

Worldwide Protein Data Bank Advisory Committee (wwPDB-AC)
Report of October 18th, 2019 Meeting
PDBj, Institute for Protein Research (IPR), Osaka University, Osaka, Japan

Chair: Peter Rosenthal

Co-Chair: Tsuyoshi Inoue

PDB Site Representatives (Nominated by wwPDB partner): Paul Adams (RCSB-PDB), Kirk Clark (RCSB-PDB), Masatsune Kainosho (BMRB), Arthur Edison (BMRB), Susan Lea (PDBe), David Brown (PDBe), Masaki Yamamoto (PDBj), Tsuyoshi Inoue (PDBj), Sarah Butcher (EMDB) and Juha Huiskonen (EMDB)

Ex Officio Community Stakeholder Representatives: Edward N. Baker (IUCr), R. Andrew Byrd (ICMRBS), Peter Rosenthal (Macromolecular EM)

wwPDB Members: Stephen K. Burley (RCSB-PDB), Sameer Velankar (PDBe), John L. Markley (BMRB), Jeffrey Hoch (BMRB), Genji Kurisu (PDBj).

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Institutional Representatives: Gerard Kleywegt (EMBL-EBI)

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wwPDB AC Meeting, October 18, 2019:

The Worldwide Protein Data Bank Advisory Committee (wwPDB-AC) and the leadership of the Research Collaboratory for Structural Bioinformatics (RCSB-PDB), the BioMagResBank (BMRB), the Protein Data Bank in Europe (PDBe), and the Protein Data Bank Japan (PDBj) met at the Institute for Protein Research (IPR), Osaka University, Osaka, Japan on October 18th 2019.

The agenda included:

1. Introduction and overview/state of the wwPDB
2. wwPDB status and organizational updates
3. Plan of PDB China
4. Plan of PDB India
5. PDB Core Archive plans
6. BMRB Core Archive plans
7. EMDB Core Archive plans
8. Questions for the AC
9. Executive session and feedback

Introduction and Overview of the wwPDB (Presenter: Kurisu)

Members of the AC were welcomed by the wwPDB PIs.

Summary: The wwPDB has had a very successful year since the past meeting in October 2018 at Hinxton, United Kingdom. There has been growth in depositions. A new Memorandum of Understanding (MOU) has been finalized and should be signed in 2020. OneDep continues to improve and has had a big impact on curation and deposition. Outreach is strong. Core archive funding is in an overall stable condition. There has been tremendous development in the last year for Associate Members located in China and India.

The wwPDB Architecture (Figure 1) and Organization (Figure 2) was described, consisting of core archives, core members, associated members, and federated resources.

wwPDB Future Architecture

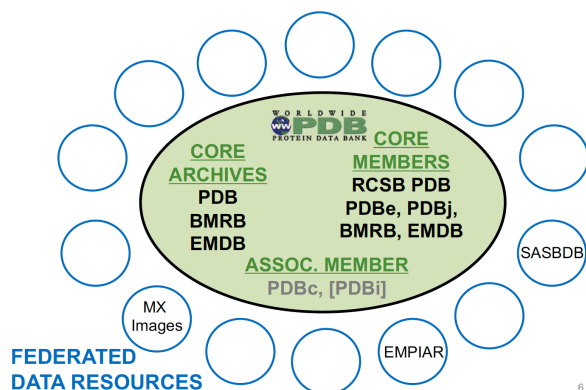


Figure 1

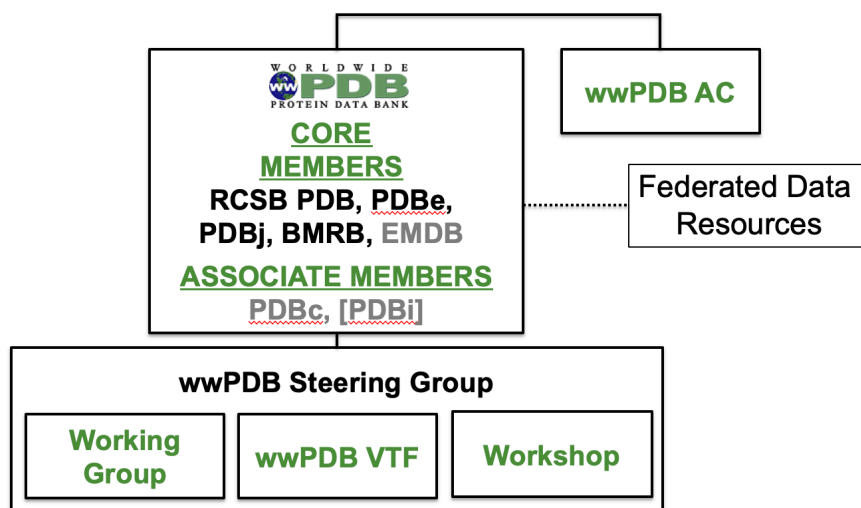


Figure 2

The Updated wwPDB Vision and Mission was provided as an Appendix to the PI presentation.

wwPDB Vision Statement

Sustain freely accessible, interoperating Core Archives of structure data and metadata for biological macromolecules as an enduring public good to promote basic and applied research and education across the sciences.

wwPDB Mission Statement

- Manage the wwPDB Core Archives as a public good according to the FAIR Principles.
- Provide expert deposition, validation, biocuration and remediation services at no charge to Data Depositors worldwide.
- Ensure universal open access to public domain structural biology data with no limitations on usage.
- Develop and promote community-endorsed data standards for archiving and exchange of global structural biology data.

Developments since 2018 AC Meeting

- Continued enhancement of the OneDep system for deposition/validation/biocuration of MX, NMR, and 3DEM
- Continued growth in 3DEM structure depositions and engagement with the 3DEM community
- Continued depositions to PDB-Dev for I/HM structures.
- Finalized the new MOU in which EMDB will become a core archive.
- Supported PDBc Leadership appointment process
- PDBx/mmCIF deposition for MX made mandatory in June 2019 with no negative impact on depositions.
- As part of ligand validation development, ED map coefficients will be provided at the wwPDB FTP site
- PDB archive versioning in place
- Atomic coordinate replacement implemented

The AC recognizes the achievements and the hard work of all involved to deliver them. The results show the wwPDB as a model of international collaboration. The federated archives should be added to the new organizational scheme diagram.

The AC anticipates signing of the MOU early in 2020 and requests that the finalized MOU be circulated to the AC.

BMRB Core Archive

- The BMRB reports advances in supporting the NMR-STAR format, including enlargement of the NMR-STAR dictionary, a NEF Translator along with support for an NMR-STAR restraints file uploaded/implemented in the OneDep System, data visualization tools in 'R' and Python, and a pipeline to calculate structures using X-Plor NIH with NMR-STAR as input file ready for testing
- Visualization tools are now accessible through Jupyter notebooks and available through BMRB GitHub.
- BMRBdep released as beta version (17 depositions). This tool provides deposition of all types of NMR data into BMRB and is used when there is not a macromolecular structure deposition.
- Delivered software restraint validation package for use in the OneDep environment within wwPDB Validation Report, currently under review by NMR

validation task force members. Integration within OneDep must still be delivered.

The AC affirms that all macromolecular structure depositions should take place through OneDep, as discussed in the archive plans section. We recognize some of the challenges, most notably in structure validation, but think that a universal solution will benefit the other wwPDB members as well as the general structural biology community.

EMDB Core Archive

- Development of EMDB Policies and Processing Procedures document.
- EM map, map/model, and model validation components for validation reports have now been developed based on the “Visual Analysis” pages for entries at EMDB. These map and map/model components will be made available in the wwPDB Validation Report, which will be made available soon as part of OneDep (anticipated availability in November 2019).

Individual wwPDB partner sites

PDBj established an agreement with EMPIAR to initiate EMPIAR-PDBj; RCSB PDB renewed Funding 2019-2023, now includes Andrej Sali/UCSF; PDBe renewed Wellcome Trust Funding 2020-2024, and launched the PDBe community-driven Knowledge Base resource, collating functional annotations and predictions for structure data in the PDB archive.

Growth of PDB Core Archive Depositions

- The PDB Core archives have experienced enormous growth with 12,179 depositions in 2018. Total released entries estimated to reach ~13,600 by the end of 2019.
- In particular, there has been a rapid growth in 3DEM depositions which exceeded NMR depositions. BMRB is on track for 773 new entries released so far in 2019. 3DEM is on track for ~2300 depositions in 2019.
- The PDB Core Archive provides more than 2.0 million downloads per day.
- The OneDep system continues to show success in managing the increased number of depositions and enabling balancing of entry processing across all wwPDB partners.

wwPDB Outreach

Outreach activities remain strong. This year included participation in international conferences such as the 2019 OneDep Developer summit, the American Crystallographic Association, Gordon Research Conference on Carbohydrates, Collaborative Computational Project 4/Advanced Photon Source meeting including depositor training, 32nd European Crystallographic Meeting, and the Asian Crystallographic Association.

wwPDB Foundation

The wwPDB Foundation is a private entity that works with the wwPDB and acts to support outreach activities of the wwPDB that are not, and cannot be, supported by the individual partner funding sources. Fundraising is ongoing and the new Chair is Celia A. Schiffer, U. of Massachusetts Medical School

The wwPDB Foundation is planning to promote the 50th anniversary of the PDB in 2021 in Indianapolis, Heidelberg, and Malaysia. Other promotional activities are being considered and planned to illustrate the significance and impact of the PDB to both the academic and lay communities world-wide.

Note attendance at wwPDB AC meetings are supported by the host site and travel and subsistence costs of core and associate member representatives are covered by the relevant institutions.

wwPDB 2018-2019 Joint Publications

Protein Data Bank: the single global archive for 3D macromolecular structure data. [Nucleic Acids Res.](#) 2019 Jan 8;47(D1):D520-D528. doi: 10.1093/nar/gky949.

Announcing mandatory submission of PDBx/mmCIF format files for crystallographic depositions to the Protein Data Bank (PDB). [Acta Crystallogr D Struct Biol.](#) 2019 Apr 1;75(Pt 4):451-454. doi: 10.1107/S2059798319004522. Epub 2019 Apr 8.

OneDep 2018/2019 Progress versus Goals

In 2018-2019 OneDep achieved important progress against its goals:

Improved Biocuration processes, better software management *via* GitHub, enabled use of external computing resource

Implemented Ligand Validation Workshop recommendations (2D depictions and ED maps)

Made mmCIF deposition mandatory for MX in June 2019 with no negative impact on depositions.

Enabled Author-initiated Coordinate Replacement

Provided wwPDB DOI landing page

Carbohydrate remediation (Ongoing)

Based on the collaboration with Global Phasing, the Buster Report code ported into OneDep for structure validation for X-ray.

The progress report for OneDep, one of the major joint activities participated in by all partners, shows the project is mostly up-to-date. Some goals have not been met in the following areas and have been re-forecasted:

Implement NMR restraint validation and NEF deposition

Implement EM map validation

To meet these goals on validation going forward, the wwPDB partners will actively engage the NMR community in 2019-2020, set clear requirements and phased plan for EM validation, and focus on resource recruiting for PTM remediation.

wwPDB Biocurator Productivity

Continuing increased efficiency since 2009, significant increase with OneDep system, and ongoing improvements in Biocuration processes.

The contribution of OneDep to productivity is demonstrated in a graph of the average number of entries processed per FTE, before and after introduction of OneDep.

The wwPDB-AC strongly applauds the progress of OneDep and its impact has been demonstrated.

AC supports the improvements and recognizes that further increases in productivity will be required to meet projected demands of the scientific community.

The AC supports prioritization in the OneDep team to ensure that the delayed validation for EM and for NMR are supported to ensure that they are available. This follows from the requirement to use OneDep for all depositions to be a core archive.

Plans for next year should include the training of the Indian and Chinese teams – not currently evident in the timetable.

wwPDB DOI Resolution

PDB ID with DOI 10.2210/pdb5AT1/pdb Redirect wwPDB landing page via CrossRef (doi.org). This new feature provides access to all data files and websites. An enhanced communication plan with journals is under development.

The AC is excited by this development. However, the initial implementation web landing page should be improved, with approved content from core archives, in order to be more inviting and clear to users.

wwPDB Core Member Funding Status

RCSB PDB: NSF/NIH/DOE funding renewed: 2019-2023

BMRB: NIH NIGMS funding: 2019-2023

The funding level provides an inadequate budget (~60% of request) and action will be needed to find additional support.

PDBe: EMBL-EBI, Wellcome Trust: 2020-2024

PDBj: NBDC-JST and AMED funding: 2019-2022

Possible additional budget from S. Korea is under investigation

EMDB: EMBL-EBI, Wellcome Trust: 2019-2023

The AC is strongly positive on the overall funding of the wwPDB partners but notes that the BMRB needs to obtain additional support. The AC is interested in supporting funding efforts by the archives and partners. Our view is that close collaboration and harmonization through tools such as OneDep across partners is essential to bring added value that supports these funding efforts.

Scheduling of Future wwPDB AC Meetings

BMRB to Host 2020 wwPDB AC

Next wwPDB AC meeting: Friday, Oct. 2nd 2020 Host: BMRB Venue:
University of Wisconsin, Madison, WI, USA

2021 wwPDB AC meeting: Tuesday, Oct. 19th 2021 Host: EMDB Venue:
EMBL-Heidelberg, Boxberg, Germany

PDB50 Celebration (Europe) to follow immediately thereafter (Oct. 20th-22nd
2021) at EMBL-Heidelberg.

Plan for PDB China (Presenter: Wenqing Xu)

PDB-China is a joint effort of National Facility for Protein Science in Shanghai (NFPS), and the iHuman Institute and SIAIS at the ShanghaiTech University.

Leadership for PDB-China (PDBc)

Profs. Wenqing Xu (director of NFPS) and Zhijie Liu (executive director of iHuman) are Co-directors of PDBc, Prof. Zhipu Luo, deputy director of PDBc
Leadership: Zihe Rao, Ray Stevens, Wenqing Xu, Zhijie Liu, Ge Jiang

Funding: NFPS has secured funding of 2.3M USD for two years from Shanghai Science Commission this year, and iHuman will provide funding for 10 FTE's. There are additional promises of long-term funding.

The leadership of PDB-China agreed to adopt and adhere to the wwPDB mission statement.

Data-in activity: Key personnel have been recruited.

Plan: On-site training by wwPDB will begin in 2020, and this will be followed by data-in activity. wwPDB PIs will determine performance criteria to set clearance for initiating data-in activities.

Data-out activity: Key personnel have been recruited and new members of the team will be recruited. Key collaborators have been identified. Also, part of the data-out plan is to merge EMDB-China to PDBc and build the PDBc interface.

Plan of PDB India (Presenter: Debasisa Mohanty)

Located at Indian Institute of Science, Bangalore

Leadership for PDB-India (PDBi)

PI, Professor Manju Bansal, Molecular Biophysics Unit, Indian Institute of Science

Co-Investigators: Prof. K. Sekar, Indian Institute of Science & Debasisa Mohanty, National Institute of Immunology, New Delhi

Funding: 600K USD has been secured for 3 years from October 2019 to September 2022 through the National Supercomputing Mission (NSM), Government of India, under the NSM Platform for Genomics & Drug Discovery (NPGDD).

The initial funding will be used mainly for staff salaries to hire 8 post-doctoral scientists or IT experts and training workshops. Computer hardware will be provided by another division of NSM.

Plan:

Year 1, set up prototype data-out, training of staff, software scripts to mirror data-out.

Year 2, Make available data-out. Testing of Data-in & training of staff for curation/validation using OneDep with training from wwPDB partners.

Year 3, Set-up data-in and accept data from India.

Develop structural bioinformatics resources, procure funding to continue.

The AC is impressed at the rapid growth of PDBc and PDBi and notes contributions of wwPDB partners in supporting these efforts.

Both PDB China and PDB India need to have 5-year funding in place to be accepted as associate members. We welcome the progress towards this and would like to see a timeline and plan for the associate membership period. This should clarify whether data-out activities in addition to data-in activities will be taken-up for each of the core archives and thus help the core archive team in their planning as well. For this to be successful, the key criteria for membership should be circulated and discussed with these members now. Part of the plan should consider the need for load balancing between sites and across geographic areas, and if so, which areas will be covered by the associate members and when.

The AC emphasizes the importance of the support and guidance that the future members will receive from their own advisory boards, which should consist of advisors with no direct role in the funded project to avoid conflicts of interest. The AC encourages the future members to appoint balanced advisory boards, both in scientific and diversity aspects.

wwPDB Core Archive Update (Presenter: Velankar)

Improved Ligand Validation

- The wwPDB Adapted software from Global Phasing Ltd. now Implemented under a formal collaboration agreement with all wwPDB partners
- Benefits:
 - Provides geometrical quality in 2D depiction
 - Provides electron density fit for crystal structures in 2D depiction

- Now mandatory at deposition: identification of Ligand(s) Of Interest (LOI, author's research focus)
 - 2D depictions provided in wwPDB Validation Report for all LOIs

Coordinate Versioning to Improve Data Quality

- Depositors can now make corrections to existing structures in the PDB Core Archive by updating the atomic coordinates while preserving the original PDB identifier
- Deployed on July 27th 2019 for all structures deposited via OneDep (Phase one)
- 1st coordinate replacement (PDB ID 5T26) released and versioned at FTP August 7th 2019 following reviewers' comments based on the wwPDB validation reports
 - Moved two polymer chains to be in the same unit cell
 - Fixed water molecules on symmetry axis

The Core archive reports ORCID utilization to improve depositor tracking to enable better management of incoming data. 25% of all Unique Depositors have provided ORCIDs. There are currently 3342 Unique PIs with ORCIDs in the PDB.

The AC supports this development and the improved data tracking and mining that it will facilitate.

The Core archive reports that ED map coefficients have been provided to depositors during biocuration for new entries as part of annual recalculation of validation reports. The ED map coefficients will be provided for existing entries at the wwPDB FTP site for better interpretation of the ligand validation by user community. A key role is to educate non-expert users of the quality of EM structures through easy to understand validation metrics (WWW.EMDATARESOURCE.ORG)

The AC applauds these developments.

Remediation to Improve Consistency and Searchability

Representation of carbohydrates (CHOs) led by RCSB PDB; post-translational modifications (PTM) led by PDBe will be the focus of PDB Core Archive plans in 2019 and 2020

Carbohydrate Remediation

This project has been communicated to the glycoscience, PDB and software developer communities via conferences/virtual meetings

Standardized nomenclature follows IUPAC/IUBMB

Adopted glycoscience community software

Provided uniform representation for oligosaccharides with community linear descriptor(s). The next steps are to identify, validate, and biocurate glycosylation

wwPDB Core Archive Plans (Presenter: Velankar)

Next Generation PDB core Data Archive

Currently, wwPDB partner sites (RCSB PDB, PDBj and PDBe) distribute the common PDB Core Archive FTP area. However, wwPDB partner sites carry out individual processes to enrich PDB Core data for their websites. These files are accessible through site-specific FTP areas. Each site is independent in developing processes to enrich “data-out” offerings. An unintended consequence is duplication of effort and difficulty in accessing this enriched data. The purpose of the Next Generation version of the PDB Core Archive is to ensure that Users can benefit from all data enrichment activities at whichever wwPDB partner website they access.

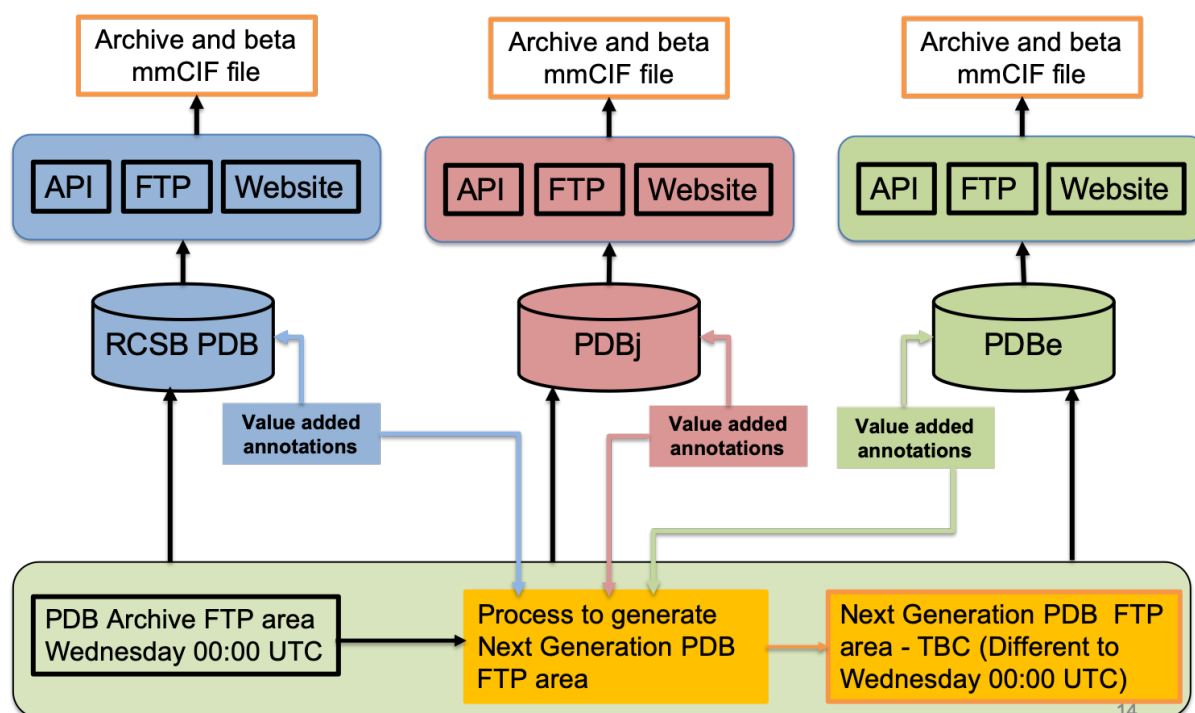


Figure 3

The Next Generation PDB Core Archive will be updated on a weekly basis, using an automated process that operates separately from the update schedule and release processes for the PDB Core Archive. The wwPDB will publish a plan for full release of this Next Generation version, with supporting update/release processes in 2020, to make it publicly available in 2021 (PDB50). wwPDB partners to seek additional joint funding to support requirement setting and software development of automated parallel, update and release processes tailored to each of the PDB Core Archives and the Next Generation version. These to include advantages of Mol* Core Library, Mol* Data Delivery, Mol* Viewer

AC recognizes this is a significant change in the collaboration of the wwPDB core members and appreciates the advantages and goals of the Next Generation version of the PDB Core Archive and it is fully supportive of the initiative.

BMRB Core Archive Plans (Presenters: Markley and Hoch)

The BMRB announced its plans to rework the BMRB website, complete testing of the BMRBdep deposition system and close the legacy deposition system. In the area of solid-state NMR data, BMRB will continue working on data deposition and data out provisions. It will work with NMRFAM to develop spin system matrices for magnetic field-independent representation of metabolites that contain corrections for pH-dependent chemical shifts. BMRB will also remediate and enlarge the small molecule database and release the beta version of the small-molecule version of BMRBdep.

BMRB Curators plan to expand the NMR-STAR data dictionary and to archive content to various data types that are under-represented in the wwPDB archive (e.g. dynamics, integrative/hybrid data, intrinsically disordered proteins, membrane proteins, metabolomics, molecular interactions, natural products, RNA, solid-state NMR).

As part of the OneDep Team, BMRB will continue development of the software suite for 3D structure validation against NMR data. As part of the PDB-Dev team, BMRB will develop protocols for validation and annotation of NMR data in the context of integrative/hybrid structure deposition.

The AC supports developments that facilitate validation and deposition through OneDep. Community consultation on common data formats is advised for full AC support. There appears to be a lack of continuity of the prior NEF project and the NMR-STAR approach favored by BMRB. The AC recommends BMRB should take a leadership role for the community and assist in a community-supported resolution.

As part of the OneDep Team, BMRB will explore the development of a deposition system for NMR structures that accommodates a full range of experimental NMR Data and the validation of structures against this data.

BMRB proposes to be the sole point of contact with Depositors

The AC supports the deposition of a wider range of experimental NMR data for validation. However, the AC continues to support deposition of all macromolecular structure data through a single OneDep deposition system, which shall remain the sole point of contact. The AC advises that the BMRB should work in collaboration with the OneDep team to develop tools to capture NMR data through OneDep. The AC views collaboration on OneDep as a requirement of a wwPDB core archive. In the current structure of the wwPDB, data that cannot be captured through OneDep may be held in federated databases. These additional data types are recognized by the AC as extremely valuable to future integration and cross-referencing activities with other data resources; however, there are strong recommendations to work within the OneDep system and seek the development of a system that resolves present complications for the benefit of the entire enterprise.

BMRB should provide a policy and procedure document for the new MOU.

BMRB Leadership Transition

As previously announced there will be a transition in the BMRB leadership. John Markley will step down as Co-Head of BMRB on April 1, 2020, and Chad Rienstra will join the leadership as Co-Head with Jeff Hoch. Jeff Hoch will become sole BMRB representative to wwPDB and sole PI of the BMRB NIH grant

The AC recognizes the outstanding contributions of John Markley and hopes his expertise will be accessible to BMRB in the future. The AC has confidence in the leadership of the BMRB going forward. Furthermore, we recognize that 2020 represents a significant transition year for the BMRB and urge support by all wwPDB members as the new leadership and structure is established. The AC supports a review of the BMRB vision when PI's meet at the EM validation workshop.

EMDB Core Archive Plans (Presenter: Gerard Kleywegt for Ardan Patwardhan)

EMDB draft policies and procedures document is under review by wwPDB PIs.

EMDB plans to add support for map segmentation data in the EMDB data model and OneDep. At present, users are asked to convert segmentations into masks. These developments will capture a new form of data analysis and author interpretation in the archive.

The EM Data-Management Workshop will be held at

EMBL-EBI: January 23-24, 2020 to review and develop the mechanism for improved EM data deposition to PDB and EMDB Core Archives

- Review updated validation report and provide feedback
- Discuss additional model, map, and map-model validation metrics for single-particle EM depositions
- Discuss deposition of segmented maps with multiscale model representation
- Formulate a list of mandatory and good-to-have data items for PDB and EMDB
 - Identify missing data categories and items
 - Update data dictionaries for PDB and EMDB
 - Discuss making PDBx/mmCIF format atomic coordinate deposition mandatory for EM (as for MX), and identify stakeholders and pain points and how wwPDB can support software developers

The AC supports these initiatives. The white paper from the 2020 EM validation workshop should be submitted for publication in the first half of 2020. This should be provided on the wwPDB websites following publication. A draft document from the 2019 EM validation workshop (not part of a wwPDB effort) could help as a basis for planning the 2020 meeting to prevent repeating the same work. In conjunction with the workshop, the wwPDB should consult with software developers and detector manufacturers to identify important fields to capture in supporting mmCIF format files for annotation and validation of electron microscopy data. For microED, policies need to be set on what critical data fields are required to accept electron diffraction data,

and where and how to deposit PDB and mmCIF data. The wwPDB should continue to develop ways of capturing and linking structural data for biological assemblies in different states or by different methods across the archives.

EMDB should provide a policy and procedure document for the new MOU.

Specific Questions/Actions for the wwPDB AC

1. Does the wwPDB AC concur with the updated Terms of Reference for the wwPDB Advisory Committee (Appendix 5, see Section 3.8)? “Membership should reflect the demographic and geographic diversity of the wwPDB stakeholder communities.”
 - *The updated Terms of Reference are unanimously supported by the AC.*
2. What is the wwPDB AC guidance regarding participant representation for the 3DEM community (Appendix 6)?
 - *The AC members acknowledge that there is no community organization, similar to the IUCr or ICMRBS/ISMAR, that represents the 3DEM community. The AC recommends that the wwPDB continue to invite suitable representatives from the EM community in accordance with the updated Terms of Reference for the wwPDB Advisory Committee on Diversity. The AC chair will continue to seek advice on this question including at the EM Data-Management Workshop EMBL-EBI: January 23-24, 2020.*
3. What is the wwPDB AC guidance regarding the duration of the comment period for the planned policy change making PDBx/mmCIF atomic coordinate files mandatory for deposition of 3DEM and microED structures (Appendix 7)?
 - *The AC supports a 6 months comment period on the planned policy change following discussion of the policy at the EM Data-Management Workshop EMBL-EBI: January 23-24, 2020.*
4. What is the wwPDB AC guidance regarding the duration of the comment period for the planned policy change making PDBx/mmCIF atomic coordinate files mandatory for deposition of NMR structures (Appendix 8)?
 - *The AC supports a 6 months comment period on the planned policy change following announcement of the policy change.*

5. Does the wwPDB AC concur with the BMRB proposal to seek federal funding that will support work with NMR software developers to adopt NMR-STAR (Appendix 9)?
 - *The AC supports this initiative to move toward a common data format noting that a successful funding proposal will require support from NMR software developers and the greater NMR community.*
6. Does the wwPDB AC have any questions or concerns regarding the individual RCSB PDB, PDBe/EMDB, PDBj, or BMRB Advisory Committee reports (Appendix 10)?
 - *The AC accepted the reports from all of the partner ACs and thanked the wwPDB for providing this information. The AC requests that individual PDBc and PDBi AC reports be submitted to the wwPDB and made available to the wwPDB AC.*

Conclusion

The wwPDB AC meeting concluded with a general discussion with the wwPDB PIs following the executive session.

The next wwPDB AC meeting is set for Friday October 2, 2020, in Madison, WI, USA.