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Emerging Opportunities in DoD Facilities Criteria, Technology Transfer, and Corrosion Prevention and Control Using the BUILDER Sustainment Management System

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ABSTRACT

On 10 September 2013 the Office of Secretary of Defense (OSD) standardized the BUILDER Sustainment Management System (SMS) as the Department of Defense-Wide facility condition assessment process and software support tool for facility infrastructure. This decision is significant for sustaining the over 1.8 billion square feet of DoD facilities. BUILDER, developed by United States Army Corps of Engineers (USACE) at Engineer Research and Development Center (ERDC) Construction Engineering Research Laboratory (CERL), supports facility sustainment investment decisions with work planning and multi-year forecasting. However, there are further benefits of the SMS approach. For example, BUILDER's knowledge base can potentially aid implementation of Corrosion Prevention and Control (CPC) strategies in DoD facilities. In addition, BUILDER provides improved means for tracking adoption and performance of facility CPC technologies, with a goal of providing feedback for construction criteria. This research begins the exploration of emerging opportunities and synergies between the BUILDER Sustainment Management System, the Unified Facility Criteria and Unified Guide Specifications system, and the CPC community of practice.

Key words: Sustainment Management System, BUILDER, Corrosion, Criteria, Asset Management

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INTRODUCTION

The BUILDER Sustainment Management System (SMS) is a web-based software application for facility component lifecycle management. The system stores and subsequently analyzes real property information and detailed system and component level information to determine key performance indicators such as age, remaining service life, and expected repair costs. Standardized inspections are supported to determine objective and repeatable Condition Index (CI) measures to identify the general physical health of the asset and its components. Functionality assessments can also be performed to evaluate user requirement changes, code compliance and obsolescence issues. This provides a comprehensive picture of the overall performance of building assets and their key components. With information about condition, functionality, and remaining service life, BUILDER guides the development of short and long-range work plans based on sound investment strategies, prioritization criteria, and budget constraints.

BUILDER consolidates a variety of building-related management issues into a single decision-support package for work identification and building sustainment. The system gives functional managers and decision-makers instant access to building inventory, current building condition indices, probability-based condition prediction models, and functionality-based mission, compliance, and obsolescence issues. It also employs a patented knowledge based inspection scheduling process to keep inspection costs low. Facility managers can develop multi-year sustainment, restoration, and modernization (SRM) funding strategies and project plans based on organizational policies, priorities, and budget constraints. Thus, this tool supports readiness reporting and SRM investment prioritization at regional and HQ levels. BUILDER improves the allocation process and return on building lifecycle investments by directing resources to the most condition critical components to avoid costly repair penalty costs, as well as the most mission critical components to manage risks of failure.

Due to its unique capabilities in managing large scale facility portfolios, many government agencies adopted BUILDER for their facility condition assessment program, even before the Office of the Secretary of Defense (OSD) standardized the BUILDER SMS across the DoD on 10 September 2013[1]. As of October 2015, approximately 1 Billion Square feet of DoD property has been inventoried and assessed in the BUILDER system.

BUILDER Inventory is at the component level, in most cases with detail to the Uniformat Level V, or more. For example, windows are inventoried with information including at a minimum, age, condition, material, and Uniformat II classification (B202001). This detailed data opens opportunities for obtaining lifecycle performance of building components. This data is used to forecast and plan sustainment work and smartly invest sustainment budgets. In addition, the data present new opportunities to use BUILDER to support DoD Criteria, the DoD CPC program, and implementations of validated products/methods.

The objective of this research is to identify the needs, current gaps, and opportunities for use as well as improvement in each of these areas. The secondary objective is to investigate the level of additional data required to obtain the necessary feedback.

EXPERIMENTAL PROCEDURE

In order to identify the needs, current gaps, and opportunities, BUILDER data was examined from a new perspective. Specific attention was given to BUILDER data schemas to correlate inventory data to building component lifecycle performance parameters of interest. The component performance parameters of interest are determined by the various user communities, such as construction guidance criteria, corrosion prevention and control, and facilities engineering in general. We explored the issue

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with representatives of each community to elaborate on the nature of the emerging opportunity, to gather information about communities of practice, and to develop a common understanding of the most likely synergies. For example, the 2014 Vision Point Systems Report, “Corrosion Factors in DoD Facilities” as part of the Facilities and Infrastructure Corrosion Evaluation (FICE) study was analyzed to determine data gaps.

RESULTS

The results of this study indicate three areas of opportunity related to BUILDER’s data and capabilities:

- DoD Facility Criteria – Unified Facility Guide Specifications (UFGS) / Unified Facility Criteria (UFC)
- Technology Transfer – Demonstration, Validation and Implementation of New Technologies
- SMS Improvement – Leveraging CPC and other subject matter expertise

A very significant gap related to all three of these areas has been obtaining quantitative feedback to validate the performance and life cycle cost effectiveness of the specified building and infrastructure components and assemblies. The DoD mainly relies on industry reliability data and standard test methods to validate building component performance and selection. For newer technologies, demonstration projects and on-site testing is used to reduce the risk associated with early adoption. In addition, DoD has employed qualitative feedback methods such as post occupancy evaluations (POE) and facility surveys to obtain performance feedback and lessons learned. However, these qualitative methods can be costly, resource intensive, and yield limited results. The following explains the need for improved quantitative feedback for each category outlined above.

DoD Facility Criteria

Facility criteria are a critical component in all facility life cycle activities. Examples of criteria include Unified Facility Criteria and Guide Specifications, industry standards and codes, and maintenance criteria, handbooks, and bulletins. DoD facility standards and design policies have been identified as adding between 8% and 32% premium to the initial cost on military construction projects compared to similar commercial facilities[2]. It is critical to determine if these specified requirements and premiums are life cycle cost effective. Data from BUILDER provides a useful tool to compare the anticipated life cycle costs with how well a product actually performed, which is an indication of how effective the criteria is serving its need. When there are gaps in data needed for desired cost analysis, the existing inventory data schema can be modified so BUILDER starts to track the needed data. This strategy would allow targeting key areas for improvement.

Recent attempts to extract this type of data from the Departments’ legacy computerized maintenance management systems (CMMS) have identified significant gaps and inconsistencies which hinder analysis as follows:[4]

Consistent Terminology and Tagging
Data captured is commentary in nature, varies in detail, and is hampered by inconsistent terminology. Building components are identified by keywords vs. standardized component and subcomponent terminology. Data transferred does also not consistently contain a Uniformat or similar section number.

Sustainment History and Costs
The amount of building component sustainment history and associated cost data transferred to BUILDER is unclear. It would be beneficial to identify when maintenance, repair, or replacement of the building component was accomplished. It is also difficult to determine facility age, component age, component material, or maintenance performed. In some Departments, CMMS data may be sufficiently

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identified and tracked so it can be linked to component specific identifying data. Further verification of this possibility is required.

Subcomponent Information

Section detail information, which is one level down from the Component-Section data level, usually identifies the type of component and material. It is unclear if this field is consistently being utilized in BUILDER or the CMMSs, and if the subcomponent lists in the CMMSs are compatible with BUILDER. Without the distress survey, BUILDER will not record what subcomponents are present. It will still have equipment/material and component sub-type data. Without the distress survey, BUILDER will not know what subcomponents are present. It will still have equipment/material and component sub-type data. Department CMMS representatives have reported that performing distress surveys for every building component is not feasible with current resources. It would therefore be necessary to identify and target key component-sections for which we need better data.

New Technologies- Technology Transfer

Early Adoption of new technologies has been identified in legislation and DoD policy as a key component for the success of programs such as Energy Independence, Sustainable Development, and Corrosion Prevention and Control (CPC). Validation of new technologies is critical as the failure rate can be much higher than established technologies. The maintenance and sustainment activities in the military departments' facility maintenance and sustainment management system databases offer the greatest opportunity to obtain true performance and reliability data. Figure 1 shows this relationship.

Figure 1: Relationship between sustainment management system and the feedback loop it creates for criteria, new technologies, and corrosion prevention and control

The outcome of builder analysis is either a one year work plan or a multiyear work forecast. In both cases work planning in BUILDER considers basic life-cycle cost factors such as facility condition, age, and the cost of repair versus replacement. However, the work planning model can be improved. For example, there are ongoing efforts to include energy costs of specific assets in the BUILDER work planning optimization models. Energy saving technologies will be included in life cycle cost calculations,

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and therefore will have the opportunity to be implemented. It is important that the life cycle benefits are considered early enough in the planning and budgeting process. Otherwise a higher initial cost will be rejected. Once funding levels and timelines are set, it can be difficult to incorporate a new idea, even if it would save cost in the long-run.

Likewise, there are certainly CPC-related technologies or design concepts which, if considered early enough in the programming and planning process, will be funded and adopted based on life-cycle advantages. BUILDER probably can be modified to capture these opportunities. This opportunity requires development.

SMS Improvement – Leveraging CPC and other Subject Matter Expertise

Corrosion Prevention and Control contributes significantly to the total ownership costs of DoD assets. It is estimated corrosion impacts DoD facilities at a cost of $2 Billion annually (including maintenance, repair, and replacement) and may be as much as 40% of an asset's life cycle cost. Congress, specifically in 10 USC Sec 2228 and the House Armed Service Committee Report accompanying H.R. 1540, The National Defense Authorization Act (NDAA) for Fiscal Year 2012 (H.R. Rep. No 112-78, p. 293), required the Department to investigate strategies for enhancing the sustainability of existing facilities and ensuring the integration of corrosion prevention and mitigation technologies in newly constructed facilities and infrastructure. The definition of corrosion as codified is "the deterioration of a material or its properties due to a reaction of that material with its chemical environment."[3] Although corrosion is traditionally thought of as the deterioration of a metal due to an oxidization reaction, as in the rusting of steel, the definition is expanded to include the degradation of non-metallic materials, such as rotting of wood, carbonation of concrete, mold and mildew destruction of fabrics and organics, degradation of composite materials, erosion corrosion, stress corrosion cracking, biological processes, and solar/UV exposure. As a result, prevention, mitigation, and repair due to corrosion degradation represent a significant amount of the department's sustainment and maintenance activities.

Once a CPC technology is placed in service there will be ongoing questions about its performance. Is it providing benefits as expected? How is the performance over the full life cycle? Is it being maintained and accepted in the field? Is a site visit needed? These and other questions may remain valid for many years. BUILDER data permanently tracked against the building and component, and is visible at all levels of the DoD facilities organizational structure. Headquarters elements are able to view and query data from all subordinate locations. Even so, BUILDER data is detailed and meaningful because it is gathered at the "building block" (component-section) level of every facility. The data is then rolled up as needed to the building or higher levels, but it can still be used for tracking individual component-section level performance. For example, if a chilled water distribution pipe system is installed in a facility, it will be recorded with its various attributes in a permanent record. The attributes could include CPC measures such as pipe lining or cathodic protection. All subsequent inspections and any comments recorded will be tracked and accessed with BUILDER. The BUILDER data structure can be enhanced to include new elements (attributes) of use in CPC efforts. These elements require identification and integration into the BUILDER SMS. The goal is to integrate CPC knowledge into facility investment decision making.

BUILDER offers a variety of standard and custom data reports. Report output could be configured to reflect needed component performance feedback. In lieu of data mining the Departments' CMSS, a standard DoD report/s offers a more effective solution.

The proposed reports would:

- Compare the actual service life with the industry expected service life for building and infrastructure components, specifically, through the comparison of the Condition Index data field (Actual vs. Expected) over time. Goal: Identify relative performance of DoD building components compared to

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industry. By identifying components that differ significantly from industry, adjustments to design/construction criteria and maintenance can be evaluated.

- Identify the amount of sustainment (maintenance, repair, & replacement) performed on building and infrastructure components. Goal: Identify components with high sustainment requirements such that a follow up analysis could determine if a better life cycle cost solution is available. This is discussed above in "Sustainment History and Costs."
- Ideally, drill down to the subcomponent or equipment level and identify key design factors such as specific materials.
- Include extra space to allow sorting by fields such as Installation, Facility Type, and Environmental Severity Index (ESI)

CONCLUSIONS

The opportunities identified can be valuable but require validation with "proof of concept" demonstrations. The three main opportunities identified in this study for improvement are DoD facility criteria, new technologies/technology transfer, and SMS improvement leveraging CPC and other techologies.

Corrosion and other criteria-related information can be gathered and tracked to identify both strong and weak CPC performance in facilities. With millions of data points, historical trending, and ongoing updates of facility databases, there are ample opportunities, even beyond those discussed in this paper. In addition, because USACE owns and controls the BUILDER system, and the service agencies own their respective data, the opportunity is present for modifying the data structure in BUILDER based on specific information required for CPC improvements.

Recommendations determined from this research include the following:

- Improve consistency of data schemas, terminology and naming conventions between CMSS and BUILDER SMS. Maximize the use of coordinated pick-lists for identifying the building component and describing inspection, maintenance, and repair activities.
- Insure inspection, maintenance, and sustainment protocols include tagging the sustainment activity with a unique identifying section number which is compatible across systems and assign a section condition index (CSCI).
- Determine the feasibility to utilize the BUILDER (section details) subcomponent data fields for inspection and maintenance activities in order to better track sustainment activities of the building component and material.
- Determine the feasibility to upload data associated with sustainment history for the building section/component. Specifically the component age and when maintenance, repair, or replacement of the building component was accomplished. If cost information is unavailable, determine if BUILDER can estimate cost based on the sustainment activity or replacement costs.
- Since the DoD Unified Facility Guide Specifications rely on Masterformat number, consider mapping and attaching the Masterformat number to the Subcomponent category in BUILDER.
- In BUILDER, add and link the Environmental Severity Factor (ESI) to each installation location.
- Determine the feasibility to expand inspection protocols to capture targeted corrosion-related degradation and repair data related to coatings and building components that have the highest corrosion costs.[4] If feasible, insure distress list includes expanded corrosion definition.

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- In BUILDER, add specific reports to analyze building component performance with queries by installation, ESI, facility type and date range. Develop a report that compares the actual service life with the industry expected service life for building and infrastructure components. In addition, develop a report which identifies the amount of sustainment (maintenance, repair, & replacement) performed on building and infrastructure components. A more thorough evaluation may also yield better analysis approaches than those mentioned here.
- Evaluate available data and consult SMEs to identify and target key component-section types for which we need better data.

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