT	Single-Photon Emission Computerized Tomography
SRRF	Super-Resolution Radial Fluctuations
STED	Stimulated Emission Depletion microscopy
STEM	Scanning transmission electron microscopy
STORM	Stochastic Optical Reconstruction microscopy
SVI	Scientific Volume Imaging
TEM	Transmission Electron Microscopy
THG	Third Harmonic Generation
TIRF	Total Internal Reflection microscopy
TTTR	Time Tagged Time-Resolved
UPOL	Palacky University Olomouc

# Executive Summary

Innovative imaging technologies contribute to revolutionary advances in knowledge in molecular biology, biomedicine, and medicine. These technologies lead to a significant quantitative and qualitative shift in both research and medical applications. The lack of these technologies, or limited access to them, would result in a loss of competitiveness in research in the Czech Republic as results in these fields are critically dependent on the use of modern imaging techniques.

Czech-BioImaging (further as CzBI) brings together the best instrumentation and expertise into a unified whole. It provides quality services to the scientific community in a coordinated and transparent manner in the Czech Republic, while sharing the costs of the implementation, further development, and operation of these services. The technological and methodological base of CzBI will significantly accelerate and streamline biomedical research by giving the access to advanced imaging technology, professional expertise gathered within nodes, sharing experiences from different projects, development of the new processes of acquiring and analyzing image data, permanent education of infrastructure personnel, and intense involvement in international scientific cooperation. CzBI builds on involvement of the Czech Republic in the large pan-European infrastructure for biological and medical imaging, Euro-BioImaging ERIC.

CzBI covers the needs of scientists on all levels of imaging – from imaging of organisms, their tissues and cells to imaging of cell organelles, transport, biomolecules, and their interactions in the healthy and pathological state of organism.

A major advantage of CzBI is the combination of the top available imaging equipment, extensive experience with imaging, a large training portfolio and a tight collaboration with commercial sector. Importance and relevance of the Research Infrastructure (further as RI) is documented in numerous original papers of highly impacted scientific journals. The other benefit to research is connected to the

development of image analysis methods, which are published including all details of the algorithms made available to the scientific community worldwide.

CzBI provides a suitably tailored and efficient educational platform with a long-term experience of its partner institutions in teaching and training. The unique feature of the CzBI RI is that it brings together the top research institutions of the Academy of Sciences with the leading universities in the Czech Republic. CzBI develops and provides new study programs and specialized international courses for students and professionals as a part of their continuous professional development. All users including Master and PhD students are trained in all available microscopic methods, biomedical engineering, medical physics/biophysics, mathematical biology, human/animal imaging and electrophysiology, neuroscience, image data processing/analysis, and related IT expertise. The ability of the CzBI RI environment to provide topics for Bc, MSc, and PhD theses, data, measurement time, expertise, possibility of work contract after graduation, and special hands-on educational courses is very important considering the quality and attractiveness of education. The quality of education is further affected by the international networking of the CzBI as well (international workshops and courses suitable both for local and international MSc/PhD students).

CzBI also conducts its own methodological research and development, particularly in the development and implementation of new imaging methods, e.g. multimodal holographic microscope, the development of new detection systems with multiple labelling, development of new applications for MPI, stereological methods, development of methods for processing, and analysis of image and 3D reconstruction, including the development of customized software applications.

There is no similar infrastructure in the Czech Republic that would cover biological and medical imaging in such a broad scope as CzBI.



# 1 What is CzBI Research Infrastructure

## 1.1 Introduction

Thanks to the rapid technological development, the innovative imaging technologies enable observing processes inside living cells, which has not been possible before. Therefore, imaging has truly become an essential engine that drives research in biological and medical sciences. In biology, imaging plays such a crucial role that more than 70% of all high-impact biosciences publications rely on or at least include advanced light and electron microscopy. Similar trend can be observed in medical research due to the non-invasive nature and rapid development in the field of medical imaging. Both the CzBI core research and collaborative activities reflect the involvement in tackling societal challenges which Europe has identified as the most urgent, be it early diagnosis using non-invasive methods, identification of health and disease factors, or healthy aging of population.

In biological imaging, the user community has been very active as the new imaging methods

(especially super-resolution and in vivo) started to appear. In the Czech Republic, the initial movement was closely related to the Czechoslovak Microscopy Society, organizing annual scientific conferences and numerous microscopy courses. This generated a substantial pool of imaging specialists and a need for further development with an institutional anchorage. This bottom-up approach proved to be effective and was developed similar to the Euro-BioImaging efforts.

## 1.2 CzBI RI

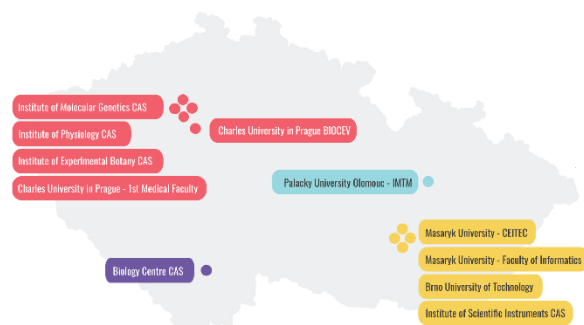
The national research infrastructure for biological and medical imaging (Czech-BioImaging; CzBI) was built as a distributed infrastructure of leading imaging facilities in the Czech Republic (see Table 1). CzBI RI provides open access to most advanced imaging technologies and expertise for the whole of the biological and biomedical research communities in both private and public sectors. The user services are performed at the CzBI core facilities

**Table 1 Institutions and core facilities involved in CzBI RI**

INSTITUTION	LOCATION	CORE FACILITY
<b>Institute of Molecular Genetics, CAS (IMG)</b>	Prague	Electron Microscopy Core Facility Light Microscopy Core Facility
<b>Biology Centre, CAS (BC)</b>	České Budějovice	The Laboratory of Electron Microscopy
<b>Brno University of Technology (BUT)</b>	Brno	Experimental Biophotonics Facility
<b>Charles University (CUNI)</b>	Prague Vestec	The Advanced Preclinical Imaging Center (1MF CUNI) The Imaging Methods Core Facility at BIOCEV
<b>Institute of Experimental Botany, CAS (IEB)</b>	Prague	The Imaging Facility of the IEB
<b>Institute of Physiology, CAS (IPHYS)</b>	Prague	The IPHYS Biomedical Imaging Facility
<b>Institute of Scientific Instruments, CAS (ISI)</b>	Brno	Laboratory of Magnetic Resonance (ISILMR)
<b>Masaryk University Brno (MU)</b>	Brno	Multimodal and Functional Imaging Laboratory CEITEC MU Cellular Imaging Core Facility of CEITEC MU Centre for Biomedical Image Analysis FI MU
<b>Palacky University Olomouc (UPOL)</b>	Olomouc	The UPOL Microscopic Facility

at different locations covering the major cities in the Czech Republic. The central hub provides management and logistic support, coordinates educational activities such as workshops and courses and ensures that individual facilities work in synergy and function together as one big unit.

The national imaging infrastructure is closely interlinked with the Czech Republic participation in the ESFRI large pan-European infrastructure for biological and biomedical imaging, Euro-BioImaging ERIC ([www.eurobioimaging.eu](http://www.eurobioimaging.eu), further as EuBI ERIC). The aim of EuBI ERIC is to provide scientists in Europe with open access to state-of-the-art technologies at all levels of biological and biomedicine research.



### 1.3 CzBI strategy: Building on the national strengths to meet the current needs

Due to a broad range of modern imaging instrumentation and its high price, it is highly unrealistic to have all of these imaging technologies locally available at one single research institution. Besides the large expenditure and costly maintenance of the instrumentation, the state-of-the-art imaging technologies require highly trained and experienced specialists to operate them. Proper in-depth expertise is necessary in order to fully benefit from all possibilities the technology has to offer and to get the correct image data. CzBI RI brings together the imaging instrumentation offered by the partners and provides users with a unified open access to the cutting edge imaging technologies, which are not available in their home institutions. The technological and methodological background of the CzBI RI will significantly speed up and boost research thanks

to the expertise accumulated within the facilities, sharing the experience from various projects and the design of new acquisition and analysis procedures for the users according to their specific needs.

Within the Czech Republic, the biological imaging part of CzBI is the only infrastructure performing cell and molecular imaging for research purposes with a large proportion of its capacity in the open access mode. The medical imaging part of CzBI is the only infrastructure performing open access mode as well. Moreover, the human imaging facility at CEITEC is the only human MRI facility in Czech Republic dedicated to science. These facilities are located in the leading universities and research institutions of the Academy of Sciences, forming together scientifically and technically very strong, coherent, and harmonized network. This network is geographically well distributed, having the axis in between Prague and Brno, but covering also northern Moravia and southern Bohemia. Moreover, some of the imaging instrumentation available in the Czech Republic is still rare in the European and/or world context, e.g. Q-PHASE multimodal holographic microscope (Tescan), magnetic particle imager (MPI), and a new 3T MRI Prisma scanner. Most importantly, the uniqueness of CzBI RI is based on the optimal combination of state-of-the-art equipment and the available expertise and advanced support of neighbouring research community.

Overall, the presented CzBI RI is multifunctional, providing top services for a large spectrum of biomedical research. As documented here and further below, a number of CzBI RI technologies or expertise is at the current world top level, or even unique. We have already had foreign visitors coming to the RI, mainly because of their need for very specialized services, e.g. in molecular botany, image analysis, cryo-electron microscopy, brain imaging, super-resolution imaging. We expect that this tendency will be strengthened in the future along with an increased awareness of foreign researchers about the CzBI RI. It is highly probable also because some of the countries are behind with planning imaging RI.

## 2 Impact

Innovative imaging technologies contribute to revolutionary advances in knowledge in medicine and molecular, cellular and developmental biology. These technologies lead to a significant quantitative and qualitative shift in both research and medical applications. The lack of these technologies, or limited access to these technologies, would result in a loss of competitiveness in research in the Czech Republic as the results in these fields critically depend on the use of modern imaging techniques.

### 2.1 Contribution to scientific research and technological development

Medical and biomedical research strongly depends on the ability to observe living systems under certain conditions (for instance pathology, therapeutic effect, drugs, etc.) and elucidating any long-term effect requires repeated non-invasive observation of living systems. Preclinical research can combine non-invasive or semi-invasive repeated measurements with subsequent post-mortem observation. Research focused on living humans must be only non-invasive. Consequently, innovation in this field is highly important for routine medical diagnostics. Presence of top technologies in CzBI facilities brings new possibilities not only to the area of basic science, but also to clinical research and, in some cases, even to clinically relevant outcomes to patients participating in specific studies. CzBI medical imaging facilities belong to leading research workplaces both from the technological aspects and the expertise provided to users. The open access enables concentration and sharing of know-how, which would not be possible in a closed regional lab. Technological development of these facilities significantly and positively affects the research in the wide scientific community.

The technological and methodological base of RI significantly accelerates and streamlines biomedical research by giving the access to a range of biological and medical imaging

technologies (e.g. advanced light microscopy, fluorescence microscopy, label free microscopy, electron microscopy including sample preparation, human and animal MRI accompanied with other neuroimaging techniques, preclinical imaging, etc.), professional expertise gathered within facilities, sharing experiences from different projects, development of the new processes of acquiring and analysing image data, permanent education of infrastructure personnel, and intense involvement in international scientific cooperation.

Presence of top technologies (and expertise) in medical imaging facilities is a key aspect for users to participate in advanced international grants, to start new emerging research topics and finally, to create excellent scientific outputs published in prestigious journals.

### 2.2 Response to user needs

The needs of the user community were initially assessed by a questionnaire. Based also on similar information from the EuBI, the CzBI RI was formulated around especially two points: demand for highly commonly used techniques,



and demand for top technologies and expertise. We can now confirm that this strategy was correct, as numbers of users coming to the RI and the portfolio of experiments solved in the RI have clearly proven the necessity of forming such biomedical imaging RI.

The focus of the CzBI RI clearly reflects recent trends in European life science research influenced, among other things, by return to and by thorough exploitation of preclinical animal studies and support of non-invasive diagnostic methods development resulting from efforts to cope with the society challenges (such as aging population; drug development effectiveness; early diagnosis of degenerative diseases, etc.). The CzBI RI is important for bridging in vitro tests to preclinical tests by means of animal models.

In CzBI, each individual core facility organizes regular meetings with users to initiate discussion about new developments and possibilities in the research area. Their main aim is to gather user feedback and exchange information between the core facility and users. This helps to ensure that the core facility activities are tailored to the demands of the local community, supports the introduction of new services, helps to define future strategies and provides valuable feedback on current operations. All major equipment to be purchased by the core facility should be discussed and agreed on at the user committee meeting. Survey within facility users is organized at partner institutions to identify missing equipment/technique.

The holding of the annual CzBI conference “Imaging Principles of Life” proved to be another useful tool for discussion with users and their needs in the field of biomedical imaging.

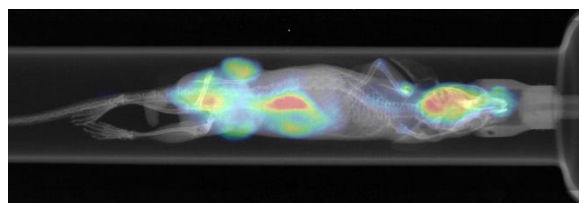
## 2.3 Socio-economic impact

The CzBI combines the best instrumentation and expertise in the field of biomedical imaging and contributes significantly to the development of biomedical sciences through its publishing, educational and methodological activities. The outputs of research activities using instrumentation available in CzBI capacities have a positive impact on the quality of life and development of biomedical knowledge of the research community in the Czech Republic.

### 2.3.1 Application potential of data and R&D results

CzBI has a wide collaboration with the application sector. Generally, the expected application outputs of the research supported by the CzBI RI include antiparasitic, antimycotic and antitumour agents, antiviral vaccines, novel treatment approaches and biomodulators, targeted drugs, genes, and diagnostics delivery systems for therapy and diagnostics of cancer and cardiovascular diseases, biosensors and protein chips, high content screening covering plethora of in-vitro, in-cellulo and in-vivo experimental procedures, application of advanced microscopy techniques for characterization of phenotypes induced by various chemical treatments, gene targeting and mutagenesis, application of advanced visualization techniques for validation on rodent models. The companies use CzBI facilities as testing and demonstrations for their products.

CzBI has contributed to a number of application outputs, which lead to the improvement of techniques, commercialization or patents. Generally, these are results of the type of development of new methods and protocols or improvement of experimental procedures and equipment, software development, etc.



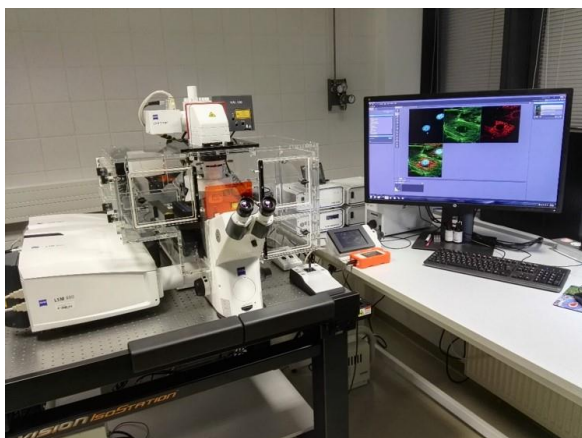
General character of the CzBI RI as well as its dual focus on medical and biological research are self-explanatory to a great extent. Types of research conducted in our partner facilities, utilizing our microscopic and other equipment, affect the society from the socio-economic point of view directly but also indirectly. Most relevant direct impact can be traced in the area of healthcare, biodiversity, radiation and environmental protection. Although the most frequent application of data categorizes into those fields, the imaging technologies that the CzBI RI holds can find their purpose in many other branches of R&D due to their versatile functionality.

### 2.3.2 Contribution to the international competitiveness of the Czech Republic

CzBI provides Czech scientists with permanent access to state-of-the-art imaging technologies, promotes their mutual cooperation and knowledge sharing. These activities significantly help increase both the internal competitiveness of research in the Czech Republic and its external visibility and relevance in the European Research area. This proactive approach is also a useful tool for the RI's purpose of transferring new technologies into practice, which is considered of key importance.

The impact that the CzBI RI has on levels of international competitiveness of the Czech Republic is unprecedented, mainly due to its concentration on organizing educational and awareness-raising activities. CzBI regularly holds scientific courses dedicated to its professional staff as well as for its users, which leads to an increased number of educated professionals in the field of bioimaging that are skilled in using high technology devices. Highly qualified infrastructure specialists receive above-standard training for equipment, operators and data processing technology suppliers, while the infrastructure educates new factory staff. This strategy contributes to the inclusion of the CzBI RI among others in the European Research Area and it permits the Czech Republic to maintain high levels of competitiveness.

Economically available state-of-the-art technology and related services in the relevant professional field open up the opportunity for relevant users in the Czech Republic to realize globally competitive results in science, research and development.



### 2.3.3 The impact to the macro-/regional development

The main benefit that the CzBI RI brings to the local setting of the research community is an increasing expertise in imaging which is a key prerequisite for a successful research in biological and medical sciences. There has been significant development and transformation in the composition of the user community in the last few years. The number of newly coming, high profile researchers visiting from abroad has been growing, which we attribute to the ever accelerating improvements in breadth of top-class technologies available and extensive expertise that the CzBI RI continues to offer. There is a visible tendency for Czech scientists working in facilities abroad, who are familiar with CzBI RI, to repeatedly come back to use our equipment for their research conducted in the foreign country as well. Outcomes of the research conducted by utilizing the new instrumentation available in the CzBI RI have a positive impact on the quality of life and development of the knowledge economy in the CR. The RI's continual upgrades in technological equipment and staff proficiency along with its growing importance in the international scientific landscape attracting the international visitors have also secondary effects. A synergistic interaction occurs in response to the CzBI partner institutions, where the facilities are located. As the institution observes the CzBI RI and facility growth, they often become inspired and put emphasized interest in the field of microscopy resulting in their independent investments in imaging equipment. This causes improvements and development of the domestic research community, competitiveness and overall modernization of instrumentation available in the Czech Republic. The CzBI RI offers a high-quality educational environment and increases qualification and employability of graduates ultimately leading to fostering the position of Czech science. Beside this, the RI encourages creation of new jobs for researchers and highly skilled technicians. New PhD positions were opened recently and more M.A. students became interested in neuroimaging and neuroscience. M.A. and PhD students have access to the infrastructure and can use high

technology and, above all, learn how to operate it. CzBI RI thus significantly contributes to the deepening of knowledge and skills of young scientists.

The CzBI RI also promotes intensive connections between research institutions and universities. Regions are strengthened in the education of students and other workers in a highly innovative knowledge-based economy with significant implications not only for scientific knowledge but also for the development of clinical applications and ultimately for the health of the population.

CzBI RI maintains long-term cooperation with foreign countries and implements joint innovative projects for the development of new imaging methods with world-famous imaging device manufacturers. It can thus help attract foreign investment into the Czech imaging industry and support the establishment of new companies in this industrial sector. On the macro level, the involvement in the EuBI stimulates cooperation with the European leading RIs which will improve research in the CR.

## 2.4 Impact on users outside of academia

The RI's most profound impact in strengthening a business area stems from its emphasized focus

on cooperation between the academic sphere and Czech commercial sector and industry. Based on a large number of measurements, the infrastructure provides feedback to the specific manufacturing companies. CzBI also carries out its own methodological research and development, the results of which are communicated to the microscope developers as well. The CzBI RI directly provides the manufacturers with ideas for improvements and further developments of imaging technologies. CzBI RI focuses on stimulation to technical advances and innovations in the area of microscopic imaging, hence it maintains continuing collaborations with Czech imaging device manufacturers. Some of those businesses are considered the world's leading manufacturers. Through regular courses and seminars, infrastructure users interact with technology vendors. This adds to greater efficiency in the development of new biotechnologies and therapies, as well as preparing joint projects with companies.

Another significant benefit is popularization of imaging methods and influencing public opinion. CzBI RI aims at raising awareness of the progressive imaging methods in public and among readers and students by organizing TV or broadcast relations, popular articles and competitions for students.



## 3 CzBI RI structure and governance

CzBI was established as a harmonized national network of top imaging facilities interconnected via a central hub predominantly covering management, logistics, and training functions. It began its work on the 1<sup>st</sup> of January 2016. The individual facilities are located at universities and research institutes of the Czech Academy of Sciences (CAS). Facilities involved in the CzBI consortium are distributed across the Czech Republic, and all of them are in full operational mode.

### 3.1 The structure of CzBI RI

CzBI is a distributed infrastructure of thirteen core facilities from nine legal entities in the Czech Republic. The host institution of the CzBI RI is the Institute of Molecular Genetics, CAS, which also hosts the CzBI RI administrative headquarters (hub) and acts as the recipient of infrastructure projects.

The relations within the infrastructure, the management of the infrastructure, and the rights and obligation of partners are laid down in the CzBI Partnership Agreement, which was concluded in 2016 and. The IMG performs the role of a coordinator and beneficiary of the national infrastructure CzBI and its relevant projects. Other partner institutions – hosting institutions of the CzBI facilities – have also committed to the infrastructure. All of them are well established institutions with settled administrative support. The CzBI observers with limited rights are not a legal part of the consortium.

CzBI RI itself does not form a legal entity. As for the ethical or legal questions (e.g. GMO, testing animals, radiation etc.), the compliance with the legal requirements is under responsibility of each individual partner of the RI.

### 3.2 Governance

The CzBI RI governance model has been designed to secure the interdependence between the decisionmaking, management and operational bodies of CzBI RI in order to function as an

integrated RI and align the interests of all CzBI stakeholders. The governance structure of CzBI RI will comprise four levels including a governing, an executive, an operational, and an advisory level.

#### 3.2.1 The Supervisory Board

The highest decision-making body is the Supervisory Board which consists of the statutory representatives or their nominated representatives from each partner institution. The statutory representative of the IMG acts as a legal representative of the CzBI RI.

#### 3.2.2 The Steering Committee

The Committee consists of leaders of imaging facilities of partner institutions and is presided by the director of RI. As a control authority of RI, it is held accountable to the Supervisory Board. The Steering Committee monitors the overall state of development of CzBI and suggests its future direction.

#### 3.2.3 The Advisory Board

The Advisory Board is composed of 10-13 high-level scientific experts from academia and industrial sectors, elected by the Steering Committee. It provides feedback to the Supervisory Board regarding the direction of CzBI RI and makes proposals to improve its functioning. The Advisory Board also periodically evaluates the scientific program of the CzBI, the quality and relevance of planned technologies, as well as facilities, and that of achieved results.



All of the above-mentioned governance bodies have their own Rules of Procedure document, which defines necessary rules of convention, rules for becoming a member, voting rules,

meeting regulations and rights and obligations of the committee and its members. The CzBI RI utilizes different forms of voting depending on the issue in question including secret vote, public vote and “per rollam” on-line vote.

### 3.3 Management

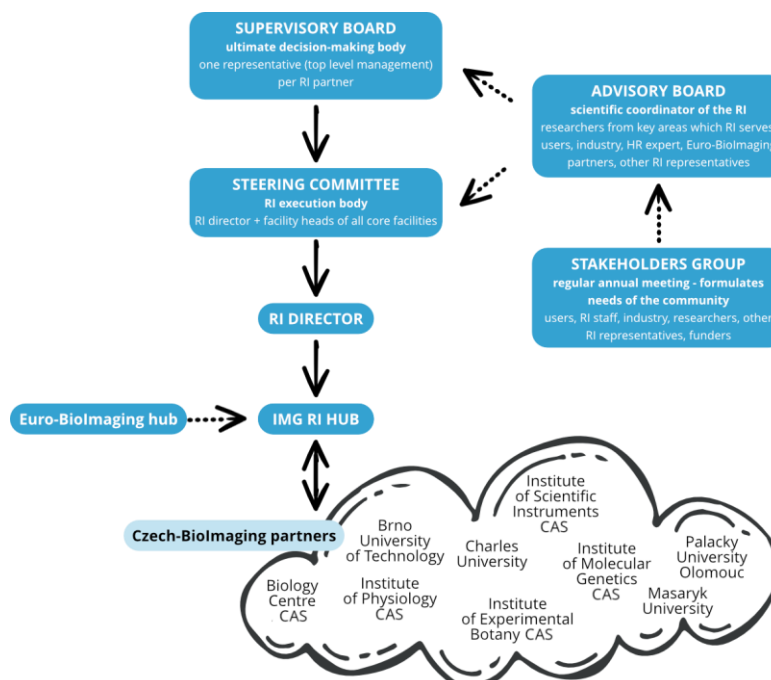
As the CzBI RI is not centralized but geographically distributed, there are two concurrent streams of administration as well as scientific management within the RI, one for the infrastructure as a whole and one for the individual partners. There is great synergy between these two components as they function in mutual cooperation coordinated from the position of the administrative centre located in the hub and scientific centre represented by the Steering Committee. Therefore, on the main, general level or operation and organization of the RI, there is the Steering Committee as a principal instance that deals with questions about the overall scientific development of the RI. On the more specific, componential level, there stand the partner facilities with their, to a degree, independent administrative, scientific and technical staff. These members perform, maintain and accomplish the mission of the CzBI RI universally decided upon by the Steering Committee. Formally, the contractual relations between the partners are defined in the

Partnership Agreement on the National Infrastructure for biological and medical imaging.

The RI’s management is divided into a scientific part and administrative part. All organs of the CzBI RI that constitute the management and organizational structure ensuring maintenance, operation and development of LRI as introduced in the above described arrangement are visualized in the chart below.

#### 3.3.1 Scientific management

On the scientific level of management, the aim is to deal with the fulfilment of the set research objectives. A key role in determining strategic goals and long-term goals is played by the Steering Committee, controlled by the CzBI Supervisory Board. The members of the Steering Committee participate in work groups on the main areas of the infrastructure, monitor the overall state of development of the RI and propose its future direction. CzBI RI is represented externally by the Director, who works closely with two Vice-Chairs and the heads of six working groups (work group areas: open access support scheme, educational activities, implementation of new technologies, data management, facility evaluation, legal and logistics issues). All important issues are discussed at meetings or via email communication. Voting is governed by the rules set out in the Rules of Procedure document.





The leaders of the CzBI Observer facilities are welcome to participate in Steering Committee meetings and discussions, but without the right to vote. This will change if they are officially accepted as members of the consortium.



### 3.3.2 Administrative management

The administrative level of the infrastructure management is primarily represented by the infrastructure hub established at the host institution (IMG). The hub team, in close cooperation with the Director and Vice-Chairs of CzBI RI, deals with the management in general, methodological management, as well as coordination of the infrastructure activities. The responsibilities of the administration also include communication with grant providers, grant agencies, audit authorities, and monitoring compliance with monitoring indicators. If necessary, the hub (namely the manager or administrative staff) asks for additional support data from administrative staff from partner institutions or directly from the leaders of the imaging facilities.

**Table 2 CzBI observers**

OBSERVER INSTITUTION	LOCATION	CORE FACILITY
Charles University (CUNI)	Prague	The Imaging Methods Core Facility Viničná
Institute of experimental medicine (IEM)	Prague	Microscopy facility IEM
Institute of scientific instruments CAS (ISI)	Brno	Laboratory of advanced electron microscopy

The hub also acts as a secretariat of the managing and advisory bodies, maintains websites and databases, coordinates the participation of CzBI in EuBI ERIC, seeks new funding opportunities, coordinates educational and awareness-raising activities and organizes regular meetings and annual conferences of CzBI. The team also collects and processes data from external infrastructure users needed for course evaluation and the quality of services provided by each facility.

The main tool for information sharing within CzBI RI is e-mail communication, web pages, intranet accessible from the web pages, where the minutes of CzBI bodies and other approved documents are stored, which are available to CzBI members upon login, other online tools (e.g. Skype, Zoom), and regular meetings of managing and advisory bodies. The day-to-day infrastructure administration is optimized to be cost-effective and simple at the same time.

### 3.4 Joining CzBI

The infrastructure has developed “Requirements for facilities - candidates that would like to join the CzBI research infrastructure” (for more informations see CzBI websites or Annex 1). To become a part of the CzBI, the candidate has to successfully go through two phases. Firstly, as a rule the facility should become an observer, ideally for 1 year, before it applies for a full membership. It is recommended to become an observer approximately 24 months before the expected date of submission of the Czech-BI application for a new grant (i.e. 36 months before the beginning of the new operational program). In 2020, three candidates were accepted as CzBI observers (see Table 2). They will be further assessed to meet the

requirements for admission and becoming full members of CzBI RI in 2021.

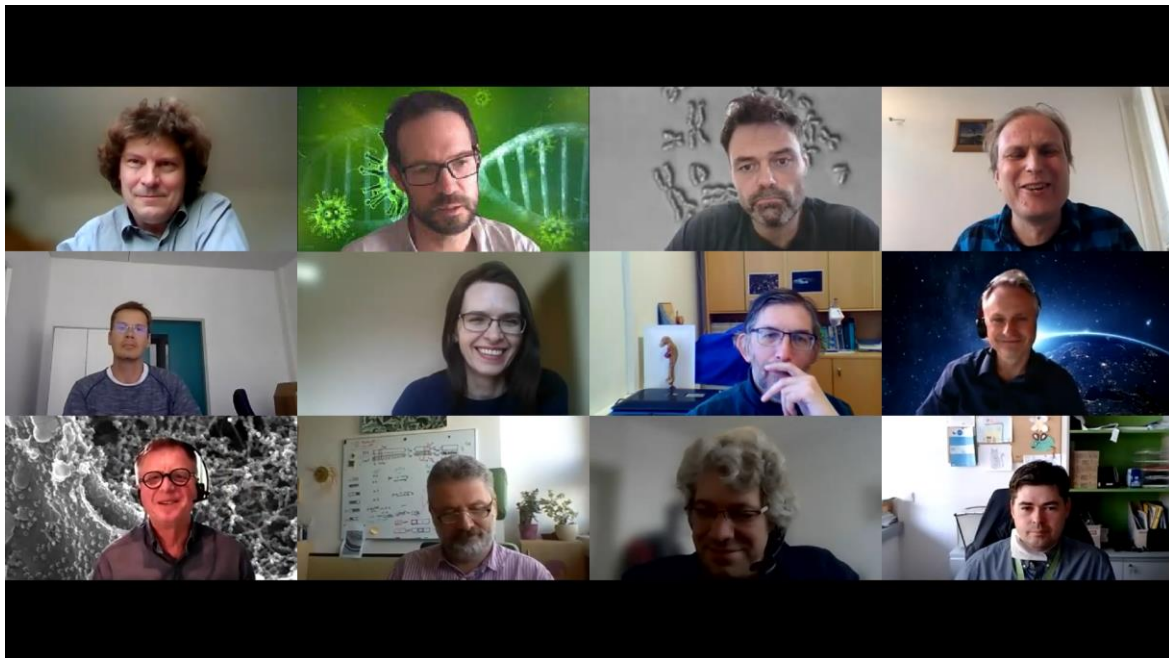
### 3.5 Review, update and discontinuation of RI elements

CzBI RI will be active for at least 20 years. It will be responsive to the changing requirements of the users and will be at the forefront of trends in research and innovation. To achieve its mission, CzBI RI implements procedures to receive and respond to feedback from its users and to monitor trends in scientific research, national and European priorities and societal needs. Regular internal and external reviews contribute to maintain excellence standards, to revise outdated methods and infrastructure and to introduce the latest equipment and technologies.

CzBI RI strongly values feedback from the end users. The positive and negative results of evaluation and satisfaction surveys lead to

subsequent awareness of the strong and weak points of the RI. Importantly, the evaluation results provide the needed impulses that can be discussed at the Steering committee meetings and they may give grounds for general growth of the infrastructure in terms of improvement of available services as well as budgetary decisions for new technologies purchase that are indicated to be demanded for research projects.

The Advisory Board also periodically evaluates the scientific program of the CzBI, the quality and relevance of planned technologies, as well as facilities, and that of achieved results. The review process take place every two years and it is coordinated by the CzBI hub and implemented at the facilities. The review report should identify shortcomings, bottlenecks and problems and suggest improvements to services. The CzBI Advisory Board makes recommendations to ensure that CzBI maintains top-quality services and cuttingedge facilities. The recommendations and advice guide plans for joint research and development activities.



## 4 Technical description of CzBI RI

The most important aspects of the CzBI infrastructure agenda are ensuring the availability, quality, and further development of the services provided by the CzBI infrastructure (see above) and further sustainability of these services. Ensuring, in particular, i. access to the high-end technology and advanced equipment for the users of the infrastructure; ii. the introduction of new biomedical imaging technologies; iii. development of display centers in the areas where the required technologies are not yet available. In a broader context, the CzBI infrastructure contributes to superior quality data and competitive scientific results which have a lot of potential to be applied in practice.

CzBI is built upon some of the most advanced and well-equipped imaging facilities and laboratories in Czech-Republic. CzBI RI covers a wide range of biomedical imaging – from biomolecules in the nanometers range up to whole tissue and organisms, including humans in healthy and/or pathological conditions. In terms of modalities, we are able to image molecular interactions, structures and processes in cells/tissues/organisms, in healthy and pathological conditions. The availability of these technologies for the scientific community is a prerequisite for maintaining the competitiveness of the biological and medical sciences in the Czech Republic.

### 4.1 Available imaging technologies and methods

#### 4.1.1 Biological imaging

Biological imaging is represented by facilities offering a wide range of imaging techniques and modalities in the field of light and electron microscopy. In light microscopy techniques, services are mainly focused on fluorescence imaging with widefield systems including TIRF modality, confocal microscopes – both point scanning and spinning disc, lightsheet microscopy, intra-vital two-photon microscopy, functional imaging using FLIM and FCS, and super-resolution imaging using different technologies – Airyscan, SRRF, SIM, STED, SMLM

(STORM, PALM, etc.). Some facilities also offer label-free imaging modalities using quantitative phase imaging, CARS, SHG, THG, two-photon autofluorescence microscopy, Raman microscopy and atomic force microscopy. All instruments and techniques are always accompanied with advice on sample preparation and help for data acquisition and analysis. In electron microscopy, CzBI RI offers routine and cryo-transmission techniques, electron tomography, immunolocalization in TEM and STEM mode, 3D reconstruction using FIB-SEM and SBF-SEM methods, analytical electron microscopy (EDS), high-resolution (cryo-)SEM and correlative light and electron microscopy (CLEM). In addition, sample preparation methods including high-pressure freezing and plunge-freezing, cryo-substitution, preparation of ultra-thin sections, immunolabeling on sections and in sample volume; preparation and immunolabeling of replicas after freeze-fracturing are provided. Post-acquisition services include processing and analysis of image data, 3D rendering and time-lapse sequence analysis in multi-channel mode, objects tracking, measurements in various software modules, development of new methods and plug-ins for image analysis and methods for biomechanical analyses, 3D visualization by virtual reality.

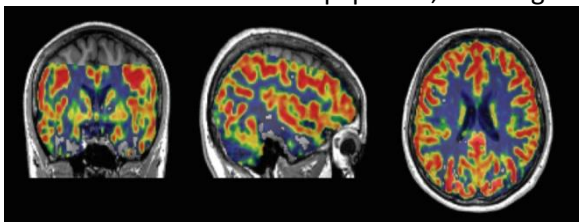


#### 4.1.2 Medical imaging

Medical imaging part is focused on in vivo imaging of animals and humans, which covers

various aspects of medical, biomedical, or even psychologically oriented research. Living systems can be visualized from the structural (anatomical) perspective, from the perspective of function, metabolism, or chemical properties, etc. The most emerging method is magnetic resonance imaging because of non-invasiveness and a wide range of observable parameters. MR scanners are available at 3 facilities (located in Prague and Brno), both for animal and human imaging. Metabolic properties can be visualized with PET, SPECT or optical imaging. This is the case of CAPI facility located in Prague, where a wide range of methods and devices can be used for really complex imaging of small animals. The two Brno facilities (MAFIL CEITEC MU and ISILMR) adopt slightly different approaches. ISILMR is focused on ultra-high field animal MRI with development of imaging methods. MAFIL is focused on human 3T imaging combining various MRI techniques (with special attention to functional MRI) with simultaneous or standalone electrophysiological measurements and non-invasive brain stimulation. Therefore, these three labs are complementary to each other and attract different segments of users. On the other hand, some users can benefit from the possibility of translation of knowledge between the human and animal level or from stronger methodological and technical support in the field of MRI given by close collaboration in this field. This is the case of understanding various human diseases, in case any proper animal models exist (e.g. neurodegenerative diseases). Newly, the portfolio of animal imaging techniques is extended by the fourth facility in Olomouc (UPOL). While animal imaging is bound with medically oriented research, human MRI can offer broader application – MRI is used in social science and humanities (e.g. psychological research, social interactions, and religion), education, economy, anthropology, etc.

The mission of the infrastructure is to provide access to excellent imaging technologies. This includes access to the equipment, training of



users, support to set-up user projects, data processing and consultations to obtain sufficient data. In case of medical imaging, there is a more important role of advanced user support, consultations, and data processing and less important role of user training than in microscopy labs. The medical imaging facilities operate more often in full-service mode than in self-service. Therefore, the medical imaging facilities need more technicians/operators, technical specialists, data processing specialists, and other experts to help users with their projects. The organizational aspects, processes and workflows are mainly focused on complex projects managed by larger research teams than on single measurements managed by individual users.

## 4.2 Implementation of New Technologies

The most important aspects of the CzBI infrastructure agenda are ensuring the availability, quality, and further development of the services provided by the CzBI and further sustainability of these services. Ensuring, in particular, i. access to the high-end technology and advanced equipment for the users of the infrastructure; ii. the introduction of new biomedical imaging technologies; iii. development of display centers in the areas where the required technologies are not yet available. In a broader context, the CzBI contributes to superior quality data and competitive scientific results which have a lot of potential to be applied in practice.

### 4.2.1 Expansion of the technology portfolio

The efforts to continually develop the infrastructure include monitoring of technological development and trends in the field of biological and medical imaging, including participation of experts from the research team at prestigious conferences, where the leading academic developers and industrial manufacturers can present their products and technological advances and the scientific community presents visions and future trends in biological and medical imaging.

The Workgroup for Implementation of new technologies was established to define procedures for identification and implementation of new technologies in the CzBI portfolio.

Standard research grants and projects often allow purchase of advanced and unique instrumentation. However, it is much harder to get financial support for reinvestment – to replace outdated standard “workhorse” equipment, which is a problem for core facilities offering routine services on standard instruments. The field of bio-imaging evolves so fast that it may be very impractical to establish a long testing procedure for official approval of the emerging technologies, especially if some of them can be quite cheap.

The main goal is thus rather an establishment of procedure how to distribute the CzBI financial resources among existing and newly emerging technologies to enhance long-term sustainability and equal development of the whole CzBI network with a focus on user needs, than which technology should be approved and which not. The procedure should be dynamic for “easy to obtain and maintain” technologies, but rather strict, requiring the consensus within CzBI, for large-scale strategic projects involving heavy investment and high running costs.

#### 4.2.2 The procedure for selecting new technologies

Based on the analysis of current situation and the identified risks the following procedure was suggested:

1. To create a database with the complete list of instruments included within CzBI, which include the years of purchase and upgrades, the purchase and upgrade prices, the usage of the instrument broke down to outside facility users, services, internal facility usage, teaching, education, service and upkeep downtimes. If possible, the running cost of the instrument could be included. The database serve as a guide in assessment which instruments need to be replaced (reinvested), which are obsolete and can be decommissioned, which technologies are

sufficiently covered (enough free capacity) and which need extension.

2. Facilities are free to include any new bio-imaging technology provided they do not request any funding for purchase and running costs – they run it on their own risks.
3. Any request for investment and/or inclusion of technology funded from different resources, but requesting to cover running costs, must be submitted in a written form one month ahead and discussed at the Steering committee. The Steering Committee will set the priorities by discussion and voting. An advice from the Advisory Board may be asked for. The request should include information on the type of investment (replacement of existing microscope, new method, only running costs), targeted audience, expected impact on the research community in Czech Republic, expected usage and expected running and personal costs.
4. The investment and development priorities will be reflected in the CzBI grant proposal for the next funding period and in distribution of potential financial cuts requested by the provider.
5. Interaction with the user community shall be organized on two levels - local user meetings and a global user meeting attached to CzBI conference. Two way communication shall be established – listen to the user needs and introduce them potentially interesting technologies. The user meeting would have four sections dedicated to the main four areas: optical microscopy, electron microscopy, large-scale imaging and data analysis. The report from the user meeting will serve as supporting information for investment decision making.



## 5 Access to the CzBI RI

In general, the CzBI offers different modes of access:

- 1) CzBI open access. CzBI operates a single entry portal ([www.czech-bioimaging.cz](http://www.czech-bioimaging.cz)) with clear and transparent information on the RI itself, its instrumentation, services, access policy, training and events.
- 2) EuBI open access. CzBI also makes up the basis for EuBI ERIC nodes and for that reason the RI's open access policy is deeply embedded within the international research infrastructure. Cooperation within the EuBI ERIC continually brings foreign users to the facilities and it ultimately connects the Czech scientific community more closely with many scientists from different countries and contexts. CzBI in cooperation with EuBI, continues to further expand and strengthen its cooperation and attraction of foreign scientists. To submit new proposals and access imaging technologies at any of the EuBI Nodes, the users have to visit the new EuBI Web Portal:  
<https://www.eurobioimaging.eu/about-us/how-to-access>.
- 3) Other access modes (e.g. collaborative projects). As the CzBI is a distributed infrastructure, the concrete rules for collaborative and contractual R&D projects are set by the individual CzBI partners. The role of CzBI is to serve as a platform, where the proposals for joint projects emerge and are discussed, and also to promote the Czech imaging facilities among potential commercial partners.

**Table 3 Open Access Services**

<b>User</b>	User has the opportunity to use instant access to cutting-edge imaging technologies, support by high-level trained staff, single point of access to facilities, technologies, and other relevant information via web-based portal, and central contact point for consultation of potential user.
<b>Head of a Facility</b>	The head of facilities participating in CzBI take care of scientific evaluation of user proposal coordinated by hub, quality management and assurance („quality seal“), and user visits at the facilities via Open Access.
<b>Hub</b>	The CzBI hub is responsible for coordination, communication, & support of access, and data and is accessible via the CzBI web portal.

### 5.1 User Access Policy

CzBI is a consortium of nine institutions. These institutions provide an open access to their instrumentation and expertise in biological and medical imaging. All users are welcome to apply for the CzBI open access. The CzBI access policy is formulated in accordance with the European Charter for Access to RI. Open Access is efficient, supportive, transparent, and open at the point of service for the user. The CzBI user will be granted access to required resources (e.g. access to instrumentation, expertise, training, data software and analysis tools) at all stages of the research project.

### 5.2 CzBI Open Access - Principles

CzBI is a distributed infrastructure that provides an open non-discriminatory access to its instrumentation and expertise. CzBI provides transparent information to (potential) users on the access rules.

CzBI through the hub and individual nodes (core facilities) support their users by providing training, advice on selection of a suitable instrument for a project, on project design/execution and evaluation, and by providing temporary repositories for image data.

The users entering the core facilities in the CzBI open access mode are requested to register and submit a project into the CzBI database of users.

Users are obliged to acknowledge CzBI in any output (publications, patents) and public presentations that were created by using the CzBI instrumentation or expertise. Users have to conform to the concrete access rules of the CzBI core facility they visit. The intellectual property created within the project is the property of the user (unless agreed otherwise).

### 5.3 CzBI Open Access Methodology

CzBI open access is an excellence-driven access mode, which is exclusively dependent on the scientific excellence, originality, quality and technical feasibility of application. The CzBI RI is open to any users that express their intention to use the RI's equipment and expertise on the condition that the proposed project meets the above-mentioned standards of excellence. More than 80% of the instrumentation capacity is devoted to the direct support to CzBI infrastructure users. The rest of the capacity is devoted to the development of methods offered to the infrastructure users and the necessary instrument maintenance as part of scientific projects. The high-value proposals are given a priority if there is a capacity bottleneck. However, in practice, we rarely encounter such situations as the infrastructure is now robust enough to accommodate quickly most of the projects.

A visualisation of the whole open access methodology can be seen in the scheme below. At the beginning of the process, the user is requested to submit an on-line application in a form of a web based unified form available at the CzBI website. The application is sent to the requested CzBI facility for review and



confirmation in terms of feasibility and available capacity. Depending on the complexity of the application, the head of the facility may request additional external evaluation. In case the application is declined by the facility, a more suitable core facility is suggested to the user by the CzBI RI hub to sustain the mutual cooperation.

According to the level of proficiency of the project in connection with its complexity, a contact person for direct communication with the user is assigned. This contact person communicates primarily with the user regarding design of the project, sample preparation, and discusses the time and instrument allocation for the project and training requirements at the facility.

The minimum standards of access support cover: assistance in preparing for the measurement including consultation of experimental design and specification of the work-flow (e.g. what samples the user plans to bring, what is available at the facility, what would be the best way of sample preparation, safety issues, etc.), and administrative preparation (e.g. requested permissions, safety trainings). Depending on the user's needs, different levels of service are offered – from mere technical assistance during the measurement to a full service including all stages of experiment preparation, execution and data analysis/evaluation.

After the project has been accomplished, an evaluation process begins to determine, whether the objectives of the visit were accomplished. This evaluation is done in a form of mutual cooperation between the user and the local representative of the facility. A consideration of a possible follow-up is also taken into account - e.g. a need for a repeated visit, a need for additional pilot feasibility studies of more complex projects, improvement of sample preparation etc. This evaluation is complemented with a short on-line satisfaction questionnaire (standardized within the RI). This feedback is used for improvement of services and for the RI to become more flexible in its efforts to maximally customize the provided services for the specific needs of users.

A detailed diagram of the entire process for each CzBI facility is shown in the Technical Annex.

# 6 CzBI Activities

## 6.1 Education and training

An important part of the services provided by core facilities involved in the CzBI project is the dissemination of the knowledge on biological and medical imaging. The majority of participating institutions have a long-term experience in teaching and training for different levels of users through practical and theoretical courses, annual workshops on new imaging techniques etc.

CzBI has established and operates a service dedicated to the organization of CzBI education and training courses at the CzBI facilities as well as to related activities such as promotion, updating and monitoring of these courses.

The service:

- Advertise training initiatives in the biomedical imaging (CzBI Hub)
- Attract and actively capture new training initiatives
- In-house staff training for best practice, career development etc.
- Offer services to training and education organizers and participants, including application and registration
- Offer a dedicated e-learning webpage to facilitate e-training
- Allow long-term follow-up of training events and trainees

This service maintains a web portal on training and education that includes a centralized information resource with searchable



catalogues, targeted to people in search of training possibilities related to biomedical imaging. Calls are distributed within the CzBI RI to solicit proposals for new courses and select ongoing course programmes for incorporation in the CzBI training and education programme. Data on performance, effectiveness and impact of CzBI courses are collected from participants in order to produce assessment reports. A quality control procedure aid scertification of the courses.

The Workgroup on Educational Activities was established to coordinate these activities and prepare the rules for the selection of training programs for financial support. Every year, the Workgroup creates the proposal of teaching activities eligible for financial support, which is submitted to the Steering Committee for decision.

### 6.1.1 Educational activities for CzBI RI users

CzBI focuses on providing education in biological and medical imaging, through regular training of users and the organization of specialized courses for different audiences ranging from students to scientists and CzBI RI workers (researchers and technicians). Training includes practical and theoretical courses for master students and PhD students, seminars, and workshops on new imaging techniques, etc.

#### Types of courses

We distinguish three types of educational activities due to the degree of financial support and connection with the infrastructure

- 1) CzBI supported courses are without financial support from RI, however they are focused on the topics related to CzBI and are solely advertised via CzBI media
- 2) Courses financially supported by CzBI met the eligibility criteria for financial support and are (co)organized by the operational team
- 3) CzBI Certified Courses met the CzBI certification criteria



## Course Eligibility for Financial Support

For training courses to be supported by CzBI, they have to meet the following conditions:

- The organizing institution/facility has to be a member of CzBI consortium
- The course has to focus on imaging methods and image analysis used in biological and biomedical imaging
- The working language has to be English
- The minimum number of participants is 10
- The training course organizer has to submit a report within 1 month after the last day of the course to Working group leader

At the beginning of the calendar year, the working group for educational activities prepares a proposal of selected courses that meet the above criteria, which must then pass the approval of the CzBI Steering Committee.

CzBI courses, which meet the financial support criteria, must acknowledge the CzBI financial support in the following manner: “We acknowledge the course is supported by the CzBI large RI project (LM2018129 funded by MEYS CR).”

## Course Certification

The training providers will have the opportunity to obtain the recognition of “CzBI Certificate” for the training activities presented through CzBI when meeting all the certification criteria. This recognition indicates a high quality training

activity as regards to the contents and organizational aspects. The courses, which meet all certification criteria, are eligible to use the “CzBI certified event” stamp in media and must acknowledge the CzBI financial support.



## Training Course Assessment

The course assessment of participant satisfaction is organized by the Hub and is done via electronic form. The assessment can include a complementary part (typically, assessment of the scientific part), which is specific to each of the courses and is performed by the organizers (on-line or on site). The Hub is available to assist with the collection of the complementary questionnaires on-line.

The satisfaction questionnaire contains questions about the general components of the course/workshop. The Hub evaluates the course assessment and informs the course organizer and the Steering Committee about the results.

**Table 4**

Criteria	CzBI Certification	General Training Course
<b>Definition and transparency of the access rules</b>	Open access to the course equally open to the international participation and actively advertised	Restricted access to the course or no active advertisement
<b>Predefined set of teaching objectives and outcomes</b>	Course has a comprehensive description: Topics and skills description Quality of the program Quality of the teachers	A short description of the course is available
<b>Assessment of the participants' achievements</b>	CzBI specified assessment is implemented	No or non-CzBI assessment is implemented

## 6.1.2 Development of staff skills and expertise

Constant education of top management and leaders of the facilities outside the field of biomedical imaging is considered very important. In 2017-2019, the Director of the CzBI RI participated in the program Executive Masters in Management of Research Infrastructures held at University Bicocca in Milan, where he developed his skills for leading LRI with global impact. In late 2020, members of the Steering Committee attended a workshop focusing on development of soft skills, more precisely on techniques to achieve consensus and improvement of communication and cooperation skills, and these educational activities will continue on yearly basis.

The professional growth of specialized staff is greatly encouraged. Participation in training, conferences, seminars and workshops (with a special emphasis on the acquisition of new technologies and methodological approaches) is a common tool for increasing proficiency of all personnel. The facility members regularly participate in training events organized in cooperation with Euro-Biolmaging ERIC. In the future, we plan to focus more on other opportunities, like International Job Shadowing Program of Global Imaging, which has been attended by several of our scientists in the past and proved to be very beneficial. Our employees are further motivated with a friendly and highly professional working environment and adequate financial remuneration.

## 6.2 Users projects / grant scheme

CzBI works closely with scientists in order to achieve the best scientific results also in previously unexplored areas. For this purpose, we developed a scheme of specific “methodological grants” for users projects which carry a strong innovative potential, which require pilot experiments to assess the feasibility of the projects, or to test a new technology. This will keep the RI in close contact with the leading research teams utilizing this cutting-edge instrumentation and microscopy techniques in

different research areas like plant biology, cell biology, immunology, physiology, neurobiology, and others.



CzBI provides financial support in performing projects within the CzBI open access to users from all over the world. The aim is to promote open access to the core facilities participating in the CzBI RI.

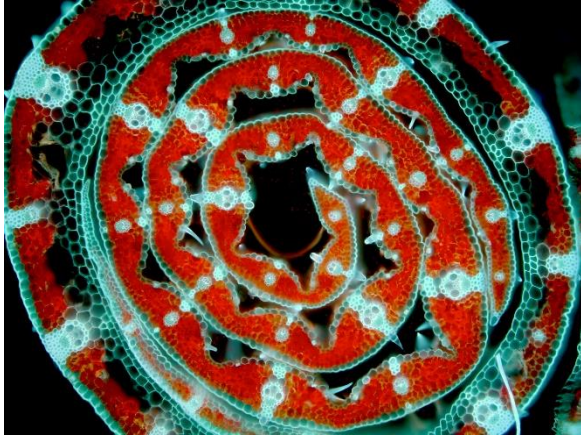
The Workgroup on Grant Scheme has been established to attend to the preparation and realization of a competition for financial support of internal one-year projects from the CzBI budget to be carried out at the CzBI core facilities. Specific focus of the Workgroup is to attend to the conditions of the calls, approval of on-line application forms, time schedule of the calls, discussion with the Steering Committee on the process of evaluation of proposals, preparation of the proposed list of supported projects to be approved by the Steering Committee, and checking the project outputs.

### 6.2.1 Applications and Call schedule

Applications have to be submitted via an on-line form. Researchers working for academic institutions and conducting independent/basic research, e.g. universities and research institutes can join the call. Both Czech and international applicants are welcome (EU or non-EU). The call is not intended for companies.

The centralized call for project proposals is now open twice a year. The deadline for applications is usually September 30 and March 31 with the

evaluation period October 1 – November 30 and April 1 – May 31. The duration of grants is 12 months starting on January 1 and July 1. The final reports of supported projects must be submitted within 30 days from the end of the project implementation.



## 6.2.2 The proposal evaluation

Every application is being reviewed by an internal evaluator and an expert panel composed of members of the Steering Committee, no external evaluators are engaged.

The formal check of the proposals is handled by the CzBI hub. Then, in the first stage, the proposals are evaluated by respective core facilities (where the projects should be carried on). In the second stage, the proposals are split into 4 internal expert panels (with members from different regions each): light microscopy, electron microscopy (including CLEM), medical imaging and image data analysis. The ratio of tentative budgets allocated to these four panels will be based on the ratio of total requested budgets (sum over all projects) for these panels. The workgroup on grant scheme will check the merged evaluation results and pass to the Steering Committee for approval.

The final reports about the results of each project will be collected by the CzBI hub. Problematic cases will be discussed by the workgroup on grant scheme.

### Evaluation criteria

- Methodological importance and impact on the future development (Is the project original, new and/or important from the methodological point of view? Are the outcomes important for the development of

the research facility and improvement of service usability?)

- Scientific excellence (Is the science sound, exciting, promising to bring important new data relevant for the current level of the field?)
- Importance of outcomes for a wide scientific community in a given field
- Feasibility of the project when considering the research approach, team size and duration of the project
- Methodological appropriateness

## 6.2.3 Funding

The financial support is transferred directly to the CzBI core facility, in which the project will be performed. Following costs are eligible for financial support:

- Contribution to the verifiably incurred costs for measurement – data acquisition
- Imaging related sample preparation (special chemicals, labels, etc. – not general lab consumables)
- Data processing and analysis

The support does not include travel costs, accommodation and daily allowances.

## 6.3 Data management

The imaging core facilities involved in Czech-Bioimaging produce a substantial amount of data that are unique and often arise from long-term and expensive experiments. Reconstruction, processing and analysis of these data frequently belong to customer services.

### 6.3.1 Data characteristics

CzBI handles the following data:

- Primary raw image data produced by its imaging instruments with the specifics of being typically very large due to multi-dimensional, multi-channel or multi-modal imaging modes
- Corresponding metadata describing how the acquisition was performed (image acquisition settings and protocols), when it was performed, who performed it, what was imaged, which staining or contrast-enhancing-agent was used if any, etc.

- Annotations of the acquired image data using plain text or graphical tools denoting specific parts of the images to highlight or classify the structures of interest; annotations are typically produced by experts (biologists or physicians) for the purpose of diagnostics or training automated image analysis methods
- Processed images after reconstruction, registration or image enhancement aimed at noise suppression and contrast improvement
- Image analysis results in the form of detected object lists, segmentation masks, trajectories or lineages of tracked objects, spreadsheet tables containing descriptors (characteristics) of detected or segmented objects, classification results, statistical results, various plots, etc.

### 6.3.2 Data ownership

The specifics of CzBI RI is that the data it acquires and handles are owned by users (more precisely by their employers) accessing the RI. This is valid for all 5 data categories mentioned above, i.e. not only for the raw image data but also for the data accompanying them or derived from them. The users can give CzBI RI permission to use the data for its own needs, such as promotion of RI (on Internet or in various media) or new image analysis method development but even in that case the users keep the ownership.



### 6.3.3 Data storage and management

There is no central RI repository, each CzBI facility is responsible for handling the data it produces in compliance with all applicable laws and regulations. Some institutions hosting facilities have lately issued data management

rules, others are working on such documents. Typically, the data is stored either locally in the facility (often directly on the computer that is attached to the imaging instrument) or on a central data storage server operated by the IT department of the hosting institution. The data storage servers operated at single institution level range from small NAS servers (tens of TBs) up to large PACS solutions (hundreds of TBs). There are no quotas on storage space per user or these quotas are negotiable to fit user needs. In any case, data are regularly backed-up, made accessible only to authorized users and special care is taken in the case of medical data to ensure security of any possible personal information. The user data is stored by the facility for a period of several months to several years. After that, the user is responsible for archiving the data (i.e., not the facility) unless agreed otherwise. For data transfers, secure Internet transfer protocols are used or CESNET FileSender service. CESNET also provides free data back-up and archiving services for academic institutions in the Czech Republic, which is welcome and used by most CzBI facilities and users.

### 6.3.4 Making data Findable, Accessible, Interoperable, Re-usable (FAIR)

As mentioned above, the user is the owner of the data and can decide whether to make the data (or at least information about its existence and access rules) public or not. Although CzBI facilities promote open science and FAIR principles, they can only encourage users to share the data with others. Unfortunately, most users choose to keep the data private either forever or at least while doing their analyses. On the other hand, more and more journals start requiring that authors publish the data along with the main paper, which contributes to the improvement of the situation.

If the user agrees to share the data with others and make it public, CzBI can help the users find the best option how to share the data and how to comply with the FAIR policy by taking the necessary steps to make the data:

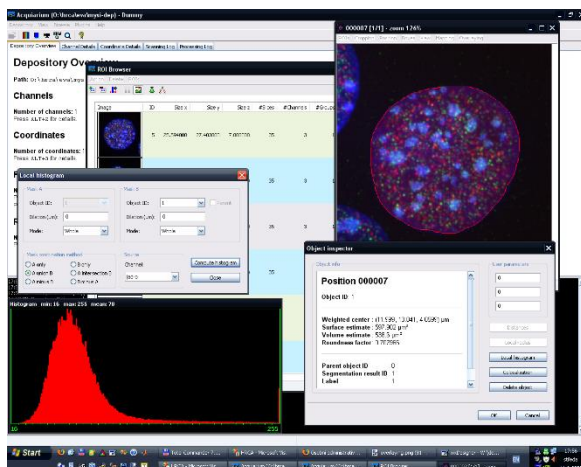
- Findable: by using globally unique and persistent data identifiers, by describing data with rich related metadata to foster

search queries, and by ensuring a solution with a user-friendly search engine providing a convenient way to find data;

- **Accessible:** through a cloud-based solution with sufficient number of dedicated endpoints along with adequate access control protocol to restrict access;
- **Interoperable:** using a well-recognized language such a JSON and standard vocabulary for all collected and stored data of all 5 types above;
- **Re-usable:** by choosing open-accessible databases whose content is fully or partially shared on demand with the right and relevant access control policy.

### 6.3.5 Image analysis

Image analysis has become an indispensable and highly demanded service, complementing sample preparation and image acquisition services. Multiple CzBI facilities have purchased several commercial licenses, especially Huygens (SVI), Imaris (Bitplane), Arivis (arivis AG), ZEN (Carl Zeiss AG) and Amira (Thermo Fisher Scientific) running on dedicated workstations, which are offered to the RI users – sometimes remotely and also to those who acquired the image data at other facilities. A dedicated IT infrastructure for large image data processing has been made operational at several facilities, especially CBIA, IMG and IMCF BIOCEV. CzBI has also increased the staff capacity for development of tailor-made solutions for image analysis tasks for which no software exists. This is realized



primarily at CBIA, IMG and IMCF BIOCEV – each facility contributes in their unique field of expertise. Also BUT has successfully developed

tailor-made software specialized in image processing and data analysis for Holographic Incoherent Quantitative Phase Imaging (hiQPI). IMCF BIOCEV has further improved their software for TTTR Data Analysis, offering users unique data treatments in the field of FLIM and FCS methods. CzBI also follows the recent trend in software development and started to use machine learning and artificial intelligence approaches for automated image analysis. To this end, GPU computing (required for deep learning) has become an indispensable part of IT infrastructure also for CzBI. Currently, a specialized GPU server equipped with 4 top GPU cards is being purchased at CBIA.

### 6.3.6 Vision for future data storage and image analysis services

Image analysis infrastructure (hardware, software, analysis services) will have to keep pace with the imaging instruments development (amount, complexity and throughput of delivered image data). Therefore, it is planned to maintain and regularly upgrade (typically each 5 years) hardware for storage, hardware for computing and software for image analysis. We will also continue following the latest development and monitor state-of-the-art methods, develop own methods for particular tasks and offer highly qualified image analysis services for both easy and difficult tasks.

## 6.4 Promotion of services and interaction with business subjects

The CzBI RI recognizes the importance of good public relations, and its primary public relations strategy is to promote itself to a wide range of audiences starting with the users on one end and general public including the media on the other. The aim is not only to attract the largest possible number of potential users, but to demonstrate how the funding has been used and contributed to the society in combination with taking the opportunity to engage possible stakeholders. The RI's collaborative approach has its centre in the hub but involves an active participation of all partners, which amplifies the outreach. The CzBI RI communication strategy focuses mainly on

researchers and students in biological and medical fields, i.e. the users. The overall objective is to get their attention and keep it for future cooperation. The RI communication activities of the CzBI hub are congruently supported by the nodes and PR units of RI partner institutions, which maximizes the impact.

The main tool for making the CzBI infrastructure visible is the **website** <https://www.czech-bioimaging.cz/> dedicated to the LRI. To fulfil the purpose of a main channel of communication with the users, the website contains information about the infrastructure, the services it provides, the list of available imaging techniques and expertise of the facilities including contacts information of all involved facilities as well as full information on the open access rules and application procedures. Additional intention of the website is to provide a basic overview of the RI to the general public, present its mission and disclose up-to-date events, news and important publications. The infrastructure is also presented on the websites of all partner institutions and on the websites of the MEYS [www.vyzkumne-infrastruktury.cz](http://www.vyzkumne-infrastruktury.cz).

The CzBI RI also displays **promotional roll-up banners** with summarized information about the facilities, their services and a geographical representation of their distribution throughout the CR, at all LRI events, mainly conferences, workshops and educational courses, in which the CzBI participates. Including the CzBI logo, these significantly increase the visibility of the infrastructure.

Promotion of the CzBI RI is fully integrated in the communication channels of the partner facilities. CzBI utilizes specific communication channels covering the Czech and international community and professional organizations (e.g. Czechoslovak Microscopy Society, Czech Radiological Society, European Microscopy Society, International Federation of Microscopy Societies, ELMI, Czech Society for Clinical Neurophysiology, Czech Neurological Society, European Network of Epilepsy Research etc.).

From the point of view of the visibility of the infrastructure, the regular participation of the CzBI representative on the **National Day of Infrastructures** is also important. In addition to

introducing the infrastructure to conference participants, we can actively participate in strategic debates on current policy-making topics for LRIs in the Czech Republic with other LRI directors, deputy ministers of industry and trade, environment, health and labour and social affairs, etc.

The communication strategy also involves organization of own conferences, workshops, seminars, invited lectures etc., which enables direct contact with (potential) users and increases the visibility of the LRI, and more broadly also of imaging modalities in general.



## 6.5 National and international connections

### 6.5.1 Interactions with other LRIs

The major area of interest of the CzBI infrastructure is developing a firm strategy of interaction with other large research infrastructures. The CzBI RI consistently works on establishing collaboration tools to engage with both transnational initiatives and local imaging research infrastructures. The aim is to create a foundation for long-term alliances of mutually beneficial cooperation internally and externally of the Czech Republic scientific community, to bring facilities together as partners and to serve the users as well as to broaden the scientific landscape of medical and biological imaging.

At the local level, the RIs partner institutions help link the CzBI infrastructure to other RIs included on the Czech Roadmap. These interactions are established with Czech Infrastructure for Integrative Structural (CIISB), which is also an Instruct-CZ node of Instruct-ERIC. The CIISB is providing expertise and access to technologies

used for integrative approaches to a structural analysis of biologically important cellular components and macromolecules - proteins, nucleic acids, and their complexes. Users of CzBI and CIISB have the possibility to use complementary techniques that are accessible through both infrastructures. For instance, users of CzBI are using cryo-electron microscopy operated by CIISB and vice versa, users of CIISB are using light microscopy and advanced imaging techniques of CzBI. Therefore, there is no competition between these two research infrastructures.

Another collaboration is running in the frame of ELIBIO project – interdisciplinary Centre of excellence between the RIs facility BIOCEV and ELI Beamlines laser facility. The focus of the project is exploring and elaborating new methods for measurements in structural biology on the basis of deep understanding of fundamental questions of physics. In this respect, a method of electron diffraction protein crystallography has a big potential. Currently, the CzBI RI is cooperating on establishment of this method using the 200 kV JEM-F200 “F2” installed at IMG EM CF.

The CzBI infrastructure also maintains a partnership with the e-infrastructure CESNET, which is a national RI for science, research and education. Among the most frequently used set of services belongs e.g. regular usage of data storage and backup services (datastorage, FileSender, ownCloud), identity management, remote user communication and security (CSIRT). Similarly, CzBI also collaborates with e-infrastructure e-INFRA CZ, especially in the area of long-term data storage and back-up. During the 2020-2022 period e-INFRA CZ should also install part of its networking and computational resources directly at the IMG to better serve the needs of bioimaging community in the Czech Republic.

The CzBI RI contributes the development of European and, by extension, global network of imaging and other related RIs. By its participation in several international infrastructures and individual projects, it helps to improve the inclusivity of access to highly specialized expertise, developed methodologies of operation and analysis of the resulting image

data. Finally, it facilitates exploiting the full potential of the cutting-edge imaging technologies available on the market.

CzBI sustains interactions with ELIXIR, the European infrastructure for biological information, supporting life science research and its translation to medicine, agriculture, bio industries, and society, representing essential parts of the Czech ELIXIR node. ELIXIR creates a bioinformatics platform accessible for a wide area of researchers and creates several biostatistical and analytical tools and workflows.

The CzBI RI is further connected to EATRIS, the European Infrastructure on Translational Medicine that brings laboratory research outcomes into new ways to diagnose and treat patients to improve the health of people worldwide.

The CzBI RI also collaborates with teams involved in COST infrastructure. In the frame of COST Action CA17121 (Correlated Multimodal Imaging in Life Sciences), a project is running aimed at optimization and development of methods for correlative light and electron microscopy. The experiments in the frame of CA15214 COST Action (An integrative action for multidisciplinary studies on cellular structural networks, EuroCellNet) involve electron microscopy studies of cytoskeletal components and their role in formation of intercellular contacts.

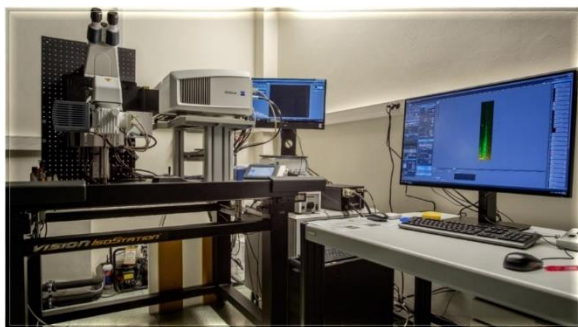


## 6.5.2 Part of EuBI ERIC

CzBI is closely related to European infrastructure EuBI ERIC, which is marked on the ESFRI Roadmap as an ESFRI Landmark. Following a two-year evaluation process by a panel of international experts, the European Strategy Forum on Research Infrastructures (ESFRI) has

granted EuBI the Landmark status of “European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences”. This status is recognised by the European Commission as a benchmark for quality, and recommends that EuBI ERIC is the “go-to” RI to support imaging research across Europe. The aim of EuBI, is to break down the barriers associated with biological and medical imaging. It is achieved by providing open access to imaging technologies, resources and expertise to scientists across Europe to alleviate the bottlenecks in their research. Since the end of 2019, EuBI ERIC was established with the Czech Republic as a founding member.

There are two existing EuBI nodes in the Czech Republic – one in Prague (residing at IMG), one in Brno (residing at MU). In 2013, both Euro-BioImaging national nodes underwent an independent expert evaluation, which, following minor changes, found them to be suitable candidates for European nodes. The Prague Node was highly rated for the breadth of imaging methods and the uniqueness of several high technologies in the European context. At the Brno node, the evaluation committee highlighted the quality research of the already functioning groups and the instrumentation of the whole. In 2015, a pilot operational phase was initiated and after the European Research Infrastructure Consortium (ERIC) was established in 2019, the project entered a fully operational phase.



In 2020, two additional CzBI facilities applied to join existing EuBI nodes and become members of Euro-BioImaging (ERIC) by submitting their Expressions of Interest as a part of 2020 Call for Nodes launched by Euro-BioImaging. Those were namely: Laboratory of Electron Microscopy, Biology Centre of the Czech Academy of Sciences to join the Prague node and Brno University of Technology, Central European

Institute of Technology Experimental Biophotonics to upgrade the Brno node. Both were ratified by the EuBI SAB in 2020. A third CzBI facility - Center for Advanced Preclinical Imaging at Charles University in Prague – 1st Medical Faculty applied to establish an independent node for preclinical imaging in Prague. The relationship between CzBI and EuBI ERIC is becoming closer, the more facilities join the nodes. Both currently existing Czech-BioImaging nodes actively participate at EuBI activities – individual scientists attend various meetings, working groups, etc. Additionally, both established EuBI nodes have signed Service Level Agreement with EuBI-ERIC, which provides the legal link between the Node and EuBI ERIC, and regulates the operation of the distributed infrastructure, in particular, mutual rights and obligations.

## 6.6 Audit, risk management and quality assurance

### 6.6.1 Risk management

A list of risks was developed during the operation of the CzBI RI. It detailed the potential risks and their owners, as well as mitigation strategies in the form of different scenarios, including alternative financial and technical options. These procedures should manage risks during the upcoming years to avoid disruptions to plans and/or cost escalations. Risk management procedures will be subject to external validation and review during the implementation phase.

#### Scientific and technological risks

Potential scientific and technological risks, threats and challenges occur in the areas below. The degree of the risk is indicated as follows:

(H) – high degree of risk, (M) – medium degree of risk, (L) – low degree of risk.

- Damage of instrumentation (H)  
Measure: Insurance of the instrumentation and facility which covers potential damage of instrumentation and property of the institution inflicted by research participants, staff or trainees/visiting students, etc.
- Medical imaging - insurance & safety of the research participants (L)



Measure: Adequate insurance is always contracted covering any infliction of injury to patients and property; proper information is provided to study participants; regular health & safety training of the LRI's staff take place.

- Insufficient expertise for a new planned instrumentation (L)

Measure: This risk is being prevented by on-going thorough practical training of the respective staff at the institutions with broad experiences in the field.

- Lack of experienced technical staff - the challenge of the RI development is to attract and keep highly skilled, knowledgeable and motivated staff. (M)

Measure: The CzBI RI supports the career development and training of technical staff, which is difficult to support from standard research grants.



- Insufficient supply of suitable graduates (H)  
Measures: The CzBI RI negotiates remuneration plans, selects undergraduates and trains them in the necessary areas, prepares good working conditions and opportunity for high-impact work and international experience, prepares individual career development plans.

- Non-efficient utilization of imaging data (M) - the challenge is to attract collaborations with mathematicians and statisticians for development of efficient and biologically relevant data mining routines, which would turn the overwhelming and still increasing amount of information provided by the technology into clearly understandable biologically relevant conclusions.

Measure: There are partners in the CzBI RI with expertise in data analysis and

deepening links with foreign teams dealing with this issue.

### Financial and legal risks

Political risks and threats of financial character take place in following areas:

- Tendency to atomisation consequently leading to relatively weaker engagement of the partners on the periphery (M)

Measure: The CzBI RI is incorporating politics of transparent management structure with equal rights of all partners, effective central system for the services offer, linkage and integration of training activities aim at all spectrum of services and expertise, common co-ordination of educational and PR activities, etc.

- Lack of financial resources necessary to cover operating and investment costs (M)

Measure: The CzBI RI as well as individual facilities are active in the search for other opportunities to obtain funding - participation in national and international grant competitions, institutional resource, etc.

- Different internal rules of the respective organizations (L)

Measure: Introduction of mechanisms and standards that help harmonize institutional differences with respect to the common RI's interests.

- Requirements for adjusting the partnership agreement (L)

Measure: The Workgroup for legal and logistic issues was established with the aim to simplify the procedure and present the Steering Committee members with proposals and recommendations. Representatives of both universities and the Academy of Science represent the Workgroup. Currently, there is a CzBI consortium contract covering the principles of operation of the RI and separate contracts for individual projects, which include budgets, performance of the mandatory indicators, etc.

- Investments to be used ineffectively based on individual needs instead of needs of the whole research community (L)

Measure: The LRI utilizes assessment forms from its users to see the areas of interest in the community. The infrastructure management also attends workshops to strengthen their soft skills and eventually implements unbiased decision-making strategies to determine investments.

- Necessity to change the planned equipment (L) - the reason may be (a) termination of production of the type of device, (b) significant increase in the price of required equipment, e.g. due to changes in exchange rates, Czech / EU customs policy, change producers' trade policies, economic crisis, etc., (c) radical shift in technological development in the field of biological and medical imaging and changing the key directions of research of our users.

Measure: Either the required specifications of the same or a similar type of device must be modified or replaced by another type of device. In the event of an emergency, the purchase can be made in part and additionally apply for additional funding from other means, even at the cost of delay and thus the moral obsolescence of the product. (c) Another measure is the continuous monitoring of technological developments and trends through the participation of experts in conferences, at which even leading manufacturers present their devices and technological solutions and the professional community presents trends in the field of biomedical imaging.

### Main challenges of CzBI RI in the course of the period 2023-2029

The main challenges for the LRI are i. selection of new technologies that are going to be complementary to each other throughout facilities ii. keeping or hiring highly qualified personnel iii. remaining to be a useful member of the EuBI nodes iv. continuing to be in close cooperation with the business sector v. continuing to increase the number of international and private sector users.

The LRI had to take into account several aspects of the planned technological development for the period 2023-2029. These are especially:

lifetime cycle of existing equipment, technological level of equipment and expertise used in standard laboratories, user requirements, new trends in technological development in the period 2023-2029, and available funding.

We performed the selection in a few steps: Initially, the individual facilities tracked the trend in the users' requests and feedback to determine, which upgrades are most demanded also considering their specific history and technological readiness of each facility. The



Steering Committee carefully discussed the propositions coming from the facilities, and agreed upon a set of instruments to be potentially included in the future portfolio also taking into account the proposed budget of the LRI. A list of the suggested new technologies as approved by the Steering Committee were afterwards forwarded to the International Advisory Board for evaluation. After the LRI obtained the recommendations of the Advisory board, it was submitted for discussion to the Supervisory Board.

To secure a top-class level of knowledge and technology expertise of LRI, we must also focus on the renewal of the busiest devices and the modernization of older equipment, which is still in use. The average lifetime of imaging equipment is 10 years, so we will have to upgrade approximately 2/3 of the current instrumentation in a time horizon of 7 years (2023-2029).

The key equipment and function modules planned for the given period are designed after

Careful consideration of all these aspects, with the combination of several of them playing a crucial role for most key equipment or function modules. As a whole, the investment plan is to contribute primarily to the CzBI infrastructure having equipment that will ensure the continuation of high quality services, with sufficient capacity and effective regional coverage. The investment plan also envisages the introduction of new technologies not yet offered within CzBI, such as the two new technologies mentioned above. The CzBI infrastructure has a high-quality spatial base suitable for the installation of all equipment. If construction and other modifications are necessary for the installation and commissioning of the equipment, they are either part of the submitted investment plan or will be provided by the host institution.

### 6.6.2 Quality assurance

Infrastructure is committed to maintaining high quality of service, so its employees regularly retrain and participate in training events designed to improve their skills. At the same time, the results of evaluation of imaging facilities by users are taken into account, as well as recommendations of the CzBI Advisory Board.

The Workgroup for Evaluation of facilities was established to define aims of internal evaluation of individual facilities (nodes) of infrastructure, and subsequently to define suitable criteria, framework, and procedures for this purpose.

#### Service evaluation by CzBI users

CzBI implements various ways to obtain the users' opinions and levels of satisfaction with services provided after they have completed their measurements. The CzBI RI obtains feedback from the users through personal discussion and through the user satisfaction questionnaire in order to improve the quality of provided services and standardize the process which helps to extend the access to imaging technologies and improve the quality of services provided.

The infrastructure dedicates the time to processing satisfaction questionnaires that are disseminated to the users periodically by the RI hub. The questionnaire is designed to gather users' opinions on the overall quality of the

provided service according to their previous experience at the respective node/facility.



The results have proven extremely helpful in order to standardize the processes, simplify access to imaging technologies and improve the practical circumstances surrounding the open access strategies. For more info see Annex X Service evaluation form – users.

#### Service evaluation by Advisory Board

There are differences among the facilities of the CzBI infrastructure. Some of these differences are given by different modalities and methodological focus of individual facilities (mainly differences between microscopic and medical imaging facilities); other differences are given by different historical situation (well-established facilities vs. the recently created facilities) and institutional background (different organizational, administrative, and economic principles for different institutions). The main goal of internal evaluation should be to prepare an overview of the current state of the infrastructure and to identify possible weakness and limitations for subsequent discussion focused on overall improvement of infrastructure. Where necessary, the outputs of internal evaluation and subsequent discussion should be used to make strategic decisions, such as distribution of the budget available to infrastructure among the project partners (institutions) and individual facilities.

Workgroup for Evaluation of facilities identified the following reasons for evaluation:

- Unification of service quality of individual facilities
- Contribution to outputs relevant for funder
- Relevance of financial need and outputs towards users and funder

- Evaluation of new facilities/partners joining CzBI
- Reasoning for future investments

The evaluation takes place every two years, starting in 2019. A subset (of members) of CzBI Advisory Board will be assigned to each CzBI facility based on their expertise. No other external evaluators will be sought.

Each facility will supply the completed documentation (see Annex A4). After the evaluation, the Advisory Board will provide the feedback to the facility leaders – a document pointing out the strengths and weaknesses of the facility. The Advisory Board will also prepare a complete report about CzBI RI, comparing the CzBI facilities and proposing further recommendations.

Evaluation outcomes/reports serve to Steering Committee and Supervisory Board of CzBI for further deliberations:

- Unification of service quality of individual facilities – how the facility abides to CzBI

policies and which level of quality is the facility up to.

- Contribution to outputs relevant to funder – budget distribution for future projects
- Relevance of financial need and outputs towards users and funder – budget distribution for future projects
- Evaluation of new facilities/partners joining CzBI – a YES/NO decision will be needed for new facilities to join
- Reasoning for future investments – budget distribution for future projects for investments

### GDPR

Within all services provided to users and in the subsequent processing of outputs (registration for open access, conferences and educational activities, entering data into reservation systems or surveys), we pay attention to compliance with the GDPR. The main principles are always set by individual partner institutions, and the CzBI hub helps to control and adhere to these principles.



# 7 Long-term planning and sustainability

## 7.1 Human resources

Our primary strategy is to maintain a balanced team composition and keep the quality of staff in all positions high. The most important aspects remain: constant search for suitable employees, their professional growth and securing financing of related costs. We follow basic principles and values such as transparency to the recruitment process, sense of fairness, objectivity, equality in opportunities and balance across categories such as gender, age, ethnicity, disabilities and other diverse backgrounds of the employees.

To ensure that the vacancies are filled by qualified personnel, we advertise job opportunities not only through job portals and CzBI website, but we also distribute the offers to partner and other academic institutions, MSMT, EuBI ERIC, etc. An important source are students, who are primarily the LRIs users. With the growing interest in imaging, some become involved in operation of the infrastructure and gradually become valid members of the team.

## 7.2 Sustainability of services

Maintaining a high standard of offered services depends on the modernization of the existing infrastructure equipment and the expansion of the portfolio of imaging methods. Therefore, we will continue to follow the latest trends in biomedicine and imaging, attend major conferences and exhibitions in the field, listen to user needs and ensure the development of infrastructure staff. At the same time, we will look for opportunities to participate in grant competitions, specifically focused on investment equipment.

## 7.3 Financing

Providing competitive salaries and enabling professional growth is key to maintaining qualified personnel. We focus on a long-term securing of resources for personal expenses and allocate a special part of the LRI budget to cover expenses for participation of team members in short trainings at other institutions to learn new or specialized techniques. At present, subsidies and operational programs of the Ministry of Education, Youth and Sports ensure the financing of the RI. The total part of the allocated funds for 2016 – 2022 represents more than 1,067 mil. CZK. The obtained funds are intended for operation and development of CzBI RI and cover personal, operational and investment expenses.

Financing of CzBI instrumentation is very demanding and requires careful planning. We are currently focusing on the operational program JAK, where we see opportunities for further infrastructure development. More detailed planning is given in the next chapter.



# 8 Financial Plans

## 8.1 CzBI financing overview 2016-2022

At present, subsidies and operational programs of the Ministry of Education, Youth and Sports ensure the financing of the RI. The total part of the allocated funds for 2016 – 2022 represents more than 1,067 mil. CZK. The obtained funds are intended for operation and development of the RI and cover personal, operational and investment expenses.

The CzBI RI was supported from these projects:

1/2016 – 12/2019

MEYS, "National Infrastructure for Biological and Medical Imaging (LM2015062)

194 mil CZK: personal expenses, operating costs

2/2016 – 4/2020

ERDF, "Modernization and support of research activities of the national infrastructure for biological and medical imaging Czech-BioImaging"

(CZ.02.1.01/0.0/0.0/16\_013/0001775)

330 mil CZK: equipment, buildings and upgraded facilities, operating costs, overheads

1/2020 -12/2022

MEYS, "National Infrastructure for Biological and Medical Imaging (LM2018129)

261 mil CZK: personal expenses, operating costs

and ERDF, "Modernization of the national infrastructure for biological and medical imaging Czech-BioImaging"

(CZ.02.1.01/0.0/0.0/18\_046/0016045)

282 mil CZK: investments, indirect costs

**Table 5 Overview of the costs of the entire infrastructure in 2016-2022**

Category	Funded 2016-2020	Anticipated 2021-2022
Operating costs	363,110,400	196,242,200
Investments	290,315,600	217,641,600
<b>Total</b>	<b>653,426,000</b>	<b>413,884,000</b>

## 8.2 Assumption of expenditures in 2023-2029

We assume that the infrastructure will continue to be financed mainly by EU and MEYS grants. The next financial cycle is set for the period 2023 to 2029. Based on the experience from previous years of RI operation and the gradual development of the operational team, services provided and instrumentation, we are able to determine the expected expenses for the given period. However, the accuracy of the expected financial expenses also depends on the possible expansion of the consortium with new member(s).

### 8.2.1 Capital requirements – Future CzBI RI investments

The infrastructure aims primarily at ensuring quality and further development of services provided to users. The basic precondition for the successful fulfilment of this goal is the equipment of the infrastructure and its condition. CzBI combines instrumentation in the total value of 1,629M CZK, while the average moral life of the equipment is around 10 years, for SW/HW about 5 years. To maintain the infrastructure equipment, annual reinvestments in instrumentation of approximately 1/10 of the value of the equipment are therefore necessary.

In the given period, there will be a severe need for technological upgrades and gradual reinvestments of technologies purchased before the year 2019. These devices are forming the core of CzBI RI facilities and their replacement will be needed to ensure the competitiveness of the RI. The total money for investments is planned evenly throughout the 2023-2029 period, but some shifts are expected to reflect the actual needs.

We have assessed 1,350M CZK for the renewal and modernization of the existing infrastructure equipment. This amount represents 70% of the price of current equipment plus a 20% increase (inflation, exchange rate changes, etc.).

Another approximately 270M CZK is intended for the purchase of new unique technologies, which will significantly contribute to the expansion of the portfolio of services provided to the user community in the Czech Republic.

Plans for future investments (beyond 2023) will be reviewed during the next 2 years considering new partners, user needs and strategic priority setting. Resources for such investments will have to be sought from core facilities through competitive funding calls and regular budgets.

### 8.2.2 Operational costs

We expect that the total amount of operating costs in 2023-2029 will reach up to 1,400-1,500 M CZK. In addition to MEYS large infrastructure support, other resources (institutional support, international and national grants) should be used to cover high financial requirements. We believe that we will be able to continue to obtain other resources up to 20% of the total non-investment costs. However, large infrastructure support of the MEYS is a key source of funding for us to ensure the functioning of the infrastructure and a high standard of services provided to users.

#### Personnel costs

Personnel costs account for approximately half of the expected total operation (non-investment) costs, necessary for the implementation / operation and further upgrades of LRI in the years 2023-2029. The costs were calculated according to the internal rules of individual partner institutions and include compulsory social and health insurance. Planned personal expenses are based on the actual level of wages and personal and risk premium and the compensation for vacation. The amount of above-tariff wage components is based on the average amount of the last year. As this is a long

period of time, the budget includes a wage increase of about 3% per year.

The structure of human resources is well balanced – 162 workers were involved in the operation of the infrastructure in 2020, most of them part-time. After the transfer to FTE, there is a very slight year-on-year increase in the total number of jobs, which is related to the development of the infrastructure and expansion of the portfolio of services provided. The increase between the current state and the plan for 2023 is also due to the expansion of infrastructure by three new facilities. Each of the individual categories of employees has an irreplaceable position in the CzBI implementation team.

#### Travel costs

Travel expenses relate to domestic and foreign business travel by infrastructure staff. It is mainly participation in specialized international and local conferences, workshops and seminars, especially methodological ones, whose aim was to strengthen the qualification of the CzBI team and contribute to improving the quality of provided services or to present the CzBI services in order to attract more external users. The staff also participates in training events abroad and internships at cooperating foreign institutions (imaging centers). Furthermore, the costs incurred relate to participation in workshops and seminars aimed at introducing new imaging techniques, demonstrations at imaging equipment manufacturers, and visits to partner institutions within EuBI or other high-end sites. Travel expenses related to participation in regular meetings of the Steering Committee and expenses of members of the Advisory Board of CzBI are also included. Travel expenses account for approximately 5% of operation costs and include registration fees, fare, accommodation, per diem, travel insurance.

#### Subcontracts

Services/subcontracts include part of the work which cannot be performed within the RI, service contracts, equipment repair and maintenance, rental of technical bottles for gases, organization of training activities (catering, rent of space etc.), organization of regular meetings of the Steering Committee, Supervisory Board and Advisory

**Table 6 The estimated total capacity in workload of the RI personnel groups in 2023**

Category	FTE in 2020	Planned FTE in 2023
Senior scientist	20.5	29.8
Junior scientist	25.5	37.0
(Laboratory) Technician	11.8	16.4
Manager/Administrator	9.2	10.0

Board, organization of annual scientific conference, legal services, PR activities and materials (posters, banners leaflets, etc.), booking system maintenance and IT support, licences, translations, shipping and transportation. There is a major increase from 2026 due to necessary service of new 3T/7T MRIs. Subcontract expenses account for approximately 43% of expected operation costs.

### Overhead

Overhead costs constitute a significant part of the budget (41% of operation costs) and are directly related to the operation of the CzBI. The calculation of overhead costs is based on applicable guidelines or methodologies of partner institutions. Indirect costs cover namely

administration costs and running costs of premises/buildings.

Other (Consumable, etc.)

Other operation costs (10%) include e.g. consumable, chemicals, special tools, small laboratory equipment (mixers, centrifuges, watches, automatic pipettes, pH electrodes, vortexes, thermostats, stirrers, balances, water baths, hoods, sterilisers, fluorescent lamps, etc.), equipment for work safety, stationery, computers and monitors for work with user's image data and other IT equipment in the form of laptops, external drives, graphics cards, PC components (memory, hard disk) or workstations.

**Table 7 The CzBI forecast budget for the operational phase from 2023 onwards. All figures in thousands CZK.**

	2023	2024	2025	2026	2027	2028	2029	Total 2023-29
<b>Staff costs</b>	91,857	95,055	101,011	104,158	107,401	110,868	114,204	724,553
<b>Travelling</b>	4,723	4,807	4,922	5,121	5,154	5,241	5,330	35,299
<b>Subcontracts</b>	29,436	31,492	33,711	45,412	46,719	47,907	49,151	283,827
<b>Overhead</b>	33,668	34,615	36,011	39,794	40,942	42,151	43,354	270,536
<b>Other</b>	7,792	9,802	10,020	10,203	10,424	10,663	10,898	69,801
<b>Investments</b>	309,153	335,150	190,011	399,408	140,650	139,300	109,653	1,623,325
<b>TOTAL</b>	476,628	510,921	375,686	604,097	351,289	356,129	332,590	3,007,342



# Annexes

## A1 Criteria to join CzBI

### Requirements for facilities - candidates who would like to join the CzBI research infrastructure

#### Preamble

*The aim of the CzBI is to make imaging services available to users from all research, educational or commercial bodies. Thus to ensure the best quality, the CzBI has to make sure that a candidate facility is in compliance with the below mentioned requirements and with the financial cycles of the infrastructure. To become a part of the CzBI, the candidate must go through two phases. Firstly, as a rule the facility should become an observer, ideally for 1 year, before it applies for a full membership. It is recommended to become an observer approximately 24 months before the expected date of submission of the CzBI application for a new grant (i.e. 36 months before the beginning of the new operational program).*

### 1) Submission of an application in order to become an observer of the CzBI infrastructure

Rules: As an observer, the facility has a right to participate in meetings and discussions of the Steering Committee, with no voting rights, and will be supported by the CzBI hub during the joining procedure.

The first step towards joining the infrastructure as an observer is to submit a structured *Application form – CzBI observer*.

#### Procedure following receipt an application:

- Evaluation by the CzBI Hub. During the evaluation of the application, the Hub will be in contact with the applicant, and will pass feedback from the CzBI bodies (e.g. questions, the delivery of missing documents, etc.).
- Decision by the Steering Committee – supportive or not

### 2) Submission of an application in order to become a member of the CzBI infrastructure

Rules: After the phase of being an observer for approximately 1 year, the observer can apply for joining the CzBI as a member. The application must be submitted at least 6 months prior to the anticipated start as a member of the CzBI. Due to the funding of the CzBI from the operational programs, it is recommended to date the beginning of the CzBI membership so that the new member can participate in the preparation of the budget and grant application as a valid member of the consortium. The membership in the CzBI should therefore start approximately 12 months before the expected date of the beginning of the new operational program cycle.

The application for a full membership in the CzBI must meet the following requirements:

- Technology/Instruments contributing to CzBI aims
- Dedicated time of the instruments for users
- Separated accounting
- Clear positioning of the imaging facility in the organization chart of the institution

The first step towards becoming a member of the CzBI infrastructure is to submit a structured application form, please see the *Annex No. 2: Application form – CzBI member*.

#### Procedure following receipt an application:

- Evaluation by the CzBI Hub. During the evaluation of the application, the Hub will be in contact with the applicant, and pass the feedback from the CzBI bodies to assure a completeness of the application.
- Decision by the Steering Committee – supportive or not
- Decision by the Advisory Board – supportive or not
- Based on the recommendation of the Steering Committee and the Advisory Board, the Supervisory Board will announce a decision.

## A2 Governance: Duties and tasks

### **CzBI Supervisory Board**

- Acts as the body having decision-making powers regarding CzBI strategies and governance
- Approves the general strategy and scientific development
- Approves the texts of Partnership agreements or their amendments (acceptance of an amendment)
- Appoints the CzBI Director
- Approves the admittance to partnership of the interested parties in CzBI (institutions, core facilities), according to the Statutes
- Terminates the membership of any member that violates or contravenes its Statutes  
*Voting rights:* One member – one vote

### **CzBI Steering Committee**

- Acts as the executive body of the CzBI responsible for the management of the CzBI
- Approves the policies and rules of open access of the CzBI RI
- Approves internal rules for ensuring the quality of professional, technical and administrative functioning of the CzBI
- Approve the rules for monitoring compliance with the indicators
- Controls the operation and monitors the overall state of development of the CzBI
- Prepares a proposal for the further direction of the CzBI infrastructure, which is submitted to the Supervisory Board for approval
- Approves the rules for the instrumental renewal of the CzBI
- Approves the rules for the expansion of the existing CzBI core facilities / new facilities
- Approves the rules for the admission of a new infrastructure partner to CzBI
- Proposes and approves the composition of the CzBI Advisory Board
- May establish working groups and advisory bodies of the CzBI
- Approves the rules for setting budgets for jointly submitted projects in new and updated calls
- Ensures professional growth of employees of the core facilities
- Approves the results of internal project calls

- Oversees the quality and long-term sustainability of the services  
*Voting rights:* One member – one vote

### **CzBI Director**

- Coordinates all CzBI activities
- Reports to the Supervisory Board
- Chair the proceedings of the Steering Committee
- Leads the CzBI Hub, which will support his/her tasks
- Employs staff working in the CzBI Hub according to the CzBI Human Resources Plan

### **CzBI Hub**

- Provides administrative support to RI
- Ensures that the decisions of the Supervisory Board are implemented
- Manages the link between the local services and the European level
- Communicates with grant providers, grant agencies and audit authorities
- Promotes the infrastructure to its various users and financial partners
- Provides documents and organizes regular meetings of the CzBI governing bodies
- Prepares and finalizes the grant proposals and annual reports
- Maintains websites and databases
- Coordinates the participation of CzBI in EuBI ERIC
- Seeks new funding opportunities
- Coordinates educational and awareness-raising activities
- Organizes the annual conferences of CzBI
- Collects and processes data from external infrastructure users needed for course evaluation and the quality of services provided by each facility

### **CzBI core facility leader**

- Coordinate CzBI activities and services at the facility and liaise with the CzBI Director, his/her staff and the Steering Committee members
- Coordinate execution of CzBI tasks at the core facility level
- Promote CzBI locally

- Engage with the local/regional academic users and industry
- Attend local meetings, conferences and trade fairs where appropriate
- Provide information, statistics and updates from the facility for CzBI Hub
- Provide infrastructure and service information for the CzBI service database
- Prepare the core facility information for the biennial CzBI Services Evaluation
- Provide news, success stories and promotional material for the CzBI Hub from the facility

## A3 Logistics within individual facilities

This annex describes the general service process of the CzBI facilities. The operations developed sequentially and they reflect the widening range of services as the facility has grown both in service volume and types.

The process generally consist of following main parts:

- Processes connected with organization of the facility hub (overall logistics of the infrastructure, facilitating user access, directing users to individual specialized facilities, communication with users, helping users before arriving at the facility, evaluation of user satisfaction, etc.). Typically, these are back-end activities.
- Processes connected with evaluation and selection of user projects (collection of project proposals, evaluation of proposals by experts and relevant facilities, informing the users, etc.). Typically, these form a mix of front- and back-end activities.
- Pre-arrival processes needed for successful accomplishing the project (need for special equipment, wet lab space, lab animals, chemicals required, special training needed, preparing the legal paperwork, etc.). Typically, these are front-end activities.
- Processes connected with performing the experiments and measurements (setting the operation conditions, initial experiment for selection of optimal parameters, actual measurement, etc.). Typically, these are front-end activities.
- Post-visit procedures (final protocol production, data transfer, user satisfaction questionnaire, invoicing, agreement on facility citation in published work, etc.). Typically, these are front-end activities.

The specifics of individual CzBI facilities are shown in the Technical and implementing annex with the help of flowchart. The flowcharts depict the current operations at every CzBI facility.

## A4 Evaluation forms

**A) Performance Assessment** (Evaluation of core facilities by Advisory Board). Definition of quantitative indicators:

<b>Name of indicator</b>	<b>Definition</b>
<b>Publications produced by users of facility</b>	Total number and list of publications produced by any type of facility users. Only publications with CzBI dedication (acknowledgement) are eligible. In the case of first few years of operation within CzBI infrastructure, user publications without proper dedication can be mentioned in the note.
<b>Publication co-authored by facility members</b>	Total number and list of publications authored or co-authored by employees of facility. Dedication to CzBI infrastructure is not required.
<b>Number of internal users</b>	Users from the same institution and faculty (economic center) as the facility providing services - unique users, i.e. same person = 1 user even in the case of multiple projects/accesses within the evaluated period
<b>Number of external users</b>	Users from different institution or different faculty (economic center) than the facility providing services - unique users, i.e. same person = 1 user even in the case of multiple projects/accesses within the evaluated period
<b>Number of foreign users</b>	Users from foreign institutions (outside of CZ) – unique users, i.e. same person = 1 user even in the case of multiple projects/accesses within the evaluated period
<b>Number of internal accesses (projects)</b>	Total number of projects (accesses) implemented for internal users within the evaluated period
<b>Number of external accesses (projects)</b>	Total number of projects (accesses) implemented for external users within the evaluated period
<b>Number of foreign accesses (projects)</b>	Total number of projects (accesses) implemented for foreign users within the evaluated period
<b>Training activities organized by facility</b>	Total number (and full list) of training activities organized by facility (workshops, educational courses, conferences, ...).
<b>Total FTE</b>	Total number of FTE associated with services provided by facility. Possible research positions (funded from research grants) should not be taken into account.
<b>Total operational budget</b>	Total budget related to operation of facility in relation to providing services. Budget for research activities (from research grants) should not be taken into account. CzBI, other institutional sources and user charges are typical sources of this budget.
<b>CzBI budget</b>	Part of previous indicator (Total operational budget) – only the budget provided by CzBI infrastructure
<b>Total personal costs</b>	Part of “Total operational budget” – only personal costs (all sources together).
<b>Investment</b>	Total existing investment costs (prices at the time of purchase) from all sources. Only investment used for CzBI services is relevant. Plus list of individual key equipment or technological units including price, year of purchase and estimated lifetime.
<b>Usage of equipment</b>	For key equipment or technological units – number of hours (based on provided services, typically measurements) during evaluated period and typical number of hours for full capacity should be provided.

Template of the evaluation form

**Evaluation form – internal evaluation of Czech-Biolmaging facilities 2018 (evaluated period 1.1.2017 – 31.12.2018)**

<b>Name of facility</b>	e.g. Multimodal and functional imaging laboratory – MAFIL	
<b>Type of facility</b>	<i>Select an option</i> Biological – optical microscopy Biological – electron microscopy Biological – combined optical and electron microscopy Medical – human imaging Medical – animal (preclinical) imaging	
<b>Institution</b>	e.g. Masaryk University, CEITEC	
<b>www</b>	e.g. <a href="http://www.ceitec.eu/mafil">www.ceitec.eu/mafil</a>	
<b>Presentation and visibility of facility</b>	Is visible CzBI logo and link to CzBI website presented on facility (institution) web pages?	YES/NO <i>Possible comments</i>
	Do the facility web pages contain a clear description of infrastructure?	YES/NO <i>Possible comments</i>
	Do the facility web pages contain description of possible user access modes, available equipment and services/expertise?	YES/NO <i>Possible comments</i>
<b>User access and outputs</b>	Number of internal users	XXX (specify number) <i>Place for comments</i>
	Number of external users	XXX (specify number) <i>Place for comments</i>
	Number of foreign users	XXX (specify number) <i>Place for comments</i>
	Number of internal accesses (projects)	XXX (specify number) <i>Place for comments</i>
	Number of external accesses (projects)	XXX (specify number) <i>Place for comments</i>
	Number of foreign accesses (projects)	XXX (specify number) <i>Place for comments</i>
	Number of training activities	XXX (specify number) <i>Provide full list of activities (date; name)</i>
	Publications produced by users of facility	XXX (specify number) <i>Provide full list of publications (date; name)</i>
Publication co-authored by facility members	XXX (specify number) <i>Provide full list of publications (date; name)</i>	
<b>Operation</b>	Total FTE	XXX (specify number) <i>Place for comments</i>
	Total operational budget	XXX (specify number) CZK
	CzBI budget	XXX (specify number) CZK

	Total personal costs		XXX (specify number) CZK	
<b>Investment</b>	Name of equipment/TU	Price without VAT	Year of purchase	Lifetime
	<i>e.g. MRI scanners</i>	<i>102 mil CZK</i>	<i>2015</i>	<i>12 years</i>
<b>Usage of equipment/TU</b>	Name of equipment/TU	No of hours	Full capacity in hours	Comment
<b>Visit of evaluators or AB members</b>	<i>Comments from visit of evaluators or AB members</i>			

**B) Czech-Biolmaging Service Evaluation Form**  
(Evaluation of Core facilities by users)

Here we present the questions from the anonymous Czech-Biolmaging Service Evaluation Form:

PHASE ONE (before arriving at the facility) – communication, agreement on technical requirements, pre-arrival instructions, logistics

- Have you attended any training in the visited facility before? (yes/no)
- Evaluation of the Phase ONE (Excellent/without major problems/with problems – specify/with serious deficiencies – specify)

PHASE TWO (experimental phase) – elaborating the protocol, experimental setup, performing measurements

- Evaluation of the Phase TWO (Excellent/without major problems/with problems – specify/with serious deficiencies – specify)

PHASE THREE (data analysis) – data processing and output, discussion of the results, providing all digital data

- Evaluation of the Phase THREE (Excellent/without major problems/with problems – specify/with serious deficiencies – specify)

Other comments.



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