INVITATION TO SUBMIT A RESEARCH PROPOSAL ON AN ASHRAE RESEARCH PROJECT

1801-TRP, Standardizing and Utilizing ASHRAE Online BIM Data Exchange Protocols

Attached is a Request-for-Proposal (RFP) for a project dealing with a subject in which you, or your institution have expressed interest. Should you decide not to submit a proposal, please circulate it to any colleague who might have interest in this subject.

Sponsoring Committee: TC 1.5, Computer Applications
Co-sponsored by: MTG-BIM, MTG, Building Information Modeling & TC 7.1, Integrated Building Design

Budget Range: $125,000 may be more or less as determined by value of proposal and competing proposals.

Scheduled Project Start Date: **September 1, 2018** or later.

All proposals must be received at ASHRAE Headquarters by 8:00 AM, EDT, May 15, 2018. NO EXCEPTIONS, NO EXTENSIONS. Electronic copies must be sent to rpbids@ashrae.org. Electronic signatures must be scanned and added to the file before submitting. The submission title line should read:" *and "Bidding Institutions Name"* (electronic pdf format, ASHRAE's server will accept up to 10MB)

If you have questions concerning the Project, we suggest you contact one of the individuals listed below:

For Technical Matters
Technical Contact
TBD

For Administrative or Procedural Matters:
Manager of Research & Technical Services (MORTS)
Michael R. Vaughn
ASHRAE, Inc.
1791 Tullie Circle, NE
Atlanta, GA 30329
Phone: 404-636-8400
Fax: 678-539-2111
E-Mail: MORTS@ashrae.net

Contractors intending to submit a proposal should so notify, by mail or e-mail, the Manager of Research and Technical Services, (MORTS) by May 1, 2018 in order that any late or additional information on the RFP may be furnished to them prior to the bid due date.

All proposals must be submitted electronically. Electronic submissions require a PDF file containing the complete proposal preceded by signed copies of the two forms listed below in the order listed below. **ALL electronic proposals are to be sent to rpbids@ashrae.org.**

All other correspondence must be sent to ddaniel@ashrae.org and mvaughn@ashrae.org. In all cases, the proposal must be submitted to ASHRAE by 8:00 AM, EDT, May 15, 2018. NO EXCEPTIONS, NO EXTENSIONS.

The following forms (Application for Grant of Funds and the Additional Information form have been combined) must accompany the proposal:

(1) ASHRAE Application for Grant of Funds (electronic signature required) and
(2) Additional Information for Contractors (electronic signature required)

ASHRAE reserves the right to reject any or all bids.

State of the Art (Background)

ASHRAE has produced, and continues to produce, a wealth of standards, guidelines, and other special publications, documenting best practices for a wide variety of building industry work processes involved in designing, commissioning, operating and maintaining buildings. Many of these publications include step-by-step tasks for adopting these best practices and include a detailed level of information required to support these work processes. Implementing the best practices detailed in an ASHRAE publication is, however, not a trivial exercise. Professional practice work processes must be tailored to the desired publication, including documenting the necessary supporting information in a standardized way so that the process can be consistently applied across future projects. Furthermore, each work process must be integrated into a firm's current practice in a manner that allows individual practitioners to share their information with a team, and deliver final documentation in a form that can be referenced and used by others.

For example, a firm wanting to implement ASHRAE Standard 180: *Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems*, must document "an inventory of equipment and systems to be inspected and maintained" (ASHRAE, 2012). Standard 180 includes a list of such equipment and systems including: Air Distribution System, Air Handler, Humidification Device, etc.

Members of this firm may also be considering the related ASHRAE Guideline 4: *Preparation of Operating and Maintenance Documentation for Building Systems*, which states that a "maintenance manual should provide all relevant information needed for the day-to-day maintenance of the HVAC&R systems" (ASHRAE, 2013). Guideline 4 includes informative details on equipment data sheets that should be part of equipment inventories (e.g., Serial Number, Location, and Preventive Maintenance Actions), and includes examples of such equipment including: Air Compressor, Air Handling Unit, Humidifier, etc.

These two ASHRAE publications each contain valuable details important to maintaining building systems, some duplicative, some synergistic, some divergent. Even where the two converge, there can be differences. For example, it is straightforward for a human expert to know that *Air Handler* (Standard 180 term) and *Air Handling Unit* (Guideline 4 term) are probably the same equipment item, as are *Humidification Device* and *Humidifier*. While an individual can sort out these differences, other team members or other consumers of final documentation may become confused by this variation in terms. However, if automated exchange of data using computers is involved, these seemingly subtle differences become critical.

The ASHRAE Terminology Glossary (ASHRAE, 2017) is a comprehensive online glossary of more than 3700 terms and definitions related to the built environment. This searchable glossary is intended to address the issue of standardizing and defining terms like *Air Handling Unit* within the ASHRAE domain. However, searches for the terms *Air Handler* and *Air Handling Unit* on the terminology website do not produce any results. A search for *AHU*, on the other hand, produces the sought for result of the glossary term *air-handling unit (AHU)*. This is clearly a glossary intended for human consumption where someone knows the possible variations in this term. It is obviously not intended for automated computer consumption or data exchange where the hyphen in *air-handling unit* causes a search for the non-hyphenated *Air Handling Unit* to fail.

This is where Building Information Modeling (BIM) comes into play. Done properly, BIM clearly documents the tasks involved in a work process and its standardized data requirements in what is called *Use Case* documentation of ***information exchange standards***. Use Case documentation can be developed for an individual work process based on an ASHRAE publication such as Standard 180. More usefully, Use Case documentation can merge related ASHRAE publications like Standard 180 and Guideline 4 into a single overarching work process that encompasses the best of both publications and standardizes terms like *Air Handling Unit* across them. Such standardization of data terms facilitates automated data exchange between software applications used in design, construction, and operations and maintenance, so that information about building equipment specified in a design tool can automatically populate a computerized maintenance management system (CMMS) used to maintain that equipment in the constructed building.

A study on trends in BIM execution among building owners in the US (Mayo et al., 2012) reported that more than half (56%) of owners **do not** have BIM requirements in place to address their needs for the operation and

maintenance phases. While existing efforts like COBie (COBie, 2016) are intended to capture facility handover data, the related standards do not specifically use ASHRAE terminology nor are they linked to ASHRAE publications that define best practices supported by these data standards. For example, ASHRAE Guideline 4 defines maintenance action properties such as work time and cost of performing a maintenance action associated with a piece of equipment. COBie does not specifically include these properties, and although generic property extensions are supported, it requires expertise in COBie to know how to add such properties and later retrieve them for use. This research project would clearly define the Guideline 4 data properties, map them to COBie property extensions, and include instructions in the user guide to support their use.

If Use Case documentation becomes more widely adopted throughout ASHRAE, the benefits of BIM-enabled work processes multiples. For example, if a BIM Use Case is also consistently developed for the currently underutilized ASHRAE Service Life and Maintenance Cost Database (ASHRAE, 2015) then data collected over time based on Standard 180 and Guideline 4 can be automatically used to populate the Service Life and Maintenance Cost Database, keeping that database up to date and of practical use to ASHRAE members. Such data exchange and reuse across the full life cycle of a building is the real promise of BIM.

BIM is currently attracting substantially increased attention within ASHRAE, with well-attended technical sessions at ASHRAE meetings illustrating the promise of BIM and advocating the benefits of employing BIM-enabled work processes in professional practice. However, many ASHRAE members are still unsure of how to adopt BIM processes in their daily practice to achieve the claimed benefits. The first hurdle in achieving BIM adoption is the development of relevant and useable information exchange standards, which define standard data representations for key information required to perform HVAC&R work processes. A subsequent hurdle to adoption is the lack of available BIM data content that adheres to existing information exchange standards, and can be readily accessed for import into, and automated data exchange between, the tools used by ASHRAE professionals.

Several efforts are underway within ASHRAE to address the issue of standard data representation (information exchange standards). SPC 205 *Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment* is developing data representation standards for equipment performance for use in energy simulation tools. The recently completed ASHRAE-supported research project 1609-RP *Defining the Capabilities, Needs and Current Limitations of Building Information Modeling (BIM) in Operations and Maintenance for HVAC&R* developed information exchange standards for representing asset management information, and a procedure for capturing this information during design and construction/installation for use during operations and maintenance (O&M), based on existing ASHRAE standards, guidelines, and technical publications.

While these efforts help clear the first hurdle identified above, they have not yet directly addressed the second hurdle of providing useable data content based on these information exchange standards that can be easily accessed and "plugged" into the software tools already being used in a design office, and then exchanged with other software tools used on a construction site and later in the maintenance and management of an operating facility.

Objective

This is where Building Information Modeling (BIM) comes into play. Done properly, BIM clearly documents the tasks involved in a work process and its standardized data requirements in what is called *Use Case* documentation of ***information exchange standards***. Use Case documentation can be developed for an individual work process based on an ASHRAE publication such as Standard 180. More usefully, Use Case documentation can merge related ASHRAE publications like Standard 180 and Guideline 4 into a single overarching work process that encompasses the best of both publications and standardizes terms like *Air Handling Unit* across them. Such standardization of data terms facilitates automated data exchange between software applications used in design, construction, and operations and maintenance, so that information about building equipment specified in a design tool can automatically populate a computerized maintenance management system (CMMS) used to maintain that equipment in the constructed building.

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Scope:
The following tasks describe in more detail the expected approach to achieve the desired project objectives.

Task 1: Identify BIM Data Sets

Using the 1609-RP *Manage Asset O&M Documentation* use case documentation, select a minimum of three to five equipment types to be included in neutral format data content generation. These equipment types should be selected based on relevance to ASHRAE members, availability of data, and value as exemplars. The 1609-RP use case documentation should be revised as the project continues to make it consistent with this new work. The 1609-RP use case documentation is available free to ASHRAE members at the Members Only Research Reports site (ASHRAE, 2016) or for purchase by non-members through the ASHRAE online bookstore.

Interim Deliverables: Draft Equipment Selection List

PMS Review Points: Review Equipment Selection List and reach consensus prior to subsequent tasks.

Task 2: Identify Related Data Standards

In addition to the 1609-RP documentation and referenced ASHRAE publications, identify other relevant references for BIM data elements (properties) for the selected equipment types. Such references include, for example, other

related ASHRAE Standards/Guidelines/Publications, CIBSE Product Data Templates (CIBSE, 2016), Green Building XML (gbXML, 2017), COBie Guide (COBie, 2016), OmniClass (OmniClass, 2016), NIBS National BIM Guideline for Owners (NIBS, 2016), etc.

Interim Deliverables: Draft Reference List

PMS Review Points: Review Reference List for possible revisions prior to subsequent tasks.

Task 3: Develop Spreadsheet Documentation

Create a spreadsheet of key properties for each equipment type, using the Data Element worksheet of the 1609-RP use case as a starting point. The expected data content includes, for example, the identified properties for Equipment Components that would help track installation and removal dates, annual run hours, warrantee information, and maintenance tasks for each component installed and maintained in a building, as documented in the 1609-RP use case *Manage Asset O&M Documentation*. This new spreadsheet will become the ASHRAE template for this research project. Where possible use ASHRAE Terminology and definitions for properties.

Using the ASHRAE template as a data model/schema guide, create and populate data content worksheets with a generic example of each equipment type selected in Task 1. These examples can be based on data used during the design phase prior to specification of commercially available equipment.

Post templates and example data content worksheets on data.ashrae.org and invite public review both within and outside ASHRAE. Within ASHRAE, begin with the sponsoring committees of this project and expand to committees with interest in the selected equipment types. Outside ASHRAE include contacts with members of CIBSE and NIBS with interest in the references identified in Task 2. Solicit specific comments on the posted templates. This task is intended to raise visibility of this effort both within and outside ASHRAE.

Interim Deliverables: Draft spreadsheet template for each equipment type, generic data content worksheet for each equipment type, draft report on public review effort.

PMS Review Points: Review spreadsheet template and data content worksheet for each equipment type as developed. Provide support in soliciting public review comments.

Task 4: Add Classification Scheme to Spreadsheet Documentation

Add a classification scheme to the spreadsheet template to support matching/mapping equipment types to different reference templates identified in Task 2 such as the CIBSE Product Data Templates and COBie. Map each ASHRAE template property to relevant references identified in Task 2. These mappings will support future formal transformations between ASHRAE objects/properties and other data formats like CIBSE and COBie, and add legitimacy to the ASHRAE template by ensuring it is not divergent from other existing data exchange standards.

Interim Deliverables: Draft spreadsheet template for each equipment type including classification scheme.

PMS Review Points: Review spreadsheet template with classification scheme data.

Task 5: Create Neutral Format Schema and Data Content Documents

Create industry standard schema and data content documents, in either XSD/XML or JSON format, based on the ASHRAE spreadsheet template and data content worksheets. These neutral format documents will support adoption and use of ASHRAE data content in implementing ASHRAE publication best practices in their work.

These neutral format documents will also support possible future development of transformation utilities for translating ASHRAE data content into other common formats such as gbXML currently used in the buildings industry for data exchange between tools used by ASHRAE practitioners.

Post the neutral format schema and content documents to the data.ashrae.org repository. These documents are intended to provide a foundation for end-user development of equipment libraries in their tool of choice.

Notify engaged public reviewers of availability of neutral format documents and solicit comments.

Interim Deliverable: Neutral format schema and content documents for each equipment type

PMS Review Points: Provide feedback on neutral format documents.

Task 6: Create End-User Implementation Guide
Create an end-user implementation guide including step-by-step procedures for utilizing the ASHRAE data content documents developed in Task 5 to support ASHRAE members and other users in the adoption of BIM in their professional practice. This implementation guide should provide details on accessing the appropriate ASHRAE data content documents and utilizing these data in their work process, including guidance on developing transformations for data exchange with other software tools and other formats such as those identified in Task 2.

Interim Deliverable: Draft End-Use Implementation Guide

PMS Review Points: Review Draft End-Use Implementation Guide

Task 7: Create Required Project Final Reports and Deliverables

Create required final reports and deliverables to successfully complete the research project.

Interim Deliverable: Final Reports and Deliverables

PMS Review Points: Review Final Reports and Deliverables

Deliverables:
Progress and Financial, Final Task and Summary Reports, Technical Paper(s), and Data shall constitute the deliverables ("Deliverables") under this Agreement and shall be provided as follows:

a. Progress and Financial Reports

Progress and Financial Reports, in a form approved by the Society, shall be made to the Society through its Manager of Research and Technical Services at quarterly intervals; specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.

Furthermore, the Contractor's Principal Investigator, subject to the Society's approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. Final Task Reports and Data Sets

Draft interim reports shall be delivered following the completion of individual tasks as agreed upon between the Contractor and the Project Monitoring Subcommittee (PMS). Each interim report should include a list of any challenges identified that could impact on-time delivery of the research. It is recommended that the drafts be developed and formatted so that they lead to the Task Final Reports listed below. The drafts are intended to increase the transparency between the contractor and project monitoring subcommittee, not to add cost to the project.

Final Task Deliverables
- Spreadsheet template for each Equipment Type including Mappings (Tasks 3 & 4)
- Neutral format documents for each equipment type (Task 5)
- End-Use Implementation Guide (Task 6)

· Final Reports and Deliverables (Task 7)

c. Final Report

A written report, design guide, or manual, (collectively, "Final Report"), in a form approved by the Society, shall be prepared by the Institution and submitted to the Society's Manager of Research and Technical Services by the end of the Agreement term, containing complete details of all research carried out under this Agreement, including a summary of the control strategy and savings guidelines. Unless otherwise specified, the final draft report shall be furnished, electronically for review by the Society's Project Monitoring Subcommittee (PMS).

Tabulated values for all measurements shall be provided as an appendix to the final report (for measurements which are adjusted by correction factors, also tabulate the corrected results and clearly show the method used for correction).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

-An executive summary in a form suitable for wide distribution to the industry and to the public.
-Two copies; one in PDF format and one in Microsoft Word.

d. *Science & Technology for the Built Environment* or *ASHRAE Transactions* Technical Papers

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (MORTS) and then to the "ASHRAE Manuscript Central" website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted as either *Science & Technology for the Built Environment* or *ASHRAE Transactions*. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in "Manuscript Central" for an *ASHRAE Transactions* Technical or HVAC&R Research papers. The paper title shall contain the research project number (1801-RP) at the end of the title in parentheses, e.g., (1801-RP).

All papers or articles prepared in connection with an ASHRAE research project, which are being submitted for inclusion in any ASHRAE publication, shall be submitted through the Manager of Research and Technical Services first and not to the publication's editor or Program Committee.

e. Data

Data is defined in General Condition VI, "DATA"

f. Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience documenting: (i) the main findings of the research project, (ii) why the findings are significant, and (iii) how the findings benefit ASHRAE membership and/or society in general.

The Society may request the Institution submit a technical article suitable for publication in the Society's ASHRAE JOURNAL. This is considered a voluntary submission and not a Deliverable. Technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

Level of Effort

The project is estimated to take no more than 18 months to complete, with a level of effort of approximately 10 person-months involving 2-3 months of Principal Investigator time and 7-8 months of professional staff time. The estimated total cost is $125,000.

Proposal Evaluation Criteria

1. Contractor's understanding of Work Statement as revealed in proposal. 30%
   a) Understanding of foundational work done in 1609-RP
   b) Understanding of intended products of this research project
   c) Understanding of application of these project products
2. Quality of methodology proposed for conducting research. 25%
   a) Organization of project
   b) Management plan
3. Qualifications of personnel for this project. 20%
   a) Project team 'well rounded' in terms of qualifications and experience in related work, including expertise in formal information exchange documentation
   b) Project manager experience
   c) Time commitment of Principal Investigator
4. Probability of contractor's research plan meeting the objectives of the Work Statement 20%
   a) Detailed and logical work plan with major tasks and key milestones
   b) All technical and logistic factors considered
   c) Reasonableness of project schedule
5. Performance of contractor on prior ASHRAE or other projects (no penalty for new contractors) 5%

Project Milestones

No.	Major Project Completion Milestones	Deadline Month
1	Task 1: Equipment Selection List Task 2: Reference List Task 3: Draft spreadsheet template for each equipment type, generic data content worksheet for each equipment type, draft report on public review effort	5
1	Task 4: Draft spreadsheet templates with classification scheme data Task 5: Neutral format schema and data content documents for each equipment type Task 6: End-Use Implementation Guide	14
3	Task 7: Final Task Reports and Data Documents, Final Summary Report, Technical Paper, Project Synopsis	18

References

1. ASHRAE, 2017. ASHRAE Terminology online searchable glossary of terms for the built environment, https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology

2. ASHRAE, 2016. ASHRAE Members Only Research Reports website, https://www.ashrae.org/standards-research--technology/members-only-research-reports-redirect

3. ASHRAE, 2015. ASHRAE Service Life and Maintenance Cost Database, http://xp20.ashrae.org/publicdatabase/

4. ASHRAE, 2013. ASHRAE Guideline 4-2008 (RA 2013): Preparation of Operating and Maintenance Documentation for Building Systems, https://www.ashrae.org/standards-research--technology/standards--guidelines/titles-purposes-and-scopes#Gdl4

5. ASHRAE, 2012. ASHRAE Standard 180-2012: Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems, http://www.techstreet.com/products/1832333

6. CIBSE, 2016. CIBSE Product Data Templates, http://www.cibse.org/Knowledge/BIM-Building-Information-Modelling/Product-Data-Templates

7. COBie, 2016. The Construction Operations Building information exchange (COBie) Guide, https://www.nibs.org/?page=bsa_cobieguide

Mayo, G. Giel, B., & Issa, R., 2012. BIM use and requirement among building owners. In Proceedings of the International Conference on Computing in Civil Engineering, Clearwater Beach, FL, USA

NIBS, 2016. NIBS National BIM Guideline for Owners, https://www.nibs.org/news/254633/Institute-Kicks-Off-Effort-to-Develop-National-BIM-Guideline-for-Owners.htm

OmniClass, 2016. The OmniClass Construction Classification System, http://www.omniclass.org/

WORK STATEMENT COVER SHEET

Date: August 10, 2017

(Please Check to Insure the Following Information is in the Work Statement)

A. Title	✔
B Executive Summary	✔
C. Applicability to ASHRAE Research Strategic Plan	✔
D. Application of the Results	✔
E. State-of-the-Art (background)	✔
F. Advancement to State-of-the-Art	✔
G. Justification and Value to ASHRAE	✔
H. Objective	✔
I. Scope	✔
J. Deliverables/Where Results will be Published	✔
K. Level of Effort	
Project Duration in Months	✔
Professional-Months: Principal Investigator	✔
Professional-Months: Total	✔
Estimated $ Value	✔
L Proposal Evaluation Criteria & Weighting Factors	✔
M. References	✔
N. Other Information to Bidders (Optional)	

Title:
Standardizing and Utilizing ASHRAE Online BIM Data Exchange Protocols

WS# 1801
(To be assigned by MORTS - Same as RTAR #)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:

ASHRAE HVAC Applications Chapter 40: Computer Applications

ASHRAE Introduction to Building Information Modeling (BIM)

Responsible TC/TG: TC 1.5 Computer Applications

Date of Vote: 8/1/2017

For		10
Against	*	0
Abstaining	*	0
Absent or not returning Ballot	*	0
Total Voting Members		10

This W/S has been coordinated with TC/TG/SSPC (give vote and date):
MTG-BIM:9-0-2-4-15 6/26/17; TC 7.1: 4-0-0-3-7 8/8/17; TC 7.3:6

Has RTAR been submitted?
Strategic Plan
Theme/Goals

No - based on previous research 1609-RP
Research Strategic Plan 2010-2015 (2018): Goal 6, Research Needs 1-4; Goals 1 and 7

Work Statement Authors: **
Robert J. Hitchcock

Proposal Evaluation Subcommittee:
Chair: Todd Gottshall, TC 1.5
Members:
Dennis Knight, MTG-BIM
Krishnan Gowri, MTG-BIM
Michel Tardif, TC 7.1
Russell Taylor TC 7.1

Project Monitoring Subcommittee:
(If different from Proposal Evaluation Subcommittee)
Chair: Todd Gottshall, TC 1.5
Members: David Branson, TC 1.5, Walter Grondzik, TC 1.5, Dennis Knight, MTG-BIM, Krishnan Gowri, MTG-BIM, Russell Taylor, TC 7.1

Recommended Bidders (name, address, e-mail, tel. number): **
Troy V. Nguyen, Ph.D., Florida Institute of Technnology, Melbourne, FL, tnguyen@fit.edu, 321-674-8256
Jason Glazer, Gard Analytics, Arlington Heights, IL, jglazer@gard.com, 847-698-5686
Mark Clayton, Ph.D., Texas A&M University, College Station, TX, Mark.Clayton@tamu.edu, 979-845-1221
Robert J. Hitchcock, Ph.D., Hitchcock Consulting, Sacramento, CA, RJHitchcock@gmail.com, 530-651-4425

(**Three qualified bidders must be recommended, not including WS authors.**)

Potential Co-funders (organization, contact person information):

	Yes	No	How Long (weeks)
Is an extended bidding period needed?		✔	
Has an electronic copy been furnished to the MORTS?	✔		
Will this project result in a special publication?		✔	
Has the Research Liaison reviewed work statement?	✔		

* Reasons for negative vote(s) and abstentions

MTG-BIM abstentions due to not reviewing WS prior to vote. TC 7.3 abstention due to Chair Not Voting. TC 7.1 3 members did not return vote.

** Denotes WS author is affiliated with this recommended bidder
Use additional sheet if needed.

WORK STATEMENT# 1801

Title:

Standardizing and Utilizing ASHRAE Online BIM Data Exchange Protocols

Sponsoring TC/TG/MTG/SSPC:

TC 1.5 Computer Applications

Co-Sponsoring TC/TG/MTG/SSPCs (List only TC/TG/MTG/SSPCs that have voted formal support)

MTG-BIM
TC 7.1

Executive Summary:

ASHRAE has produced a wealth of publications documenting best practices for a wide variety of building industry work processes involved in designing, commissioning, operating and maintaining buildings. Many of these publications include a detailed level of information required to support these work processes. However, there is little standardization of these information requirements across publications that would facilitate adoption and implementation of these best-practice work processes by ASHRAE members.

Building Information Modeling (BIM) is currently attracting substantially increased attention, with well-attended technical sessions at ASHRAE meetings illustrating the promise of BIM and advocating the benefits of employing BIM-enabled work processes in professional practice. However, many ASHRAE members are still unsure of how to adopt BIM processes in their daily practice to achieve the claimed benefits. In particular, small firms with limited resources find the initial barrier too high to change their current work processes.

Two significant hurdles in achieving BIM adoption are: 1) the development of relevant and useable *information exchange standards*, and 2) the lack of available BIM data exchange protocols (i.e., data models and content) that adhere to these information exchange standards, and that can be readily accessed for import into, and automated data exchange between, the tools already being used by ASHRAE professionals.

While there are standards efforts taking place within the US and internationally to address these hurdles, these efforts are not targeted specifically to standardizing BIM for ASHRAE publications for adoption by ASHRAE members. As stated in the ASHRAE Research Strategic Plan 2010-2018 there is a research need to "develop data exchange protocols for HVAC&R information within ASHRAE, consistent with the standards and protocols being adopted by other BIM communities."

Several efforts are underway within ASHRAE to address the first hurdle. An effort to address the second hurdle has been recently initiated within ASHRAE by establishing a web-based repository for hosting data exchange protocols and making them publicly available for both human and computerized use. However, no such content is yet available through this repository.

BIM standardization has been underway for several years in other building industry organizations such as NIBS (National Institute of Building Sciences) (NIBS, 2016), ISO (International Organization for Standardization), and CIBSE (Chartered Institution of Building Services Engineers) (CIBSE, 2016). While there is overlap in these efforts, none are specifically tailored to support ASHRAE members using ASHRAE publications. Ideally, information exchange standards based on ASHRAE publications would be coordinated with other relevant efforts to ensure consistency and data exchange interoperability between resulting standards.

Applicability to the ASHRAE Research Strategic Plan:

The proposed research comprehensively supports *Goal 6: Building Information Modeling of energy efficient, high performing buildings* of the ASHRAE Research Strategic Plan 2010-2018, addressing all of the identified challenges of BIM by : 1) Ensuring that research projects address the increasingly cross cutting requirements of BIM, interoperability and information exchange, 2) Stimulating greater awareness of the implications of BIM on Society technical activities, 3) Developing interoperable tools and products of its own to support member adoption of BIM, and 4) Working effectively with external bodies such as the buildingSMART alliance and Open Green Building XML Schema, Inc. (gbXML).

Specifically, this proposed research scope and technical approach addresses each of the four research needs identified within Goal 6, by: 1) developing data exchange protocols for HVAC&R information within ASHRAE, consistent with the standards and protocols being adopted by other BIM communities 2) developing reference use cases for HVAC&R applications in support of ASHRAE Guideline 20, 3) producing guidance for ASHRAE TCs on the development of BIM processes and tools, and 4) developing guidance and examples for process assessment in a BIM

Application of Results:

The proposed research would develop easily useable data content made publicly available via the new ASHRAE data portal at data.ashrae.org, and would also develop accompanying user guidance for ASHRAE membership in utilizing the data in the adoption of BIM in their professional practice. The developed data content and user guidance would be based on the results of the previous ASHRAE research project 1609-RP: *Defining the Capabilities, Needs and Current Limitations of Building Information Modeling (BIM) in Operations and Maintenance for HVAC&R.*

Previously, ASHRAE research project 1609-RP documented a work process use case entitled *Manage Asset O&M Documentation.* This use case was developed following the ASHRAE Guideline 20 protocol, and documents steps in the work process of managing assets, and identifies and defines the building information required to perform these process steps. For example, this use case documentation identified data properties for Equipment Component assets that are needed to track equipment installation and removal dates, annual run hours, warranty information, and maintenance tasks for each component installed in a building. The definition of these properties is based on ASHRAE Guideline 4: *Preparation of Operating and Maintenance Documentation for Building*

State-of-the-Art (Background):

ASHRAE has produced, and continues to produce, a wealth of standards, guidelines, and other special publications, documenting best practices for a wide variety of building industry work processes involved in designing, commissioning, operating and maintaining buildings. Many of these publications include step-by-step tasks for adopting these best practices and include a detailed level of information required to support these work processes. Implementing the best practices detailed in an ASHRAE publication is, however, not a trivial exercise. Professional practice work processes must be tailored to the desired publication, including documenting the necessary supporting information in a standardized way so that the process can be consistently applied across future projects. Furthermore, each work process must be integrated into a firm's current practice in a manner that allows individual practitioners to share their information with a team, and deliver final documentation in a form that can be referenced and used by others.

For example, a firm wanting to implement ASHRAE Standard 180: *Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems*, must document "an inventory of equipment and systems to be inspected and maintained" (ASHRAE, 2012). Standard 180 includes a list of such equipment and systems including: Air Distribution System, Air Handler, Humidification Device, etc.

Members of this firm may also be considering the related ASHRAE Guideline 4: *Preparation of Operating and Maintenance Documentation for Building Systems*, which states that a "maintenance manual should provide all relevant information needed for the day-to-day maintenance of the HVAC&R systems" (ASHRAE, 2013). Guideline 4 includes informative details on equipment data sheets that should be part of equipment inventories (e.g., Serial Number, Location, and Preventive Maintenance Actions), and includes examples of such equipment

Advancement to the State-of-the-Art:

An effort to address the second hurdle toward BIM adoption has been initiated within ASHRAE. A web address Uniform Resource Locator (URL) has been established by ASHRAE for hosting electronic information content and making that content publicly available for both human and fully automated computerized use. That URL is data.ashrae.org and is designed to provide a repository for ASHRAE data content. However, no such data content is yet available through that website.

As mentioned above, ASHRAE research project 1609-RP developed information exchange standards, based on ASHRAE publications, for representing asset management information across a facility life cycle, with a focus on use during O&M. Specifically, 1609-RP documented a *Manage Asset O&M Documentation* use case adhering to the Guideline 20 work process documentation procedure. An accompanying user guide provides direction on implementing a BIM asset management program based on this use case. This use case documentation provides an excellent starting point for developing neutral format data content that could be made available through the data.ashae.org repository. The user guide also provides a starting point for end-user guidance on utilizing the data.ashrae.org content in adopting a BIM-enabled work process customized to ASHRAE members.

This follow-on research project would develop structured data content based on the 1609-RP use case documentation, and post these data to the ASHRAE data content repository to support public access for import into, and automated data exchange between, the tools used by ASHRAE professionals. This data content would include industry standard schema and data content documents, in either XML/XSD (eXtensible Markup Language/Schema Definition) or JSON (JavaScript Object Notation) format. These neutral format documents would encourage future development of transformation utilities for translating ASHRAE data content into other common formats to further facilitate automated data exchange.

To facilitate end-user adoption of this data content in support of BIM-enabled work processes, the research project would develop accompanying user guidance documentation that would also be made publicly available through the repository.

Justification and Value to ASHRAE:

ASHRAE members and the Society as a whole have expressed increasing interest in adopting Building Information Modeling (BIM) to improve professional work processes and the overall performance of the built environment. Several ASHRAE technical activities (e.g., Guideline 20, SPC 205, MTG-BIM) and research projects (e.g., 1354-RP, 1468-RP, 1609-RP) have been working to develop relevant and useable information exchange standards, which define standard data representations for key information required to perform HVAC&R work processes. The availability of useable data content based on existing ASHRAE publications, coordinated with similar efforts underway outside ASHRAE, is a required next step in promoting the adoption of BIM-enabled work processes by ASHRAE members.

The proposed research is designed to create BIM data content in a commonly used neutral format (e.g., XML or JSON), aligned with relevant existing BIM standards, and make this content available to ASHRAE members through the established ASHRAE data repository (data.ashrae.org).

The proposed research would also provide detailed end-user guidance in employing the data repository to facilitate adoption of ASHRAE BIM data content.

In addition to facilitating the adoption of BIM by ASHRAE members, readily available ASHRAE BIM data content with user guides would raise the visibility and perceived value of BIM-enabled interoperability within ASHRAE and promote its continuing development within other technical activities of the Society.

Furthermore, availability of BIM data based on existing ASHRAE publications would increase reference to, and adoption of, these ASHRAE publications. For example, numerous ASHRAE publications address commissioning, maintenance and management activities, but are not often put into practice in part because of a lack of data

Objectives:

The objective of this research project is to bring data exchange protocols based on ASHRAE publications, to useable completion and availability by: 1) aligning ASHRAE exchange protocols with relevant existing BIM standards, 2) creating neutral format data content downloadable from the new ASHRAE data repository (data.ashrae.org), and 3) documenting end-user guidance to support ASHRAE members in implementing these data exchange protocols in the adoption of BIM in their professional practice. A long term objective is to use this example to encourage ASHRAE committees to develop additional data exchange protocols based on their publications.

Scope/Technical Approach:

The following tasks describe in more detail the expected approach to achieve the desired project objectives.

Task 1: Identify BIM Data Sets

Using the 1609-RP *Manage Asset O&M Documentation* use case documentation, select a minimum of three to five equipment types to be included in neutral format data content generation. These equipment types should be selected based on relevance to ASHRAE members, availability of data, and value as exemplars. The 1609-RP use case documentation should be revised as the project continues to make it consistent with this new work. The 1609-RP use case documentation is available free to ASHRAE members at the Members Only Research Reports site (ASHRAE, 2016) or for purchase by non-members through the ASHRAE online bookstore.

Interim Deliverables: Draft Equipment Selection List

PMS Review Points: Review Equipment Selection List and reach consensus prior to subsequent tasks.

Task 2: Identify Related Data Standards

In addition to the 1609-RP documentation and referenced ASHRAE publications, identify other relevant references for BIM data elements (properties) for the selected equipment types. Such references include, for example, other related ASHRAE Standards/Guidelines/Publications, CIBSE Product Data Templates (CIBSE, 2016), Green Building XML (gbXML, 2017), COBie Guide (COBie, 2016), OmniClass (OmniClass, 2016), NIBS National BIM Guideline for Owners (NIBS, 2016), etc.

Interim Deliverables: Draft Reference List

PMS Review Points: Review Reference List for possible revisions prior to subsequent tasks.

Task 3: Develop Spreadsheet Documentation

Create a spreadsheet of key properties for each equipment type, using the Data Element worksheet of the 1609-RP use case as a starting point. The expected data content includes, for example, the identified properties for Equipment Components that would help track installation and removal dates, annual run hours, warrantee information, and maintenance tasks for each component installed and maintained in a building, as documented in the 1609-RP use case *Manage Asset O&M Documentation*. This new spreadsheet will become the ASHRAE template for this research project. Where possible use ASHRAE Terminology and definitions for properties.

Using the ASHRAE template as a data model/schema guide, create and populate data content worksheets with a generic example of each equipment type selected in Task 1. These examples can be based on data used during the design phase prior to specification of commercially available equipment.

Post templates and example data content worksheets on data.ashrae.org and invite public review both within and outside ASHRAE. Within ASHRAE, begin with the sponsoring committees of this project and expand to committees with interest in the selected equipment types. Outside ASHRAE include contacts with members of CIBSE and NIBS with interest in the references identified in Task 2. Solicit specific comments on the posted templates. This task is intended to raise visibility of this effort both within and outside ASHRAE.

Interim Deliverables: Draft spreadsheet template for each equipment type, generic data content worksheet for each equipment type, draft report on public review effort.

PMS Review Points: Review spreadsheet template and data content worksheet for each equipment type as developed. Provide support in soliciting public review comments.

Scope/Technical Approach (Continued 2):

Task 4: Add Classification Scheme to Spreadsheet Documentation

Add a classification scheme to the spreadsheet template to support matching/mapping equipment types to different reference templates identified in Task 2 such as the CIBSE Product Data Templates and COBie. Map each ASHRAE template property to relevant references identified in Task 2. These mappings will support future formal transformations between ASHRAE objects/properties and other data formats like CIBSE and COBie, and add legitimacy to the ASHRAE template by ensuring it is not divergent from other existing data exchange standards.

Interim Deliverables: Draft spreadsheet template for each equipment type including classification scheme.

PMS Review Points: Review spreadsheet template with classification scheme data.

Task 5: Create Neutral Format Schema and Data Content Documents

Create industry standard schema and data content documents, in either XSD/XML or JSON format, based on the ASHRAE spreadsheet template and data content worksheets. These neutral format documents will support adoption and use of ASHRAE data content in implementing ASHRAE publication best practices in their work.

These neutral format documents will also support possible future development of transformation utilities for translating ASHRAE data content into other common formats such as gbXML currently used in the buildings industry for data exchange between tools used by ASHRAE practitioners.

Post the neutral format schema and content documents to the data.ashrae.org repository. These documents are intended to provide a foundation for end-user development of equipment libraries in their tool of choice.

Notify engaged public reviewers of availability of neutral format documents and solicit comments.

Interim Deliverable: Neutral format schema and content documents for each equipment type

PMS Review Points: Provide feedback on neutral format documents.

Task 6: Create End-User Implementation Guide

Create an end-user implementation guide including step-by-step procedures for utilizing the ASHRAE data content documents developed in Task 5 to support ASHRAE members and other users in the adoption of BIM in their professional practice. This implementation guide should provide details on accessing the appropriate ASHRAE data content documents and utilizing these data in their work process, including guidance on developing transformations for data exchange with other software tools and other formats such as those identified in Task 2.

Interim Deliverable: Draft End-Use Implementation Guide

PMS Review Points: Review Draft End-Use Implementation Guide

Task 7: Create Required Project Final Reports and Deliverables

Create required final reports and deliverables to successfully complete the research project.

Interim Deliverable: Final Reports and Deliverables

PMS Review Points: Review Final Reports and Deliverables

Scope/Technical Approach (Continued 3):

Deliverables/Where Results Will Be Published:

Progress and Financial, Final Task and Summary Reports, Technical Paper(s), and Data shall constitute the deliverables ("Deliverables") under this Agreement and shall be provided as follows:

a. Progress and Financial Reports
Progress and Financial Reports, in a form approved by the Society, shall be made to the Society through its Manager of Research and Technical Services at quarterly intervals; specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.

Furthermore, the Contractor's Principal Investigator, subject to the Society's approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. Final Task Reports and Data Sets
Draft interim reports shall be delivered following the completion of individual tasks as agreed upon between the Contractor and the Project Monitoring Subcommittee (PMS). Each interim report should include a list of any challenges identified that could impact on-time delivery of the research. It is recommended that the drafts be developed and formatted so that they lead to the Task Final Reports listed below. The drafts are intended to increase the transparency between the contractor and project monitoring subcommittee, not to add cost to the project.

Final Task Deliverables

- ***Spreadsheet template for each Equipment Type including Mappings (Tasks 3 & 4)***
- ***Neutral format documents for each equipment type (Task 5)***
- ***End-Use Implementation Guide (Task 6)***
- ***Final Reports and Deliverables (Task 7)***

c. Final Summary Report
A written final summary report, in a form approved by the Society, shall be prepared by the Institution and submitted to the Society's Manager of Research and Technical Services by the end of the Agreement term, containing details of all research carried out under this Agreement, including a summary of the individual task deliverables. Unless otherwise specified, the final draft report shall be furnished electronically for review by the Society's Project Monitoring Subcommittee (PMS).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:
-An executive summary in a form suitable for wide distribution to the industry and to the public.
-Two electronic copies; one in PDF format and one in Microsoft Word.

d. Science and Technology for the Built Environment or ASHRAE Transactions Technical Papers
One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (MORTS) and then to the "ASHRAE Manuscript Central" website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted as either Research Papers for Science and Technology for the Built Environment or Technical Paper(s) for ASHRAE Transactions. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in "Manuscript Central" for an ASHRAE Transactions Technical or Science and Technology for the Built Environment papers. The paper title shall contain the research project number (1609-RP) at the end of the title in parentheses, e.g., (1609-RP).

All papers or articles prepared in connection with an ASHRAE research project, which are being submitted for inclusion in any ASHRAE publication, shall be submitted through the Manager of Research and Technical

Deliverables/Where Results Will Be Published (Continued):

e. Data
Data is defined in General Condition VI, "DATA"

Delivered Data shall include electronic copies of the final versions of the ASHRAE Templates with Generic Example Data (Task 2), the Example Data Sets in neutral format (Task 3), and the End-User Implementation Guide (Task 4). Following PMS and Sponsoring Committee approval, these data will be posted to the ASHRAE data repository (data.ashrae.org).

f. Project Synopsis
A written synopsis totaling approximately 100 words in length and written for a broad technical audience, which documents 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general shall be submitted to the Manager of Research and Technical Services by the end of the Agreement term for publication in ASHRAE Insights

Level of Effort:

The project is estimated to take no more than 18 months to complete, with a level of effort of approximately 10 person-months involving 2-3 months of Principal Investigator time and 7-8 months of professional staff time. The estimated total cost is $125,000.

Proposal Evaluation Criteria:

No.	Proposal Review Criterion	Weighting Factor
1	Contractor's understanding of Work Statement as revealed in proposal. a) Understanding of foundational work done in 1609-RP b) Understanding of intended products of this research project c) Understanding of application of these project products	30%
2	Quality of methodology proposed for conducting research. a) Organization of project b) Management plan	25%
3	Qualifications of personnel for this project. a) Project team 'well rounded' in terms of qualifications and experience in related work, including expertise in formal information exchange documentation b) Project manager experience	20%
4	Probability of contractor's research plan meeting the objectives of the Work Statement a) Detailed and logical work plan with major tasks and key milestones b) All technical and logistic factors considered c) Reasonableness of project schedule	20%
5	Performance of contractor on prior ASHRAE or other projects (no penalty for new contractors)	5%

Project Milestones:

No.	Major Project Completion Milestone	Deadline Month
1	Task 1: Equipment Selection List Task 2: Reference List Task 3: Draft spreadsheet template for each equipment type, generic data content worksheet for each equipment type, draft report on public review effort	5
2	Task 4: Draft spreadsheet templates with classification scheme data Task 5: Neutral format schema and data content documents for each equipment type Task 6: End-Use Implementation Guide	14
3	Task 7: Final Task Reports and Data Documents, Final Summary Report, Technical Paper, Project Synopsis	18

Authors:

Robert J. Hitchcock

References:

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Mayo, G. Giel, B., & Issa, R., 2012. BIM use and requirement among building owners. In Proceedings of the International Conference on Computing in Civil Engineering, Clearwater Beach, FL, USA

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OmniClass, 2016. The OmniClass Construction Classification System, http://www.omniclass.org/

Other Information for Bidders (Optional):

Feedback to RAC and Suggested Improvements to Work Statement Process

Now that you have completed the work statement process, RAC is interested in getting your feedback and suggestions here on how we can improve the process.

Notes on revisions to 1801-WS in response to RAC comments

This is basically a research project to create Revit families. There are lots of commercial firms doing this already.

The work statement has been revised from creating proprietary format data content such as Revit, to creating BIM data content in a **commonly used neutral format (e.g., XML or JSON)**. This change will allow data content that has been standardized from ASHRAE publications to be created for download from the ASHRAE data repository (data.ashrae.org) in a format that can be transformed into other formats as desired. As such, the resulting data sets will complement and help existing BIM content creators versus competing with them.

Standards already in place.

While there are BIM standardization efforts taking place within the US and internationally, these efforts are not targeted specifically to standardizing BIM for ASHRAE publications for adoption by ASHRAE members. As stated in the ASHRAE Research Strategic Plan 2010-2018 there is a research need to "develop data exchange protocols for HVAC&R information within ASHRAE, consistent with the standards and protocols being adopted by other BIM communities." (From Executive Summary section of revised work statement)

A study on trends in BIM execution among building owners in the US (Mayo et al., 2012) reported that more than half (56%) of owners do not have BIM requirements in place to address their needs for the operation and maintenance phases. While existing efforts like COBie are intended to capture facility handover data, the related standards do not specifically use ASHRAE terminology nor are they linked to ASHRAE publications that define best practices supported by these data standards. For example, ASHRAE Guideline 4 defines maintenance action properties such as work time and cost of performing a maintenance action associated with a piece of equipment. COBie does not specifically include these properties, and although generic property extensions are supported, it requires expertise in COBie to know how to add such properties and later retrieve them for use. This research project would clearly define the Guideline 4 data properties, map them to COBie property extensions, and include instructions in the user guide to support their use. (From Advancement to the State-of-the-Art section of revised work statement)

The intent of this proposed research is to specify information exchange standards based on ASHRAE publications **that would be aligned with other relevant efforts to ensure consistency and data exchange interoperability between resulting standards**. This intent is stated in the Executive Summary, Application of Results, Advancement to the State-of-the-Art, Objectives, and specifically addressed in Tasks 2, 4 and 6 of the Scope/Technical Approach.

6 - Not enough background was provided for this reviewer to understand the problem

Please see revised Executive Summary and State-of-the-Art (Background).

11 - The author shows that a lot of work is being done by others, including NIST and CIBSE. I struggled to really understand (a) what data are needed for which aspects of BIM relevant to ASHRAE and the construction industry, and (b) how the proposed ASHRAE effort would

substantially increase the impact of the work underway elsewhere. Or is it just needed to give ASHRAE "chips" at the BIM table? That might be sufficient, and I might just not be subtle enough to "get" it.

Please see Paragraph 2 under response to “Standards already in place” comment above. The proposed research would focus on data needed for Operations and Maintenance that are clearly specified in a number of ASHRAE publications, but not specified in corresponding detail in existing BIM standards. Also relevant to this comment, while ASHRAE does have a seat at the table of other BIM standards efforts, ASHRAE has not yet provided substantial technical input into these efforts. The products of this proposed research would provide clear technical documentation of ASHRAE-tailored input. This technical documentation would also include instructions for adopting ASHRAE BIM standards within the larger BIM standard community.

5 - The WS did not adequately describe the proposed work, or the need for it.

Please see revised Scope/Technical Approach and State-of-the-Art (Background).

12 - One of TC members voted against this WS stating that this work is already being done by others and there is not need to use ASHRAE funds for it. I am inclined to agree.

Please see response to the first comment above. The one negative TC voter was asked to review the revised work statement and commented “I read over the work statement, and it looks good. I like the use of “neutral format (e.g., XML or JSON)” for the BIM data content creation. This sounds more like it will complement and help existing BIM content creators versus competing with them.”

11- But, this just may reflect my inability to figure out what they propose. 5 - Certainly BIM is important to ASHRAE. But it's difficult to say whether this particular proposal is relevant.

Please see revised Executive Summary, State-of-the-Art (Background) and Scope/Technical Approach.

11- I can't tell

I am not sure how to respond to this repeated comment other than to request that the reviewer read the revised work statement.

12 - The question is whether it should be done as an ASHRAE research project.

The proposed research would focus on data needed for Operations and Maintenance that are clearly specified in a number of ASHRAE publications, but not specified in corresponding detail in existing BIM standards. BIM standard efforts that are not tailored to ASHRAE publications are not as useful to ASHRAE members wishing to implement the best practices from these publications.

As stated in the Justification and Value to ASHRAE section of the work statement “Furthermore, availability of BIM data based on existing ASHRAE publications would increase reference to, and adoption of, these ASHRAE publications. For example, numerous ASHRAE publications address commissioning, maintenance and management activities, but are not often put into practice in part because of a lack of data standards and easily adopted step by step practices.”

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Robert Hitchcock, Work Statement Author, rjhitchcock@gmail.com

FROM: Michael Vaughn, Manager of Research and Technical Services (MORTS)

CC: Shinsuke Kato, Research Liaison 1.0, kato@iis.u-tokyo.ac.jp

DATE: July 19, 2016

SUBJECT: Work Statement (1801-WS), "Populating and Utilizing ASHRAE Online BIM Data Content"

During their recent Annual meeting, the Research Administration Committee (RAC) reviewed the subject Work Statement (WS) and voted to return with comments.

Below are the issues, concerns, and questions that must be addressed in your next submission of the WS if you choose to resubmit.

1. This is basically a research project to create Revit families. There are lots of commercial firms doing this already. This research should not be funded by ASHRAE.
2. Standards already in place.

Please coordinate changes to this Work Statement with your Research Liaison, Shinsuke Kato, RL1@ashrae.net or kato@iis.u-tokyo.ac.jp , prior to resubmitting it to the Manager of Research and Technical Services for further consideration by RAC.

Also, it is necessary that you provide a new TC vote on the revised Work Statement, and a letter describing how each of the above items were addressed in the revision.

If you wish for this work statement to be reconsidered at the next RAC meeting, the revised Work Statement must be sent (electronically) to Michael Vaughn, Manager of Research and Technical Services (morts@ashrae.net) by **August 15, 2016**. The next opportunity for consideration after this deadline is **December 15, 2016** for consideration at RAC's 2017 winter meeting.

Project ID	**1801**	
Project Title	**Populating and Utilizing ASHRAE Online BIM Data Content**	
Sponsoring TC	TC 1.5, Computer Applications	
Cost / Duration	$125,000 / 18 Months	
Submission History	**1st WS Submission, RTAR Stage Skipped**	
Classification: Research or Technology Transfer		
RAC 2016 Annual Meeting Review	**RTAR STAGE SKIPPED**	
Check List Criteria	**VOTED NO**	**Comments & Suggestions**
State-of-the-Art (Background): The WS should include some level of literature review that documents the importance/magnitude of a problem. If not, then the WS should be returned for revision. - **RTAR Review Criterion**	**#9, #5**	**11** - Yes, there is some literature review. **5** - Not enough background was provided for this reviewer to understand the problem.
Advancement to the State-of-the-Art Is there enough justification for the need of the proposed research. Will this research significantly contribute to the advancement of the State-of-the-Art. **RTAR Review Criterion**	**#11, #9, #5**	**11 -** the author shows that a lot of work is being done by others, including NIST and CIBSE. I struggled to really understand (a) what data are needed for which aspects of BIM relevant to ASHRAE and the construction industry, and (b) how the proposed ASHRAE effort would substantially increase the impact of the work underway elsewhere. Or is it just needed to give ASHRAE "chips" at the BIM table? That might be sufficient, and I might just not be subtle enough to "get" it. **5** - The WS did not adequately describe the proposed work, or the need for it. **12** - One of TC members voted against this WS stating that this work is already being done by others and there is not need to use ASHRAE funds for it. I am inclined to agree.
Relevance and Benefits to ASHRAE: Evaluate whether relevance and benefits are clearly explained in terms of: a. Leading to innovations in the field of HVAC & Refrigeration b. Valuable addition to the missing information which will lead to new design guidelines and valuable modifications to handbooks and standards. Is this research topic appropriate for ASHRAE funding? If not, Reject. **RTAR Review Criterion**	**#11, #9, #5**	**11-** But, this just may reflect my inability to figure out what they propose. **5** - Certainly BIM is important to ASHRAE. But it's difficult to say whether this particular proposal is relevant.
IF ABOVE THREE CRITERION ARE NOT ALL SATISFIED - MARK "REJECT" BELOW		
Detailed Bidders List Provided? The contact information in the bidder list should be complete so that each potential bidder can be contacted without difficulty.		**11** - 3 potential bidders identified.
Proposed Project Description Correct? Are there technical errors and/or technical omissions that the WS has that prevents it from correctly describing the project? If there are, than the WS needs major revision.		**11**- I can't tell
Task Breakdown Reasonable? Is the project divided into tasks that make technical and practical sense? Are the results of each task such that the results of the former naturally flow into the latter? If not, then major revisions are needed to the WS that would include: adding tasks, removing tasks, and re-structuring tasks among others.		**11** - I can't tell
Adequate Intermediate Deliverables? The project should include the review of intermediate results by the PMS at logical milestone points during the project. Before project work continues, the PMS must approve the intermediate results.	**#9**	**11 -** I can't tell
Proposed Project Doable? Can the project as described in the WS be accomplished? If difficulties exist in the project's WS that prevent a successful conclusion of the project, then the project is not doable. In this situation, major revision of the WS is needed to resolve the issues that cause the difficulty.	**#9**	**11** - I can't tell
Time and Cost Estimate Reasonable? The time duration and total cost of the project should be reasonable so that the project can be as it is described in the WS.	**#9**	**11** - I can't tell
Proposed Project Biddable? Examining the WS as a whole, is the project described in the WS of sufficient clarity and detail such a potential bidder can actually understand and develop a proposal for the project? This criterion combines the previous three criteria into an overall question concerning the usefulness of the WS. If the WS is considered to not be biddable, then either major revisions are in order or the WS should be rejected.	**#9**	**12** - The question is whether it should be done as an ASHRAE research project.

Decision Options	**Initial Decision**	**Approval Conditions**
ACCEPT		**6** - A well written and detailed WS. 11 - This WS may be perfectly intelligible to those doing BIM R&D. It is not to me, as a research person and generalist. I vote "return" in the hope that I will get something back that is both readable and biddable. **9** - Developing BIM models for ASHRAE makes no sense. The Negative vote from TC 1.5 says it best "This is basically a research project to create Revit families. There are lots of commercial firms doing this already. I don't see why ASHRAE should fund a company to do. This. In fact, this is not a research project, it's more of a data content-creation project. Research projects should be focused on research not the. Creation of data objects or even the development of software tools. **5**- This could be a very valuable project, but the WS authors did not build a good case. **12** - only 5 of the 8 TC members approved this, one voted against one abstained and 2 did not vote.
COND. ACCEPT		
RETURN		
REJECT		

RETURN Vote - Topic is probably acceptable for ASHRAE research, but RTAR is not quite ready.
REJECT Vote - Topic is not acceptable for the ASHRAE Research Program

1791 Tullie Circle NE ▪ Atlanta, Georgia 30329-2305 ▪ Tel 678.539.1211 ▪ Fax 678.539.2211 ▪ http://www.ashrae.org

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Manager
Research & Technical Services

mvaughn@ashrae.org

TO: Steven Rosen, Chair TC 1.5, srosen2004@comcast.net
Todd Gottshall, Research Subcommittee Chair TC 1.5, tgottshall@westernallied.com
Robert Hitchcock, Work Statement Author, rjhitchcock@gmail.com

FROM: Michael Vaughn, Manager of Research and Technical Services (MORTS)

CC: Shinsuke Kato, Research Liaison 1.0, kato@iis.u-tokyo.ac.jp

DATE: July 19, 2016

SUBJECT: Work Statement (1801-WS), "Populating and Utilizing ASHRAE Online BIM Data Content"

During their recent Annual meeting, the Research Administration Committee (RAC) reviewed the subject Work Statement (WS) and voted to return with comments.

Below are the issues, concerns, and questions that must be addressed in your next submission of the WS if you choose to resubmit.

1. This is basically a research project to create Revit families. There are lots of commercial firms doing this already. This research should not be funded by ASHRAE.
2. Standards already in place.

Please coordinate changes to this Work Statement with your Research Liaison, Shinsuke Kato, RL1@ashrae.net or kato@iis.u-tokyo.ac.jp , prior to resubmitting it to the Manager of Research and Technical Services for further consideration by RAC.

Also, it is necessary that you provide a new TC vote on the revised Work Statement, and a letter describing how each of the above items were addressed in the revision.

If you wish for this work statement to be reconsidered at the next RAC meeting, the revised Work Statement must be sent (electronically) to Michael Vaughn, Manager of Research and Technical Services (morts@ashrae.net) by **August 15, 2016**. The next opportunity for consideration after this deadline is **December 15, 2016** for consideration at RAC's 2017 winter meeting.

Project ID	**1801**	
Project Title	**Populating and Utilizing ASHRAE Online BIM Data Content**	
Sponsoring TC	TC 1.5, Computer Applications	
Cost / Duration	$125,000 / 18 Months	
Submission History	**1st WS Submission, RTAR Stage Skipped**	
Classification: Research or Technology Transfer		
RAC 2016 Annual Meeting Review	**RTAR STAGE SKIPPED**	
Check List Criteria	**VOTED NO**	**Comments & Suggestions**
State-of-the-Art (Background): The WS should include some level of literature review that documents the importance/magnitude of a problem. If not, then the WS should be returned for revision. - **RTAR Review Criterion**	**#9, #5**	**11** - Yes, there is some literature review. **5** - Not enough background was provided for this reviewer to understand the problem.
Advancement to the State-of-the-Art Is there enough justification for the need of the proposed research. Will this research significantly contribute to the advancement of the State-of-the-Art. **RTAR Review Criterion**	**#11, #9, #5**	**11 -** the author shows that a lot of work is being done by others, including NIST and CIBSE. I struggled to really understand (a) what data are needed for which aspects of BIM relevant to ASHRAE and the construction industry, and (b) how the proposed ASHRAE effort would substantially increase the impact of the work underway elsewhere. Or is it just needed to give ASHRAE "chips" at the BIM table? That might be sufficient, and I might just not be subtle enough to "get" it. **5** - The WS did not adequately describe the proposed work, or the need for it. **12** - One of TC members voted against this WS stating that this work is already being done by others and there is not need to use ASHRAE funds for it. I am inclined to agree.
Relevance and Benefits to ASHRAE: Evaluate whether relevance and benefits are clearly explained in terms of: a. Leading to innovations in the field of HVAC & Refrigeration b. Valuable addition to the missing information which will lead to new design guidelines and valuable modifications to handbooks and standards. Is this research topic appropriate for ASHRAE funding? If not, Reject. **RTAR Review Criterion**	**#11, #9, #5**	**11-** But, this just may reflect my inability to figure out what they propose. **5** - Certainly BIM is important to ASHRAE. But it's difficult to say whether this particular proposal is relevant.
IF ABOVE THREE CRITERION ARE NOT ALL SATISFIED - MARK "REJECT" BELOW		
Detailed Bidders List Provided? The contact information in the bidder list should be complete so that each potential bidder can be contacted without difficulty.		**11** - 3 potential bidders identified.
Proposed Project Description Correct? Are there technical errors and/or technical omissions that the WS has that prevents it from correctly describing the project? If there are, than the WS needs major revision.		**11**- I can't tell
Task Breakdown Reasonable? Is the project divided into tasks that make technical and practical sense? Are the results of each task such that the results of the former naturally flow into the latter? If not, then major revisions are needed to the WS that would include: adding tasks, removing tasks, and re-structuring tasks among others.		**11** - I can't tell
Adequate Intermediate Deliverables? The project should include the review of intermediate results by the PMS at logical milestone points during the project. Before project work continues, the PMS must approve the intermediate results.	**#9**	**11 -** I can't tell
Proposed Project Doable? Can the project as described in the WS be accomplished? If difficulties exist in the project's WS that prevent a successful conclusion of the project, then the project is not doable. In this situation, major revision of the WS is needed to resolve the issues that cause the difficulty.	**#9**	**11** - I can't tell
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Proposed Project Biddable? Examining the WS as a whole, is the project described in the WS of sufficient clarity and detail such a potential bidder can actually understand and develop a proposal for the project? This criterion combines the previous three criteria into an overall question concerning the usefulness of the WS. If the WS is considered to not be biddable, then either major revisions are in order or the WS should be rejected.	**#9**	**12** - The question is whether it should be done as an ASHRAE research project.

Decision Options	**Initial Decision**	**Approval Conditions**
ACCEPT		**6** - A well written and detailed WS. 11 - This WS may be perfectly intelligible to those doing BIM R&D. It is not to me, as a research person and generalist. I vote "return" in the hope that I will get something back that is both readable and biddable. **9** - Developing BIM models for ASHRAE makes no sense. The Negative vote from TC 1.5 says it best "This is basically a research project to create Revit families. There are lots of commercial firms doing this already. I don't see why ASHRAE should fund a company to do. This. In fact, this is not a research project, it's more of a data content-creation project. Research projects should be focused on research not the. Creation of data objects or even the development of software tools. **5**- This could be a very valuable project, but the WS authors did not build a good case. **12** - only 5 of the 8 TC members approved this, one voted against one abstained and 2 did not vote.
COND. ACCEPT		
RETURN		
REJECT		

RETURN Vote - Topic is probably acceptable for ASHRAE research, but RTAR is not quite ready.
REJECT Vote - Topic is not acceptable for the ASHRAE Research Program

WORK STATEMENT COVER SHEET

Date: May 10, 2016

(Please Check to Insure the Following Information is in the Work Statement)

A. Title	X
B Executive Summary	X
C. Applicability to ASHRAE Research Strategic Plan	X
D. Application of the Results	X
E. State-of-the-Art (background)	X
F. Advancement to State-of-the-Art	X
G. Justification and Value to ASHRAE	X
H. Objective	X
I. Scope	X
J. Deliverables/Where Results will be Published	X
K. Level of Effort	
Project Duration in Months	18
Professional-Months: Principal Investigator	2
Professional-Months: Total	8
Estimated $ Value	125
L Proposal Evaluation Criteria & Weighting Factors	X
M. References	X
N. Other Information to Bidders (Optional)	

Title:

Populating and Utilizing ASHRAE Online BIM Data Content

WS# 1801

(To be assigned by MORTS - Same as RTAR #)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:

ASHRAE HVAC Applications Chapter 40: Computer Applications

ASHRAE Introduction to Building Information Modeling (BIM)

Responsible TC/TG: TC 1.5 Computer Applications

Date of

For		5
Against	*	1
Abstaining	*	0
Absent or not returning Ballot	*	2
Total Voting Members		8

This W/S has been coordinated with TC/TG/SSPC (give vote and date):

TC 7.1: 6/0/0/3/9 4/29/2016

MTG-BIM: 8/0/1/3/12 5/7/2016

Has RTAR been submitted? No – based on previous research 1609-RP

Strategic Plan Research Strategic Plan 2010-2015 (2018)

Theme/Goals Goal 6: Research Needs 1-4

Goals 1, 5, and 7

Work Statement Authors: **

Robert J. Hitchcock

Proposal Evaluation Subcommittee:

Chair: Todd Gottshall, TC 1.5

Members: Dennis Knight, MTG-BIM

Krishnan Gowri, TC 7.1

Michel Tardif, TC 7.1

Project Monitoring Subcommittee:

(If different from Proposal Evaluation Subcommittee)

Chair: Todd Gottshall, TC 1.5

Members: David Branson, TC 1.5

Walter Grondzik

Dennis Knight, MTG-BIM

Krishnan Gowri, TC 7.1

Recommended Bidders (name, address, e-mail, tel. number): **

Troy V. Nguyen, Ph.D., Florida Institute of Technology, Melbourne, FL
tnguyen@fit.edu, 321-674-8256
Jason Glazer, Gard Analytics, Arlington Heights, IL
jglazer@gard.com, 847-698-5686
Mark Clayton, PhD, Texas A&M University, College Station, TX
Mark-clayton@tamu.edu, 979-845-1221

Potential Co-funders (organization, contact person information):

(Three qualified bidders must be recommended, not including WS authors.)

	Yes	No	How Long (weeks)
Is an extended bidding period needed?		X	
Has an electronic copy been furnished to the MORTS?	X		
Will this project result in a special publication?		X	
Has the Research Liaison reviewed work statement?	X		

* Reasons for negative vote(s) and abstentions

TC 1.5 Negative vote: This is basically a research project to create Revit families. There are lots of commercial firms doing this already. I don't see why ASHRAE should fund a company to do.this. In fact, this is not a research project, it's more of a data content-creation project. Research projects should be focused on research not the. creation of data objects or even the development of software tools.

MTG-BIM Abstention: Work Statement author

** Denotes WS author is affiliated with this recommended bidder
Use additional sheet if needed.

WORK STATEMENT# 1801-WS

Title:

Populating and Utilizing ASHRAE Online BIM Data Content

Sponsoring TC/TG/MTG/SSPC:

TC 1.5 Computer Applications

Co-Sponsoring TC/TG/MTG/SSPCs (List only TC/TG/MTG/SSPCs that have voted formal support)

Executive Summary:

Building Information Modeling (BIM) is currently attracting substantially increased attention, with well-attended technical sessions at ASHRAE meetings illustrating the promise of BIM and advocating the benefits of employing BIM-enabled work processes in professional practice. However, many ASHRAE members are still unsure of how to adopt BIM processes in their daily practice to achieve the claimed benefits. In particular, small firms with limited resources find the initial barrier too high to change their current work processes.

Two significant hurdles in achieving BIM adoption are: 1) the development of relevant and useable information exchange standards, and 2) the lack of available BIM data content that adheres to these information exchange standards, and that can be readily accessed for import into, and automated data exchange between, the tools already being used by ASHRAE professionals.

Several efforts are underway within ASHRAE to address the first hurdle. An effort to address the second hurdle has been recently initiated within ASHRAE by establishing a web-based repository for hosting data content and making it publicly available for both human and computerized use. However, no such data content is yet available through this repository.

The overall objectives of this research project are to develop easily useable Building Information Model (BIM) data content, based on ASHRAE publications, to be made publicly available via the new ASHRAE data repository (data.ashrae.org); and to document end-user implementation guidance to support ASHRAE members in utilizing the data content in the adoption of BIM in their professional practice.

This is follow-on research to ASHRAE 1609-RP, which developed information exchange standards based on ASHRAE publications for representing asset management information across a facility life cycle, with a focus on use during O&M. Specifically, 1609-RP documented a *Manage Asset O&M Documentation* use case adhering to the Guideline 20 work process documentation procedure. This use case documentation provides an excellent starting point for developing data content that can be made available through the data.ashae.org repository. An accompanying 1609-RP user guide also provides a starting point for end-user guidance on utilizing the data.ashrae.org content in adopting a BIM-enabled work process customized to ASHRAE members.

The proposed research specifically addresses the research needs identified within *Goal 6: Building Information Modeling of energy efficient, high performing buildings* of the ASHRAE Research Strategic Plan 2010-2015 (extended to 2018), by: 1) developing data exchange protocols for HVAC&R information within ASHRAE, consistent with the standards and protocols being adopted by other BIM communities, 2) developing reference use cases for HVAC&R applications in support of ASHRAE Guideline 20 “Documenting HVAC&R Work Processes and Data Exchange Requirements”, 3) producing guidance on the deployment of BIM processes and tools, and 4) developing guidance and exemplars for use cases in a BIM environment.

Applicability to the ASHRAE Research Strategic Plan:

The proposed research directly supports *Goal 6: Building Information Modeling of energy efficient, high performing buildings* of the ASHRAE Research Strategic Plan 2010-2015 (extended to 2018). Specifically, this research supports *Objective 2: Develop the information, guidance and examples needed to support the adoption of BIM in the wider technical activities of the Society*. As a follow-on to the recently completed research project 1609-RP, the proposed research also supports *Objective 1: Embrace and embed interoperability in the development and execution of ASHRAE Research and the standards, guidelines and technical publications which are based on that research.*

The proposed research scope and technical approach specifically addresses each of the four research needs identified within Goal 6, by: 1) developing data exchange protocols for HVAC&R information within ASHRAE, consistent with the standards and protocols being adopted by other BIM communities 2) developing reference use cases for HVAC&R applications in support of ASHRAE Guideline 20, 3) producing guidance for ASHRAE TCs on the deployment of BIM processes and tools, and 4) developing guidance and exemplars for use cases in a BIM environment.

The proposed research also supports the following ASHRAE Research Strategic Plan goals:

Goal 1: Maximize the actual operational energy performance of buildings and facilities by addressing needed research to accelerate application of building information modeling (BIM), and to ensure that BIM systems are designed to meet information needs for commissioning and operations and maintenance, including coordinating with buildingSMART Alliance and Construction Operations Building Information Exchange (COBie).

Goal 5: Support the development of ASHRAE energy standards and reduce effort required to demonstrate compliance, by addressing needed research to continue to develop BIM to automate the creation of energy models from architectural/mechanical/electrical BIM data files.

Goal 7: Support development of tools, procedures and methods suitable for designing low-energy buildings, by addressing the technical challenge of developing standards for conveying information from Computer Aided Design CAD and BIM models to energy models.

Application of Results:

The proposed research would develop easily useable data content made publicly available via the new ASHRAE data portal at data.ashrae.org, and would also develop accompanying user guidance for ASHRAE membership in utilizing the data in the adoption of BIM in their professional practice.

For example, the 1609-RP use case *Manage Asset O&M Documentation* identified properties for Equipment Components that would help track installation and removal dates, annual run hours, warrantee information, and maintenance tasks for each component installed in a building. These properties are based on ASHRAE Guideline 4: *Preparation of Operating and Maintenance Documentation for Building Systems* (ASHRAE, 2013) and Standard 180: *Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems* (ASHRAE, 2012), and are intended to support both O&M activities and eventual data population of the ASHRAE Service Life and Maintenance Cost Database (ASHRAE, 2015). It is critical that these properties be standardized to support the work processes of collecting these data during design and construction, updating these data during O&M, and exchanging these data with the Service Life and Maintenance Cost Database. This is the point of information exchange standards like those developed in 1609-RP. ***However, information exchange standards do not become useable by practitioners until data sets based on these standards are implemented in the software tools practitioners use in the field.***

This project would create example data sets of these standardized properties, in commonly used software tool formats, and post them to the ASHRAE data portal. These data sets could then be downloaded by practitioners for direct import into the software tool of their choice. The accompanying user guide would instruct practitioners in how to import these data sets into their tool and export populated data sets for exchange with other tools and practitioners through design, construction, and O&M; and more easily add new data collected during O&M to the

Service Life and Maintenance Cost Database.

Readily available ASHRAE BIM data content with user guides would also continue to raise the visibility of BIM-enabled interoperability within ASHRAE and promote its continuing development within other technical activities of the Society. When ASHRAE members have useable examples like the one described above, they will better understand the benefits of BIM and the need of information exchange standards for their technical activities.

State-of-the-Art (Background):

Building Information Modeling (BIM) is currently attracting substantially increased attention, with well-attended technical sessions at ASHRAE meetings illustrating the promise of BIM and advocating the benefits of employing BIM-enabled work processes in professional practice. However, many ASHRAE members are still unsure of how to adopt BIM processes in their daily practice to achieve the claimed benefits. The first hurdle in achieving BIM adoption is the development of relevant and useable information exchange standards, which define standard data representations for key information required to perform HVAC&R work processes. A subsequent hurdle to adoption is the lack of available BIM data content that adheres to existing information exchange standards, and can be readily accessed for import into, and automated data exchange between, the tools used by ASHRAE professionals.

Several efforts are underway within ASHRAE to address the issue of standard data representation (information exchange standards). SPC 205 *Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment* is developing data representation standards for equipment performance for use in energy simulation tools. The recently completed ASHRAE-supported research project 1609-RP *Defining the Capabilities, Needs and Current Limitations of Building Information Modeling (BIM) in Operations and Maintenance for HVAC&R* developed information exchange standards for representing asset management information, and a procedure for capturing this information during design and construction/installation for use during operations and maintenance (O&M), based on existing ASHRAE standards, guidelines, and technical publications.

While these efforts help clear the first hurdle identified above, they have not yet directly addressed the second hurdle of providing useable data content based on these standard representations that can be easily accessed and "plugged" directly into the software tools already being used in a design office, and then exchanged with other software tools used on a construction site or in the maintenance and management of an operating facility.

There are related efforts such as the CIBSE Product Data Templates effort in the UK (CIBSE, 2016), and work in the US on the COBie Guide (COBie, 2016), OmniClass (OmniClass, 2016), the NIBS National BIM Guideline for Owners (NIBS, 2016), and others. These efforts would be leveraged within this project to build on existing work, and to assure that this project develops data content that is consistent with the standards and protocols being adopted by other BIM communities

Advancement to the State-of-the-Art:

An effort to address the second hurdle toward BIM adoption has been recently initiated within ASHRAE. A web address Uniform Resource Locator (URL) has been established by ASHRAE for hosting electronic information content and making that content publicly available for both human and fully automated computerized use. That URL is data.ashrae.org and is designed to provide a repository for ASHRAE data content. However, no such data content is yet available.

As mentioned above, ASHRAE research project 1609-RP developed information exchange standards, based on ASHRAE publications, for representing asset management information across a facility life cycle, with a focus on use during O&M. Specifically, 1609-RP documented a *Manage Asset O&M Documentation* use case adhering to the Guideline 20 work process documentation procedure. An accompanying user guide provides direction on implementing a BIM asset management program based on this use case. This use case documentation provides an excellent starting point for developing data content that could be made available through the data.ashae.org repository. The user guide also provides a starting point for end-user guidance on utilizing the data.ashrae.org content in adopting a BIM-enabled work process customized to ASHRAE members.

This follow-on research project would develop structured data content based on the 1609-RP use case documentation, and post these data to the ASHRAE data content repository to support public access for import into, and automated data exchange between, the tools used by ASHRAE professionals. Along with neutral format spreadsheet data templates, data sets would be created in selected formats used by common buildings industry software tools. To facilitate end-user adoption of these data sets in support of BIM-enabled work processes, the research project would develop accompanying user guidance documentation that would also be made publicly available through the repository.

Justification and Value to ASHRAE:

ASHRAE members and the Society as a whole have expressed increasing interest in adopting Building Information Modeling (BIM) to improve professional work processes and the overall performance of the built environment. Several ASHRAE technical activities (e.g., Guideline 20, SPC 205, MTG-BIM) and research projects (e.g., 1354-RP, 1468-RP, 1609-RP) have been working to develop relevant and useable information exchange standards, which define standard data representations for key information required to perform HVAC&R work processes. The availability of useable data content based on existing ASHRAE publications, coordinated with similar efforts underway outside ASHRAE, is a required next step in promoting the adoption of BIM-enabled work processes by ASHRAE members.

The proposed research is designed to create BIM data content in a variety of commonly used formats, and make this content available to ASHRAE members through the established ASHRAE data repository (data.ashrae.org).

The proposed research would also provide detailed end-user guidance in employing the data repository to facilitate adoption of ASHRAE BIM data content.

In addition to facilitating the adoption of BIM by ASHRAE members, readily available ASHRAE BIM data content with user guides would raise the visibility and perceived value of BIM-enabled interoperability within ASHRAE and promote its continuing development within other technical activities of the Society.

Furthermore, availability of BIM data based on existing ASHRAE publications such as standards, guidelines, and technical publications would increase reference to, and adoption of, these ASHRAE publications.

Objectives:

The overall objectives of this research project are: 1) to develop easily useable Building Information Model (BIM) data content to be made publicly available via the new ASHRAE data repository (data.ashrae.org); and 2) to document end-user implementation guidance to support ASHRAE members in utilizing the data content in the adoption of BIM in their professional practice.

Scope/Technical Approach:

The following tasks describe in more detail the expected approach to achieve the desired project objectives.

Task 1: Identify BIM Data Sets

Using the 1609-RP *Manage Asset O&M Documentation* use case documentation, select three to five equipment types to be included in data content generation. These equipment types should be selected based on relevance to ASHRAE members, availability of data, and value as exemplars. The 1609-RP use case documentation should be revised as the project continues to make it consistent with this new work. The 1609-RP use case documentation is available free to ASHRAE members at the Members Only Research Reports site (ASHRAE, 2016) or for purchase by non-members through the ASHRAE online bookstore.

In addition to the 1609-RP documentation and referenced ASHRAE publications, identify other relevant references for BIM data elements (properties) for the selected equipment types. Such references include, for example, other related ASHRAE Standards/Guidelines/Publications, CIBSE Product Data Templates (CIBSE, 2016), COBie Guide (COBie, 2016), OmniClass (OmniClass, 2016), NIBS National BIM Guideline for Owners (NIBS, 2016), etc.

Interim Deliverables: Draft Equipment Selection List, Draft Reference List

PMS Review Points: Review Equipment Selection List and Reference List for possible revisions prior to subsequent tasks.

Task 2: Develop Neutral Format Documentation

Create a neutral format spreadsheet of key properties for each equipment type, using the Data Element worksheet of the 1609-RP use case as a starting point. The expected data content includes, for example, the identified properties for Equipment Components that would help track installation and removal dates, annual run hours, warrantee information, and maintenance tasks for each component installed and maintained in a building, as documented in the 1609-RP use case *Manage Asset O&M Documentation*. This neutral format spreadsheet will become the ASHRAE template. Where possible use ASHRAE Terminology and definitions for properties.

Add a classification scheme to each template to support matching/mapping equipment types to different reference templates identified in Task 1 such as the CIBSE Product Data Templates and COBie. Map each ASHRAE template property to relevant references identified in Task 1. These mappings will support future formal transformations between ASHRAE objects/properties and other data formats like CIBSE and COBie, and add legitimacy to the ASHRAE template by ensuring it is not divergent from other existing data exchange standards.

Populate ASHRAE templates with a generic example of each equipment type. These examples can be based on data used during the design phase prior to specification of commercially available equipment.

Post templates on data.ashrae.org and invite public review both within and outside ASHRAE. Within ASHRAE, begin with the sponsoring committees of this project and expand to committees with interest in the selected equipment types. Outside ASHRAE include contacts with members of CIBSE and NIBS with interest in the references identified in Task 1. Solicit specific comments on the posted templates. This task should start to raise visibility of this effort.

Interim Deliverables: Draft Neutral Format Spreadsheet for each Equipment Type including Mappings, Generic Example Spreadsheet for each Equipment Type, Draft Report on Public Review Effort.

PMS Review Points: Review Neutral Format Spreadsheet for each Equipment Type as developed. Provide support in soliciting public review comments.

Scope/Technical Approach (Continued 2):

Task 3: Create Example Data Sets in Various Formats

Create example data sets for each of the ASHRAE Templates in selected formats used by common buildings industry software tools such as Revit, MicroStation, FM:Systems, etc. and add to the data.ashrae.org repository. These data sets should provide a foundation for end-user development of equipment libraries in their tool of choice.

Notify engaged public reviewers of availability of data sets and solicit comments.

Interim Deliverable: Data Sets for each Equipment Type for each Format

PMS Review Points: Provide feedback on data format selection. Test download of example data sets and provide feedback.

Task 4: Create End-User Implementation Guide

Create an end-user implementation guide including step-by-step procedures for utilizing the ASHRAE data sets developed in Task 3 to support ASHRAE members and other users in utilizing the developed data content in the adoption of BIM in their professional practice. This guidance must be detailed enough to allow an experienced industry software user to access and download the appropriate data sets, import these data into the software of their choice, utilize the data in their work process, and export these data to other formats such as those identified in Task 1.

Interim Deliverable: Draft End-Use Implementation Guide

PMS Review Points: Review Draft End-Use Implementation Guide

Deliverables/Where Results Will Be Published:

Progress and Financial, Final Task and Summary Reports, Technical Paper(s), and Data shall constitute the deliverables ("Deliverables") under this Agreement and shall be provided as follows:

a. Progress and Financial Reports

Progress and Financial Reports, in a form approved by the Society, shall be made to the Society through its Manager of Research and Technical Services at quarterly intervals; specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.

Furthermore, the Contractor's Principal Investigator, subject to the Society's approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. Final Task Reports and Data Sets

Draft interim reports shall be delivered following the completion of individual tasks as agreed upon between the Contractor and the Project Monitoring Subcommittee (PMS). Each interim report should include a list of any challenges identified that could impact on-time delivery of the research. It is recommended that the drafts be developed and formatted so that they lead to the Task Final Reports listed below. The drafts are intended to increase the transparency between the contractor and project monitoring subcommittee, not to add cost to the project.

Final Task Deliverables

- ***Neutral Format Spreadsheet for each Equipment Type including Mappings (Task 2)***
- ***Generic Example Spreadsheet for each Equipment Type (Task 2)***
- ***Data Sets for each Equipment Type for each Format (Task 3)***
- ***End-Use Implementation Guide (Task 4)***

c. Final Summary Report

A written final summary report, in a form approved by the Society, shall be prepared by the Institution and submitted to the Society's Manager of Research and Technical Services by the end of the Agreement term, containing details of all research carried out under this Agreement, including a summary of the individual task deliverables. Unless otherwise specified, the final draft report shall be furnished electronically for review by the Society's Project Monitoring Subcommittee (PMS).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:
-An executive summary in a form suitable for wide distribution to the industry and to the public.
-Two electronic copies; one in PDF format and one in Microsoft Word.

d. HVAC&R Research or ASHRAE Transactions Technical Papers

One or more papers shall be submitted first to the ASHRAE Manager of Research and Technical Services (MORTS) and then to the "ASHRAE Manuscript Central" website-based manuscript review system in a form and containing such information as designated by the Society suitable for publication. Papers specified as deliverables should be submitted as either Research Papers for HVAC&R Research or Technical Paper(s) for ASHRAE Transactions. Research papers contain generalized results of long-term archival value, whereas technical papers are appropriate for applied research of shorter-term value, ASHRAE Conference papers are not acceptable as deliverables from ASHRAE research projects. The paper(s) shall conform to the instructions posted in "Manuscript Central" for an ASHRAE Transactions Technical or HVAC&R Research papers. The paper title shall contain the research project number (1609-RP) at the end of the title in parentheses, e.g., (1609-RP).
All papers or articles prepared in connection with an ASHRAE research project, which are being submitted for inclusion in any ASHRAE publication, shall be submitted through the Manager of Research and Technical Services first and not to the publication's editor or Program Committee.

Deliverables/Where Results Will Be Published (Continued):

e. Data

Data is defined in General Condition VI, "DATA"

Delivered Data shall include electronic copies of the final versions of the ASHRAE Templates with Generic Example Data (Task 2), the Example Data Sets in Various Formats (Task 3), and the End-User Implementation Guide (Task 4). Following PMS and Sponsoring Committee approval, these data will be posted to the ASHRAE data repository (data.ashrae.org).

f. Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience, which documents 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general shall be submitted to the Manager of Research and Technical Services by the end of the Agreement term for publication in ASHRAE Insights

Level of Effort:

The project is estimated to take no more than 18 months to complete, with a level of effort of approximately 10 person-months involving 2-3 months of Principal Investigator time and 7-8 months of professional staff time. The estimated total cost is $125,000.

Proposal Evaluation Criteria:

No.	Proposal Review Criterion	Weighting Factor
1	Contractor's understanding of Work Statement as revealed in proposal. a) Understanding of foundational work done in 1609-RP **b)** Understanding of intended products of this research project **c)** Understanding of application of these project products	**25%**
2	Quality of methodology proposed for conducting research. a) Organization of project b) Management plan	**25%**
3	Qualifications of personnel for this project. **a)** Project team 'well rounded' in terms of qualifications and experience in related work, including expertise in formal information exchange documentation and various commercially available software tools used in the buildings industry **b)** Project manager experience **c)** Time commitment of Principal Investigator	**25%**
4	Probability of contractor's research plan meeting the objectives of the Work Statement a) Detailed and logical work plan with major tasks and key milestones b) All technical and logistic factors considered c) Reasonableness of project schedule	**20%**
5	Performance of contractor on prior ASHRAE or other projects (no penalty for new contractors	**5%**

Project Milestones:

No.	Major Project Completion Milestone	Deadline Month
1	**Task 1:** Equipment Selection List, Reference List	**2 mo. from start**
2	**Task 2:** Draft Neutral Format Spreadsheet for each Equipment Type including Mappings, Generic Example Spreadsheet for each Equipment Type, and Draft Report on Public Review Effort.	**6 mo. from start**
3	**Task 3:** Data Sets for each Equipment Type for each Format	**10 mo. from start**
4	**Task 4:** End-Use Implementation Guide	**14 mo. from start**
5	**Final Deliverables:** Final Task Reports and Data Sets, Final Summary Report, Technical Paper, Project Synopsis	**18 mo. from start**

Authors:

Robert J. Hitchcock

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ASHRAE, 2012. ASHRAE Standard 180-2012: Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems, http://www.techstreet.com/products/1832333

CIBSE, 2016. CIBSE Product Data Templates, http://www.cibse.org/Knowledge/BIM-Building-Information-Modelling/Product-Data-Templates

COBie, 2016. The Construction Operations Building information exchange (COBie) Guide, https://www.nibs.org/?page=bsa_cobieguide

NIBS, 2016. NIBS National BIM Guideline for Owners, https://www.nibs.org/news/254633/Institute-Kicks-Off-Effort-to-Develop-National-BIM-Guideline-for-Owners.htm

OmniClass, 2016. The OmniClass Construction Classification System, http://www.omniclass.org/

Other Information for Bidders (Optional):