FACILITY MAINTENANCE AND SCHOOL CONSTRUCTION IN MARYLAND

Report to the General Assembly

January 20, 2016

Interagency Committee on School Construction:

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INTRODUCTION: MAINTENANCE AND CAPITAL EXPENDITURES

A reciprocal relationship exists between facility maintenance and capital investments. Intuitively, facility owners understand that good maintenance of building systems and equipment will defer or reduce the need for capital investments, and likewise that a judicious, well-timed use of capital investment should reduce the burden on maintenance staff, time and resources while prolonging the life of the building. Both forms of investment are likely to result in better building performance, a reduced risk of building failure, and savings in operations and utility expenditures. Most important, these combined investments will have positive effects on the health and well-being of building occupants.

These issues become particularly acute in the arena of school facility maintenance and construction. Maryland's 1,392 public school buildings, occupying more than 138 million square feet of floor area with have an average age of 28 years as of September 2015,[1] hold on a daily basis nearly 880,000 students as well as teachers, administrators, support staff, and community visitors.[2] Public schools are frequently the most visible institution in a residential community, and the vulnerable population they house is a continuous object of concern for parents, the teaching community, and health professionals. These facilities are also expensive to build and expensive to operate: a typical new elementary school in 2015 costs about $30 million in taxpayer funds, and the energy and other operating expenses of school buildings constitute one of the largest single categories of spending in most educational budgets. Public school buildings thus play a primary role in the social, symbolic, and financial life of the community; maintaining them in good order is an essential public responsibility.

THE 2015 JOINT CHAIRMEN'S REPORT

The 2015 *Joint Chairmen's Report* on the Fiscal 2016 State Operating Budget and State Capital Budget (the *JCR*) states that the "budget committees are interested in understanding the extent to which failures in school maintenance contribute to increase public school construction costs."[3] The committees have charged the Interagency Committee on School Construction (IAC) with:

1. *Evaluating the relationship between identified maintenance deficiencies and school construction needs for each jurisdiction.*

2. *Identifying areas of improvement in each jurisdiction.*

3. *Recommending best maintenance practices to avoid the need for future costly school construction projects.*

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[1] Interagency Committee on School Construction, Managing for Results submission, September 10, 2015.

[2] WBAL NewsRadio 1090, January 13. Detailed information is available from the Maryland State Department of Education, Division of Curriculum, Assessment, and Accountability at: 2016.http://www.marylandpublicschools.org/MSDE/divisions/planningresultstest/doc/20152016Student/2015-2016_Enrollment.pdf

[3] "Report on the Fiscal 2016 State Operating Budget (HB 70) and the State Capital Budget (HB 71) and Related Recommendations" ("Joint Chairmen's Report"), Annapolis, Maryland 2015 Session, page 18

To address these issues, the IAC turned to its own in-house experience of 1,740 maintenance surveys carried out between the fall of 2006 and the spring of 2014; the literature on industry standards; and the experience of the LEA facility planners and maintenance managers, the individuals who carry the daily obligation to maintain their school buildings in good order.

FINDINGS

I. Extent to which failures in school maintenance contribute to increase public school construction costs

Relation of Capital Requests and Maintenance Survey Results

The large size of the annual requests from local boards of education for State capital funds is an indication of the capital need among the school systems in Maryland. It can be asked whether the size of the requests is driven by a failure to maintain existing school facilities, i.e., are projects for building upgrades and replacements requested prematurely because school systems are not taking proper care of their assets?

To answer this question, we examined the overall maintenance results for 682 existing school facilities for which projects were submitted to the State between FY 2009 and FY 2014 for Capital Improvement Program (CIP) funding.[4] New school requests, which are driven by either enrollment capacity needs or programmatic requirements, are not included in this assessment. While the results for individual categories in any school facility can vary widely, the overall survey result offers a generalized view of how well a school is maintained.

Chart 1. Maintenance Survey Results for Existing Building Requests, FY 2009 - FY 2014

		OVERALL MAINTENANCE SURVEY RESULTS FOR REQUESTED FACILITIES (Note 1)									
		SUPERIOR		GOOD		ADEQUATE		NOT ADEQUATE		POOR	
STATEWIDE	NUMBER OF CIP REQUESTED FACILITIES, FY 2009-2014 Existing Buildings Only (Note 3)	NO. OF RE-QUESTS	% OF TOTAL	NO. OF RE-QUESTS	% OF TOTAL	NO. OF RE-QUESTS	% OF TOTAL	NO. OF RE-QUESTS	% OF TOTAL	NO. OF RE-QUESTS	% OF TOTAL
Systemic Renovation Requests	446	22	4.93%	227	50.90%	181	40.58%	15	3.36%	1	0.22%
Renovation Requests (Note 2)	182	24	13.19%	105	57.69%	52	28.57%	1	0.55%	0	0.00%
Replacement School Requests	54	22	40.74%	15	27.78%	16	29.63%	1	1.85%	0	0.00%
TOTAL:	682	68	9.97%	347	50.88%	249	36.51%	17	2.49%	1	0.15%

Notes:

(1) "Overall Maintenance Survey Results" refers to the total published rating for the facility as of January 2016, not to individual inspection categories within the facility. The ratings cover the period FY 2007 - FY 2014.

(2) "Renovation Requests" includes: Complete Renovation, Partial Renovation, Limited Renovation, Renovation with Addition, Open Space Pod Conversion, and Science Classroom Renovation.

[4] For an explanation of the IAC Maintenance Survey methodology, see "Maintenance of Maryland's Public School Buildings, Fiscal 2014 Report", at www.pscp.state.md.us.

(3) Each facility is recorded once per project, even if funds were requested over two or more fiscal years for a specific project; a facility is recorded as many times as separate projects were requested over one or more fiscal years.

The chart indicates that almost 61% of the existing school facilities submitted for funding between FY 2009 and FY 2014 received overall ratings of Superior or Good. 37% received a rating of Adequate, and less than 3% received a rating of Not Adequate or Poor.

These results suggest that the large size of the capital projects that are represented in the annual submissions by LEAs for Capital Improvement Program funding – averaging approximately $700 million per year in requests to the State since FY 2006 – is driven not by poor maintenance leading to premature deterioration or failure of existing facilities, but rather by the need to build capacity for larger student enrollments, to adapt existing school facilities to meet contemporary educational requirements through renovations and additions, and to replace and upgrade building systems or entire buildings due to the normal aging of building systems. Because the 35 categories used in the survey are based on maintenance requirements rather than capital needs, they do not always align with the State's capital project categories (for example, an HVAC replacement project might cut across several maintenance categories, including Rooftop Equipment, Flashing, Electrical Distribution and Electrical Service, Equipment Rooms, etc.); consequently, a more detailed study would be needed to determine the relationship between individual categories of systemic renovation project requests and the maintenance ratings for that category.

In the period FY 2006 to FY 2017, 3,719 capital requests with a total State value of $8.3 billion fell into three broad categories as follows:[5]

- Projects to build enrollment capacity, where student enrollment growth exceeds the available capacity of schools.

  Project types: New schools and additions for capacity purposes (addition projects typically have very little impact on existing building systems).
  - 22.28% of total requested value
  - 13.34% of total project requests

- Projects for existing schools to meet educational program needs, where older facilities are educationally inadequate.

  Project types: Replacements, major renovations, limited renovations, open space pod and science classroom renovations, and additions for programmatic purposes. Most of these projects (with the exception of additions for programmatic purposes) will also involve the upgrade or replacement of some existing building systems.
  - 56.50% of total requested value
  - 24.09% of total project requests

- Projects to upgrade and replace individual building systems to meet contemporary standards of energy and water conservation and of building performance.

[5] Since the funding capacity of both the State and the local governments sets a limit to how much capital work can be carried out each year, the Capital Improvement Program (CIP) only partially reflects the total capital need. Of the $700 million in requests, the State has been able to fund an average of $313 million, or 45%, each year since FY 2006.

Project types: Systemic renovation projects, including replacement or upgrade of roofs, boilers, chillers, architectural and structural repairs, doors and windows, electrical and communication systems, and vertical conveyance systems. These projects generally provide a direct and immediate benefit for the maintenance of the school building.

- 21.14% of total requested value
- 61.09% of total project requests[6]

These figures show that approximately 21% of the capital expenditure on school construction is spent on the systemic renovation projects in the third category that directly address the deferred maintenance backlog. Since Chart 1 shows that almost 56% of the requests for systemic renovation projects were in schools that received a rating of Superior or Good, and another 41% were in schools with a rating of Adequate, the data suggests that these projects are submitted because of normal aging rather than inadequate maintenance. A portion of the expenditures for the first two categories above – projects to build enrollment capacity and projects to meet educational needs in existing schools - also reduces the deferred maintenance backlog, but only a detailed, project-by-project analysis could distinguish this amount from expenditures in these projects that are related to programmatic and architectural improvements.

In the exceptional case where a requested project is in a school with a rating of Not Adequate or Poor, the other rationales for submission are invariably also present. The IAC staff routinely questions LEAs regarding systemic renovation project requests which are technically eligible for State funding but which appeared to be submitted prematurely. Additional documentation must be submitted to justify the project. Typically in these cases, the cause of the premature failure was poor specifications or faulty installation of the original building system, not a lack of maintenance. An example includes boilers in Prince George's County that were originally purchased, in an effort to reduce first costs, with a 10-year service life rather than with the industry standard of 20 to 30 years.[7] This contrasts with the situation in which an LEA may not follow up roofing inspections with timely repairs, leading to accelerated deterioration of the asset and possibly a premature request for replacement. In this case, the IAC would undertake discussions with the LEA to confirm its own observations; if they are correct, IAC staff would then undertake a monitoring program to ensure that the LEA changes its practices and protects the asset as it is required to do.

[6] Source: PSCP fiscal databases.

[7] Discussion with LEA, October 26, 2015. See IAC "Guidelines for Maintenance of Public School Facilities in Maryland," May 30, 2008, Section IV for a schedule of industry service lives for various types of equipment and systems.

II. Evaluating the relationship between identified maintenance deficiencies and school construction needs for each jurisdiction

While there is a common-sense linkage between the quality of maintenance and school construction needs, it is difficult to quantify this relationship. Investments that directly impact on maintenance must compete with the other two arenas of capital expenditure, the construction of new space to reduce over-crowding and renovations and additions to address educational programs. With limited capital budgets, local boards of education must make difficult choices among these three broad sets of priorities; neglect in any one area will have consequences that affect education and the well-being of students. As a result, the school construction needs of Maryland's local educational administrations (LEAs), as expressed in their annual Capital Improvement Program (CIP) and other capital requests to the State, do not directly reflect either the results of the PSCP maintenance inspection reports or those of the LEA's internal Comprehensive Maintenance Plan. The best capital plans do, however, achieve a balance among the three priorities.

Evidence from the Industry

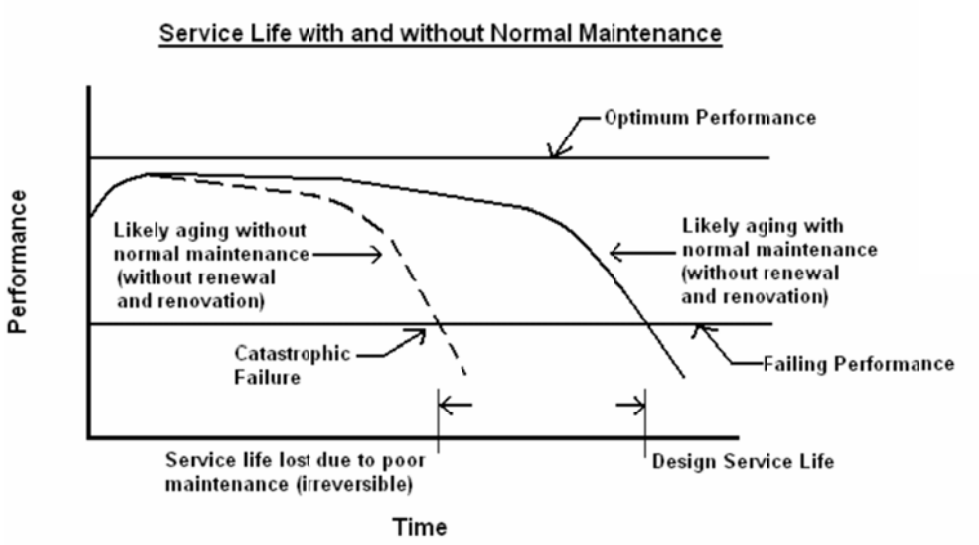
The facility management industry establishes a strong link between maintenance and capital investment. The Facility Conditions Index (FCI) is a widely accepted single-figure measure "that provides a relative scale of the overall condition of a given facility or group of facilities within a facility portfolio. The index is derived by dividing the total repair cost, including educational adequacy and site-related repairs, by the total replacement cost for the set of facilities."[8] The FCI of an individual building can be maintained by good maintenance and can be improved through capital investment; by the same token, inadequate maintenance or delayed capital investment will lead to the decline of the FCI. One research paper asserts

> *…the SFCA [i.e., School Facilities Condition Assessment] for various states and counties…estimated the current average FCI of all schools to deteriorate by 16 to 24 percent over the next 10 years if no funding is applied to renew expiring facility systems.*[9]

This relationship is expressed conceptually in the following chart. "Aging" in the chart can be expressed by declining FCI: all building systems age through normal wear and tear, but good maintenance delays this process. The dashed line indicates an accelerated deterioration that will result from insufficient maintenance, substantially shortening the service life of the building. The slope of the "Likely aging" line depends on many factors, including among others facility age and the history of facility planning and maintenance (see page 9). Not least among these factors is the original quality of construction: if this quality is reduced, the facility will age faster unless it receives additional maintenance attention. The steeper the negative slope of the "Likely aging" line, the more rapidly will the effect of insufficient maintenance be shown.

[8] Jacobs Project Management, in IAC, "Baltimore City: Public School Construction Program Block Grant Funding: A Report to the Legislative Committees," January 8, 2013, page I-4, available at www.pscp.state.md.us.

[9] Bello, Mustapha A. and Vivian Loftness, "Addressing Inadequate Investment in School Facility Maintenance" (Carnegie Mellon University School of Architecture, May 2010), p. 12



Within the spectrum of maintenance approaches – reactive, preventive, predictive, and Reliability Centered Maintenance (RCM)[10] are commonly found classifications – the least expensive method, preventive maintenance (PM), is described in the literature as providing the best return on investment. According to Wei Lin Koo of Jones Lang LaSalle,

> *Compared to no preventive maintenance, an investment in preventive maintenance not only pays for itself but also produces a huge return…At the portfolio level, the analysis indicated a net present value of $2 billion over a 25-year period for a…$0.33/sf… preventive maintenance program. That represents a return on investment of 545 percent. The bulk of the return comes from increasing the useful life of equipment. Energy savings account for approximately 7 percent of the return.*[11]

Results of similar magnitude are corroborated by other sources:

> *Studies indicate that every $1 of preventive maintenance that is deferred will result in $4 of expenditures to ultimately repair or replace those building systems.*[12]

> *80% of a facility's maintenance issues can be addressed by performing preventive maintenance on only 20% of the facility's systems.*[13]

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[10] Pride, Alan "Reliability-Centered Maintenance (RCM)" (Whole Building Design Guide, https://www.wbdg.org/resources/rcm.php): "Reliability-Centered Maintenance (RCM) is the optimum mix of reactive, time- or interval-based, condition-based, and proactive maintenance practices.…These principal maintenance strategies, rather than being applied independently, are integrated to take advantage of their respective strengths in order to maximize facility and equipment reliability while minimizing life-cycle costs."

[11] Koo, Wei Lin, "Thinking Like a CFO: Prevention Pays, Analysis Shows," December 2002 (at http://www.facilitiesnet.com). See also Koo, Wei Lin and Tracy Van Hoy, "Determining the Economic Value of Preventive Maintenance," date unknown (Jones Lang LaSalle whitepaper). The $0.33/sf represents an annual allocation, and is often shown as $/sf/year.

[12] Council of the Great City Schools, "Reversing the Cycle of Deterioration in the Nation's Public School Buildings," October 2014, p. 8

[13] SchoolDude, "An Ounce of Prevention is Worth a Pound of Cure: Examining the Costs, Benefits and Best Practices of a Preventive Maintenance Plan in Your Educational Institution" (at https://www.schooldude.com, date unknown).

SchoolDude, a leading entity in the field of school facility research and management, indicates that PM can lead to a 50% to 65% reduction in the rate of emergency work and a 28.6% to 39.3% reduction in the cost of such work; a 16% reduction in corrective maintenance work as a percentage of total work over a 5-year period; a 30% extension of the life a roof; and with other M&O improvements, an estimated 50-60% energy savings in an existing building.[14]

LEA Maintenance Survey Results and CIP Requests

Chart 1 showed that that there is no evidence that on a statewide basis, the large CIP requests are driven by inadequate maintenance of facilities. To determine whether individual LEA requests might be driven by a failure to maintain school facilities, the IAC examined CIP requested funding amounts for the period FY 2009 to FY 2014. Chart 2 relates the total CIP requests of each LEA to the overall Maintenance Inspection ratings received by its schools.

Chart 2. Maintenance Survey Results and CIP Requests, FY 2009 - FY 2014

MAINTENANCE AND CAPITAL IMPROVEMENT, FY 2009 - FY 2014

	TOTAL VALUE OF LEA CAPITAL REQUESTS FY 2009 - FY 2014 (State and Local) (000,000)		OVERALL MAINTENANCE SCORES & RATINGS, FY 2007 - FY 2014						SURVEYS CONDUCTED FY 2007 - FY 2014												
			AVERAGE OVERALL MAINTENANCE SCORE		LOWEST OVERALL MAINTENANCE SCORE		HIGHEST OVERALL MAINTENANCE SCORE		SUPERIOR (S) + GOOD (G)					ADEQUATE (A)		NOT ADEQUATE (NA) + POOR (P)					TOTAL SURVEYS
LEA	Total	Average Annual	Score	Rating	Score	Rating	Score	Rating	S: No.	% of Total	G: No.	% of Total	S+G: % of Total	A: No.	% of Total	NA: No.	% of Total	P: No.	% of Total	NA+P: % of Total	S+G+A+ NA+P
Allegany	$ 5.9	$ 0.99	**90.2**	G	78.9	A	97.1	S	6	22%	18	67%	**89%**	3	**11%**	0	0%	0	0%	**0%**	27
Anne Arundel	$ 284.6	$ 47.43	**88.6**	G	74.5	NA	99.3	S	24	16%	81	54%	**70%**	41	**28%**	3	2%	0	0%	**2%**	149
Baltimore County	$ 606.5	$ 101.08	**89.2**	G	77.2	A	100.0	S	18	9%	146	72%	**80%**	40	**20%**	0	0%	0	0%	**0%**	204
Calvert	$ 60.5	$ 10.09	**95.0**	G	82.8	A	100.0	S	18	58%	12	39%	**97%**	1	**3%**	0	0%	0	0%	**0%**	31
Carroll	$ 32.1	$ 5.35	**90.3**	G	83.4	A	97.0	S	2	15%	7	54%	**69%**	4	**31%**	0	0%	0	0%	**0%**	13
Caroline	$ 99.5	$ 16.59	**91.8**	G	81.6	A	98.9	S	13	25%	35	69%	**94%**	3	**6%**	0	0%	0	0%	**0%**	51
Cecil	$ 33.7	$ 5.62	**95.0**	G	83.2	A	100.0	S	23	64%	11	31%	**94%**	2	**6%**	0	0%	0	0%	**0%**	36
Charles	$ 101.4	$ 16.90	**90.7**	G	76.6	A	99.5	S	9	20%	28	64%	**84%**	7	**16%**	0	0%	0	0%	**0%**	44
Dorchester	$ 43.1	$ 7.19	**90.0**	G	80.2	A	97.3	S	7	41%	5	29%	**71%**	5	**29%**	0	0%	0	0%	**0%**	17
Frederick	$ 336.8	$ 56.13	**91.2**	G	82.4	A	100.0	S	17	22%	55	70%	**91%**	7	**9%**	0	0%	0	0%	**0%**	79
Garrett	$ 4.5	$ 0.75	**92.8**	G	87.9	G	99.2	S	5	26%	14	74%	**100%**	0	**0%**	0	0%	0	0%	**0%**	19
Harford	$ 222.5	$ 37.08	**89.2**	G	76.7	A	98.1	S	9	15%	34	55%	**69%**	19	**31%**	0	0%	0	0%	**0%**	62
Howard	$ 242.2	$ 40.36	**92.0**	G	82.2	A	98.8	S	21	25%	60	71%	**95%**	4	**5%**	0	0%	0	0%	**0%**	85
Kent	$ 0.6	$ 0.11	**90.3**	G	85.8	G	97.0	S	2	22%	7	78%	**100%**	0	**0%**	0	0%	0	0%	**0%**	9
Montgomery	$ 892.1	$ 148.69	**88.2**	G	72.4	NA	98.9	S	26	10%	149	58%	**68%**	79	**31%**	3	1%	0	0%	**1%**	257
Prince George's	$ 516.5	$ 86.09	**84.9**	A	71.1	NA	98.9	S	7	3%	104	40%	**42%**	139	**53%**	13	5%	0	0%	**5%**	263
Queen Anne's	$ 32.6	$ 5.43	**90.0**	G	78.2	A	97.8	S	4	22%	9	50%	**72%**	5	**28%**	0	0%	0	0%	**0%**	18
St. Mary's	$ 33.2	$ 5.54	**92.0**	G	80.6	A	99.7	S	10	31%	17	53%	**84%**	5	**16%**	0	0%	0	0%	**0%**	32
Somerset	$ 19.8	$ 3.30	**86.4**	G	77.0	A	97.8	S	2	15%	5	38%	**54%**	6	**46%**	0	0%	0	0%	**0%**	13
Talbot	$ 1.5	$ 0.25	**93.9**	G	85.8	G	99.6	S	6	55%	5	45%	**100%**	0	**0%**	0	0%	0	0%	**0%**	11
Washington	$ 72.1	$ 12.02	**91.3**	G	76.0	A	100.0	S	14	25%	34	62%	**87%**	7	**13%**	0	0%	0	0%	**0%**	55
Wicomico	$ 91.4	$ 15.24	**92.1**	G	79.8	A	100.0	S	13	45%	11	38%	**83%**	5	**17%**	0	0%	0	0%	**0%**	29
Worcester	$ 11.3	$ 1.88	**88.4**	G	76.7	A	98.6	S	2	12%	11	65%	**76%**	4	**24%**	0	0%	0	0%	**0%**	17
Baltimore City	$ 595.2	$ 99.21	**81.6**	A	65.2	P	96.6	S	6	3%	46	21%	**24%**	132	**60%**	34	16%	1	0%	**16%**	219
Statewide	**$ 4,339.9**	**$ 723.3**	**90.2**	**G**	**79.0**	**A**	**98.8**	**S**	**264**	**15%**	**904**	**52%**	**79%**	**518**	**30%**	**53**	**3%**	**1**	**0%**	**1%**	**1,740**

The chart shows:

The Average Overall rating for most LEAs is in the range of Good, with two LEAs averaging in the Adequate range:

- Prince George's County Public Schools: The study period covers a number of years in which facility leadership in the school system was deficient. Since 2013, a change of leadership has brought about significant aspects of improvement in every branch of facility administration, including organizational structure, staffing, training, and

[14] SchoolDude, ibid.

accountability. It is anticipated that these changes will begin to manifest themselves in the FY 2015 and subsequent maintenance scores and ratings.

- Baltimore City Public Schools represents a unique set of circumstances. These have been addressed in a separate IAC report, "Baltimore City Public Schools: Administration of Capital Projects," dated December 1, 2015, page 11ff.[15] The report includes a number of recommendations with respect to both maintenance and capital project administration.

The Lowest Overall rating for most LEAs is in the Adequate range, with three large LEAs that had schools in the Not Adequate range and one with a school in the Poor range:

- Anne Arundel County Public Schools: out of 149 surveys, three (2%) were rated at Not Adequate. On re-inspection, two of the schools were rated as Good and one was rated as Adequate[16].

- Montgomery County Public Schools: out of 257 surveys, three (1.2%) were rated at Not Adequate. On re-inspection, one of the schools was rated as Adequate and one was rated as Superior. The re-inspection rating for the third school was performed in FY 2015 and is under review.

- Prince George's County Public Schools: out of 263 surveys 13 (4.9%) were rated at Not Adequate. Two of the schools were re-inspected twice (the second time to monitor the correction of specific deficiencies rather than the entire facility). On re-inspection, three of the schools were rated as Good and 11 were rated as Adequate. One of the schools was closed and therefore was not re-inspected.

- Baltimore City Public Schools: out of 219 surveys, 34 (15.5%) were rated at Not Adequate and one (0.5%) was rated at Poor. The Public School Construction Program is analyzing information to determine whether on re-inspection a particular facility improved in its rating, remained the same, or may have improved but then declined in a subsequent (round 2) inspection.

Every school system had at least one school that received a rating of Superior. For Calvert, Cecil and Talbot County Public Schools, more than 50% of the schools surveyed in the study period earned ratings of Superior. Seven schools in six LEAs achieved a perfect score of 100%:

- Battle Monument Special (Baltimore County)
- Plum Point Elementary (Calvert County)
- Bay View Elementary (Cecil County)
- Governor Thomas Johnson Middle (Frederick County)
- Ruth Ann Monroe Primary (Washington County)
- J.M. Bennett High (Wicomico County)
- Willards Elementary (Wicomico County)

[15] http://www.pscp.state.md.us/Reports

[16] A school building that receives an overall rating of Not Adequate or Poor is given 60 days to correct the deficiencies and is then re-inspected. Some of the schools found to be Not Adequate during the study period were or will be re-inspected in FY 2015 or FY 2016.

Given the complexities of managing even a small school, these results are noteworthy, and attest to the excellent maintenance practices of these jurisdictions.

Capital Investments and Maintenance: Industry Budgeting Methodologies and Maryland Requirements

The most accurate method to identify the future maintenance budget and capital investment needs of any building involves a detailed facility condition assessment (FCA) combined with a life cycle cost analysis (LCCA): inventory all building elements, evaluate the current condition of each, use industry literature and other sources to determine both annual maintenance requirements and long-term capital replacement timeframes, and assign an inflation-adjusted figure to each line item for a 20 to 30 year time period. The typical FCA presents a snapshot in time of the current condition of each facility and the cost to upgrade it to like-new condition; the LCCA will determine when capital renewal expenditures must be made. In practice, the expense involved in this detailed method makes it impossible to carry out; we are not aware of any school system in the United States that has carried out an FCA combined with LCCA of its entire building plant at this level of detail.

Instead, the facility management industry has developed broadly predictive formulas to assist public owners to establish appropriate and realistic maintenance and capital renewal budgets. The factors that can be taken account of in such predictive models are:

- Age of Facility
- System Technologies Complexities
- Construction Quality
- Use / Functional Demand
- Type of Facility
- Size of Facility
- Location of Facility
- Current Condition / Deferred Maintenance
- Current / Plant Replacement Value
- Current Plant Value / Initial Acquisition cost
- System Replacement Cost
- System Lifecycle Cost
- Facility Maintenance Planning
- Budget Constraint[17]

Of these factors, facility age, facility planning, and construction quality are acknowledged as most influential in establishing future budgets.[18] A general rule that appears to be widely accepted is based on the Plant Replacement Value (PRV) (also called Current Replacement Value, CRV) of the facility, requiring that for a building with an anticipated 50-year service life, the owner should expend a certain percentage of the PRV on annual maintenance, and should set aside another percentage of PRV in a "refresh" fund for anticipated capital renewals that will be needed within the anticipated service life of the facility (i.e. roof replacement, mechanical system replacement or upgrade, etc). In a recent report, the Council of the Great City Schools referenced a 1990 study by the National Research Council and others that recommended:

[17] Bello and Loftness, op. cit., p. 12

[18] Ibid, p. 13, referencing Monterecy, O. P., "A formula budgeting model and framework for controlling physical plant deferred maintenance: an empirical analysis of public schools in Rhode Island," Doctoral dissertation, University of Connecticut 1985.

that owners spend between 2 percent and 4 percent of the current replacement value of a building every year on maintenance, with maintenance including routine and preventive maintenance and repairs, as well as capital replacements and renewals of major systems as they reach their expected life. A 2 percent spend rate assumes the facility has a 50-year life expectancy, and a 4 percent spend rate assumes the facility has a 25-year life expectancy.[19]

The methodology described here falls under the general title of Plant Value Methodology.[20] The logic of this method is based on the depreciation rate of the building: since a 50-year facility loses 2% of its original value every year over a 50 year span, the facility will only retain optimal building performance if 2% is invested every year into maintenance and 2% into capital renewal. In practice, since building systems need to be replaced episodically and on varying schedules rather than on a yearly basis, the 2% budget for capital renewal should be viewed as an investment that will be called upon when needed within the life of the building. By this logic, a 25-year building with a 4%/year depreciation would require an annual investment of 4% for maintenance and 4% for capital renewal. However, these figures assume that there is no backlog of deferred maintenance at the building; if there is, then additional funding is needed to eliminate the backlog over a defined period of time.[21]

No formulaic approach to determining maintenance and capital investment is perfect. The factors that successfully sustain a school facility, particularly under conditions of constrained operating resources, are too complex to be reduced to a purely quantitative basis; the IAC finds that they include, for example, elements such as the morale and attitudes of the in-school and central office employees, the procedures that are established to identify deficiencies and correct them in a timely manner, and the quality of leadership offered by the school principal, factors that can be readily observed but that cannot be quantified.

Nevertheless, using the above formula and assuming that Maryland's schools were originally built for a 50-year life, then the method based on PRV would require that the public invest some $929 million per year in school facility maintenance and operations, and another $929 million per year in capital renewal of the facilities, as follows:

Total area of Maryland schools:	138,509,600 square feet
Replacement cost (building plus site, as developed for the FY 2017 CIP):	$335.58 / s.f.
Total cost of replacement (area X cost/sf):	$46.481 billion
2% annual budget for maintenance and repairs:	$929.6 million
2% annual budget for capital renewal:	$929.6 million

[19] Council of the Great City Schools, op. cit., page 16. The referenced National Research Council report is "Committing to the Cost of Ownership: Maintenance and Repair of Public Buildings" (National Academy Press, Washington, D.C., 1990).

[20] Other methodologies described by Bello and Loftness include Life Cycle Cost, Condition Assessment, Facility Infrastructure Sustainment Cost, Navy Long-Range Maintenance Planning (LRMP), Applied Management Engineering (AME), Incremental Budget, and Summation. In addition, Biedenweg and Hutson developed a methodology for Stanford University called BRCI (i.e., "Before the Roof Caves in").

[21] PRV does not account for the crucial factor of original construction quality. Bello and Loftness have accounted for this by developing a formula in which PRV accounts for 35% of the calculation and Current Plant Value (CPS) accounts for 65%. CPV is "the initial acquisition cost adjusted to the current year for inflation, improvements and changes in size or capacity. The adjustment for inflation and resulting increase in value accounts for a facility's age." The authors use the same 2% for maintenance and 2% for capital renewal, but apply it to a baseline of cost that is more inclusive than the simpler PRV method. They examined a number of competing methodologies, and found that their proposed formula met the broadest requirements for ease of comprehension and ready availability of data. Bello and Loftness, op. cit., p. 21ff.

Total annual M&O and capital renewal cost: $1.859 billion

Reconciled data on how much Maryland school systems actually spend on school maintenance and capital renewal is difficult to obtain, in large part because school systems account for factors in different ways.[22] A thorough analysis would require a detailed reconciliation that lies beyond the current staffing capacities of the IAC. It is safe to say, however, that no school system in Maryland – and, most likely, very few in the entire United States – is capable of budgeting the amount of funds that the NRC formula requires. In fact, with the increase of square footage and concurrent reduction of maintenance and custodial staffing, it is more likely that the trend is in the opposite direction.

This statement points to the important linkage between the quality of construction and maintenance: if maintenance budgets are currently constrained and are predicted to remain so, then it is essential that school facilities be built to high standards using durable building systems and equipment. The Council of the Great City Schools report states:

> *Purchasing the least expensive piece of equipment may initially be alluring; however, over the life of the building, that decision may cost considerably more than a higher quality piece with a greater initial cost. Life-cycle evaluations should factor in both the initial cost and the cost to operate and maintain the equipment over its expected life. For example, lesser quality equipment may consume more power, require more periodic maintenance, offer a shorter warranty, and ultimately may require replacement sooner. Together, these total life-cycle cost considerations should be weighed for all major purchases. Additionally, districts should consider the funding for both the initial expenditure and the continuing expenditures. Often, the latter funding comes from a more finite operations budget; therefore using more readily available capital funds to buy a higher quality piece of equipment may preserve scarce operating funds later.* [23]

At the same time, school facility planners face the need for flexibility to adapt their school buildings to changes in educational requirements, in the characteristics and size of the student body, and in community preferences. This dilemma, which can be characterized as the Durable / Flexible Equation, is under study by the IAC working with a number of LEA facility planners.

Proposed Maryland Methodology Based on Maintenance Survey Results

The mission of the Public School Construction Program can be summarized as equity: no school in the state should be of substantially less quality than the average, and the average should be very high. A robust program of capital investment is one aspect of achieving this goal; another is high quality maintenance applied to every school in the state.

The overall goal of the Maintenance Inspection Program reflects the mission of the Program: every school in the state should be in Good to Superior condition, and should either remain steady at this rating or should be improving. Logically, this means that the number of schools with ratings of Adequate will also stay steady or will decrease over time, and the number of schools with ratings of Not Adequate or Poor will decidedly decrease. Presumably, if every maintenance item within each school is in Good to Superior condition and is either holding steady or improving, the overall score of the school will reflect this and will meet the overarching program goal.

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[22] As an example, one school system might include the materials needed to protect roads and driveways under winter weather conditions under the Maintenance budget, while another school system might carry these same items under a different budget category, e.g. Transportation.

[23] Council of the Great City Schools, op. cit., p. 34.

Two dimensions, Quality and Trendline, should in combination indicate whether the State and the LEAs are on the right track to achieve equity among all of its school buildings. Each of the 35 maintenance categories will be examined:

- Quality: The overall quality of the category, averaged over a six-year period. Quality is measured by the percentage of observations that fall into the Superior-plus-Good, the Adequate, and the Not Adequate-plus-Poor ratings across the study period.[24] Quality can be described on a descending scale from Noteworthy to Very High Concern:
    - *Noteworthy*: As nearly good as it is possible to be.
    - *Good Job*: Commendable effort and results, but with improvements indicated.
    - *Average*: Achieves building performance without compromising the safety or health of building occupants or the educational program, but requires significant improvement.
    - *Of Concern*: May compromise the safety or health of building occupants, or the educational program, if not attended to.
    - *Of High Concern*: Will likely lead to dangerous health or safety situations, or to interruption of the educational program, and should be addressed immediately.
    - *Of Very High Concern*: Requires urgent, immediate action to prevent harm to building occupants and/or interruption of the educational program.

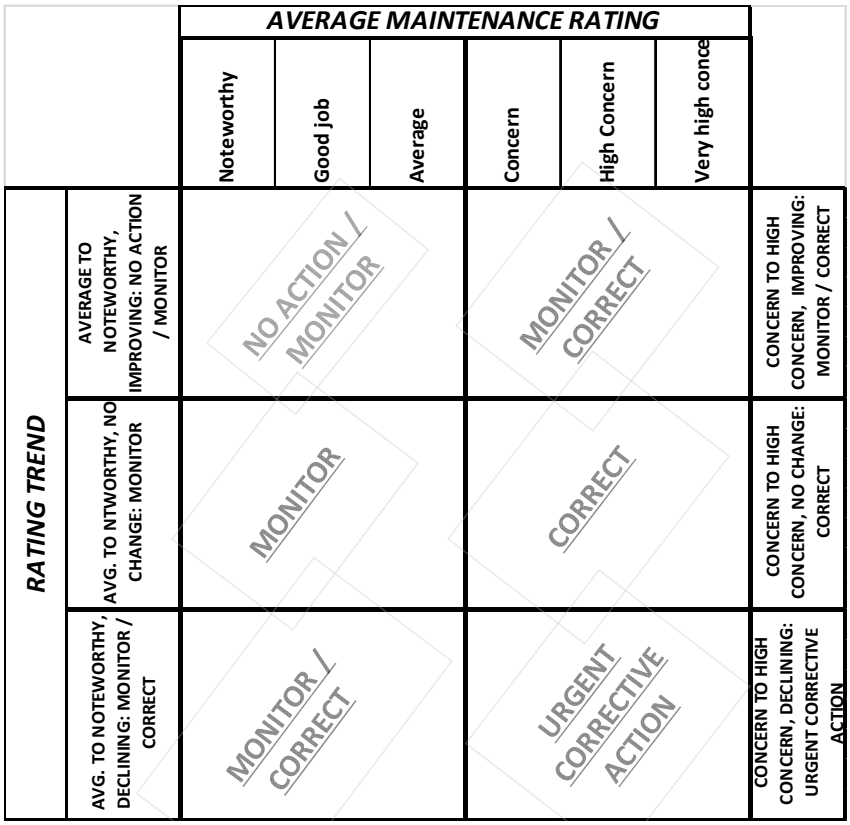
- Trend: The trendline of the category, as measured by changes in the six-year average ratings. Trendlines can be described as Improving, as No Change, or Declining.

Six permutations of these two factors are possible. Each maintenance category can be assigned to one of the six areas; each leads to different general actions:

Quality of Category / Trendline	**Action to be Taken**
• Quality is Average to Noteworthy, and is Improving:	No Action/Monitor
• Quality is Average to Noteworthy, and with No Change:	Monitor
• Quality is Average to Noteworthy, and is Declining:	Monitor / Correct
• Quality is of Concern to of Very High Concern, but is Improving:	Monitor / Correct
• Quality is of Concern to of Very High Concern, and with No Change:	Needed Corrective Action
• Quality is of Concern to of Very High Concern, and is Declining:	Urgent Corrective Action

This range of possible actions is expressed in the following conceptual matrix:

[24] Quality in this methodology is measured by the same method used in the IAC Managing for Results (MFR) assessment of maintenance. The MFR states: "Progress [in the maintenance of schools] is measured by determining whether the average six-year percentage of combined Superior and Good overall ratings holds steady or increase, the percentage of Adequate overall ratings at a minimum holds steady, and the percentage of Not Adequate and Poor overall ratings decreases over time."



This same methodology can also be applied to the maintenance categories in each LEA, and with the same objective, to guide appropriate actions to resolve the maintenance issues of highest concern. However, this analysis will require detailed review of an enormous quantity of information: with 35 maintenance categories in 24 jurisdictions leading to any one of six possible outcomes, there are more than 5,000 data points that must be examined. Any conclusions drawn from such a study would serve only as a first screening; true recommendations for action could only be developed in intense consultation with the staff of the LEA itself. Although a worthy ambition, this is a scope of work that lies well beyond the staff resources of the IAC at this time.

A Spectrum of Actions

Examination of the specific maintenance categories covered by the Maryland inspection process leads to the conclusion that just as not all capital investments are driven by maintenance needs, not all categories of maintenance deficiency can be solved through a capital project. Actions must be targeted to the specific requirements of the task to be solved: in some cases capital investment is appropriate, in others investment must be made into human and other operational resources, and in still other cases a combination of these approaches is called for. Mechanical deficiencies are likely to be solved through large and costly capital investments; issues of cleanliness and sanitation depend almost exclusively on human labor; and in between, the persistent deficiencies found in life safety systems across almost every LEA depend on a combination of capital investment into fire alarm and other systems and the need for well-trained and diligent inspectors of fire extinguishers.

Detailed decisions about the needs of each facility must be made on a building-specific basis. The typical range of actions includes:

- Capital intensive systems: Increase the funding for capital projects in this category (and concurrently ensure that planning, design, construction administration, and post-construction activities are carried out a high quality, with sufficient trained personnel, and on a reasonable schedule)

- Labor intensive systems: Increase the numbers of personnel and ensure that they have sufficient training and resources within an organizational structure that supports their tasks.

- Capital and labor intensive systems: Increase both capital funding and maintenance/custodial personnel and resources.

Next Steps

Detailed analysis of the results of the Maintenance Survey data for FY 2007 through FY 2014 is required in order to develop an approach for action. FY 2007 was the first year that the Maintenance Inspection Program was housed in the Public School Construction Program; FY 2014 is the last year for which the PSCP has complete data. This period will allow three six-year groups to be examined, so that trend lines can be determined for separate maintenance categories at the statewide level, for the overall condition of maintenance in individual LEAs, and at a far higher level of detail, for specific maintenance categories within the individual LEAs.

Such a data analysis, combined with the field observations of the Maintenance Inspectors, will permit the efforts of the IAC to be focused into those maintenance categories that are consistently problematic, i.e., those that show both a low level of quality and have a trendline that indicates either no change or decline. Certain vulnerable areas emerge simply from reading the individual school maintenance reports; among these are fire extinguishers that are not regularly certified, utility shut-off valves that are not properly labelled, electrical and mechanical equipment that is blocked by storage, ceiling tiles that are not replaced in a timely way once leaks are discovered and corrected, and roof joints and flashings that are failing. Depending on the type of deficiency, the appropriate response may be an increase in capital funding in specific areas, e.g. roofing; an increase of training in others, e.g. the certification of fire extinguishers or proper storage practices; or even an exploration of alternative building technologies that may be more suited to the resource limitations of Maryland's school systems.

While great efforts are being made to maintain Maryland's schools in an acceptable state, the detailed information provided by the Maintenance Inspection Program reveals that there are persistent problems on a statewide level in specific areas of facility management, and that individual LEAs, even those with good facility management programs, struggle with persistent problems, including the lack of personnel and other resources. The methodology for action outlined here will assist the IAC to most effectively take action to ensure that all Maryland schools are maintained at acceptable levels of quality.

III. Identifying areas of improvement in each jurisdiction

In the July survey, LEAs were asked to "identify the areas in which you believe your organization could be improved" and "any steps you have taken to make improvements in these areas." Seven LEAs responded; their comments are provided below under the topics queried.

In the nine years that the Maintenance Inspection Program has resided with the Public School Construction Program, the PSCP Inspectors have become very familiar with the maintenance practices of the 24 LEAs. Observations from the Inspectors are included in the topics below.

a. Leadership

BALTIMORE COUNTY
- Professional development at all levels.

FREDERICK
- Improving leadership at all levels.

PRINCE GEORGE'S
- Stable leadership.

PSCP MAINTENANCE INSPECTORS
- Professional training, credentialing, and regular testing of supervisory staff (FRE)
- Engagement of an architect with construction experience to lead a small LEA (SOM)
- Engagement of specialist to oversee daily operations of schools (WOR)

b. Organizational Structure

ANNE ARUNDEL
- Community use:
  - AA Co. Recreation and Parks after school programs: additional use causes wear and tear on the facilities.
  - Summer programs reduce time to make repairs, and clean and maintain the buildings.
- Non-central location of the Facilities Division.

CHARLES
- Monthly staff meetings with supporting services departments.

FREDERICK
- Created two-tier leadership maintenance team, organized by geographic areas, with each area including the same composition of trades and disciplines (allows for succession planning and opportunities for leadership at all levels).

PRINCE GEORGE'S
- Building Services has reorganized and divided plant operations and maintenance.
- Collaboration between the Maintenance Department and the Capital Program Department.

WASHINGTON
- Consolidation of smaller elementary schools into single, larger schools to lower operating costs and increase efficiency; less expensive than renovating or replacing existing schools.

c. Personnel: Staffing and Training

ANNE ARUNDEL

- Hiring and keeping qualified employees is becoming more difficult because compensation is not keeping pace with the improving economy.
- The current work force is aging and the next generation of workers are not considering working in one organization for 20-30 years.
- Result: depletion of the knowledge base.

CHARLES

- Foreman involvement in preliminary design of capital projects
- Foreman involvement in construction oversight to verify quality control
- Integrated energy management office within Foreman of Mechanical/Electrical/ Plumbing for effective communication on operation of building systems
- Utilizing Preventative Maintenance Foreman on capital projects to ensure installation meets design requirements

FREDERICK

- HVAC controls experience is rare and we are attempting to develop internal talent.
- Intend to perform a gap analysis.
- Instituted peer training and offer professional credential (IFMA Facility Management Professional) to maintenance and operations staff.
- Implementing root cause analysis training.

PRINCE GEORGE'S

- Identifying funding to add a second shift for maintenance to support preventive maintenance program.
- Working with Prince George's Community College to establish training for HVAC techs and other specialty trades.

WASHINGTON

- Educational Support Personnel are hired at "Step 1" of the salary scale regardless of prior experience per Association expectations.

PSCP MAINTENANCE INSPECTORS

- Custodial staff:
  - Make preventive maintenance the responsibility of the custodians at each school (MO)
  - Training and better oversight over custodians (PG)
- Higher qualifications, more knowledgeable and responsible building service workers (CARR, CHAS,)

d. Resources (budget, staffing, data systems, equipment, supplies, other)

ANNE ARUNDEL

- Overall funding levels and predictability of the funding stream.
- Current Maintenance operating fund is parallel to 1988-1989 funding for everyday maintenance requirements.
- Controls systems are not being replaced as rapidly as needed and parts are becoming difficult to find, reducing energy savings.
- Has minimal preventative maintenance staffing, affecting life of equipment and requiring more maintenance service calls.

- Funding is needed for:
  - Facilities management software programs
  - Metering to view real time energy use.

BALTIMORE COUNTY
- Additional funding

CHARLES
- Standardization of parts and facility components on construction projects.
- Increased funding would allow for a more thorough scope of work.

FREDERICK
- Additional resources for technology (i.e. School dude, ArcView, etc) and building automation.
- Working to improve project scopes for better budget estimates and efficient project implementation.

HOWARD
- Continued budget cuts: increased number of deferred maintenance projects and less staff.

PRINCE GEORGE'S
- Implemented 'School Dude Maintenance Direct' to collect work orders, track materials, project completion, cost manpower, etc.

WASHINGTON
- Limited number of tradespersons per total building area maintained.
- Systemic renovations limited by available funding.

PSCP MAINTENANCE INSPECTORS
- Balanced and targeted capital improvements to reduce the maintenance burden:
  - Roofing (ALL, CAL)
  - HVAC (CAL
  - General renovations (CARO)
  - Comprehensive Capital Improvement Program (AA, QA, WAS)
- Adequate materials provided to maintenance personnel (CAL)
- Use of a recently closed building to allow adequate storage of materials and equipment (DOR)

e. Other

ANNE ARUNDEL
- Increasing regulatory and environmental compliance costs such as MDE, MBE, prevailing wage, MEMA, and high performance buildings.

CHARLES
- Quality Control measures ensure work orders are being completed effectively and efficiently:
  - Foremen inspections of staff work
  - Customer survey responses once work order is completed

WASHINGTON
- Eliminate the use of portable classrooms, more costly to operate and maintain, and present security challenges.

PSCP MAINTENANCE INSPECTORS

- Energy management systems to reduce operating expenses (ALL, FRE, HOW, WAS)
- Third shift to allow backlog of equipment to be serviced (AA)
- Equipment inventory (FRE, WAS)
- Computerized Maintenance Management System with work order capabilities (CMMS) (BCTY, FRE, WAS)
- BIM (Building Information Modeling) related maintenance management (WIC)

IV. Recommending best maintenance practices to avoid the need for future costly school construction projects

The Literature

A Maryland-specific best practices manual would supplement the vast literature that is available on the subject, ranging from the maintenance manuals issued by manufacturers, vendors and installers to the high-level procedures and practices recommended in the literature of the federal government, the military forces, and other large organizations. A sampling includes:[25]

- U. S. Department of Energy (DOE) FEMP "Operations and Maintenance Best Practices Guide" by Greg Sullivan PE, CEM, Pacific Northwest National Laboratory (presented at Energy 2003, August 18, 2003)
- *O&M Best Practice Series* by Portland Energy Conservation, Inc.
- National Institute of Building Sciences *Whole Building Design Guide* (WBDG) "Optimizing Operations and Maintenance (O&M)"

LEA Best Practices

In July 2015, school facility planners were asked to provide recommendations for best maintenance practices. The responses of the LEAs are summarized below; their responses are testimony to the effort made by local school officials to achieve good maintenance, particularly in a time of extreme fiscal constraints. In addition, the PSCP Maintenance Inspectors were asked to summarize some of the best practices they have observed from their nine years of statewide maintenance inspections, as well as from their prior experience in building construction and management. These best practices are organized under the following categories:

Institutional Organization

- Streamlining management by having a Director of Facilities which includes Maintenance, Operations, and Planning, Design and Construction (AA)
- Excellent communication among Construction, Planning, and Maintenance Departments (CAL)
- Uses a business model that regularly achieves good results and shows continuous improvement (FRE)
- Collaborative work encouraged with horizontal and vertical relationships across all departments (FRE)
- Decentralized organizational structure organized by areas promotes familiarity with facilities and faster service (FRE)

[25] All are referenced in the Whole Building Design Guide (WBDG) "Optimizing Operations and Maintenance (O&M)" by the National Institute of Building Sciences. This document contains a wealth of references to other maintenance literature.

- Departments of Maintenance & Operations and Facilities Planning & Development are co-located (WAS)
- Board of Education has a standing Facilities Sub-Committee which meets monthly with Maintenance and Facilities leaders (WAS)

Budget

- Balanced Capital Improvement Program (AA)
- Solar arrays powering five schools free funds for maintenance and operations (CARO) Board often makes quarterly adjustments to operating funding levels and dedicates resources from the fund balance to support systemic renovations and other small projects (WAS)

Operations

- Established third shift maintenance program, allowing equipment to be shut down for servicing without affecting the instructional program (AA, DOR, QA)
- Schedule work during non-school hours (HOW)
- Predictive Maintenance (thermal imaging, laser alignment, etc.) as well as preventive maintenance (FRE)
- Formal turn-over of construction project to maintenance with digital records and training on systems. (FRE)
- Project debriefings with building users within 6-12 months of completion of project (FCPS)
- Commitment to community engagement (FRE)
- Continuous Improvement Plan (HOW)
- Six Sigma (HOW)[26]
- Maintenance and facilities staffs work cooperatively with instructional leaders (WAS)

Staffing and Training

- Cross training staff to help continue the knowledge base (AA)
- Empowering employees by engaging them in decisions (BACO)
- Allowing decisions to be made at the lowest possible level (BACO)
- Continuous employee training program, with support for staff and an awards program for improvement and achievement (CEC)
- IFMA certification, Project management training, professional memberships (FRE)
- Peer Training (trade training led by rising leadership within the tradesmen) (FRE)
- Entry plans when promoted to leadership positions (FRE)
- Participates in instructional staff leadership training (FRE)
- Including instructional staff on interview teams when hiring new positions
- On-boarding, orientation and safety training (FRE)
  - Behavior Modification (HCPSS Green School Program)
  - Green Cleaning Techniques by custodial staff
  - Year Round Team Cleaning
  - Gallup - Employee Engagement, Strength Finding and Q12
  - Strength Based Culture - find out what on does well; identify talents, building into strengths and career success.
- On-going post training surveys (FRE)
- On-Line Professional Development (HOW)
- Code Compliance Training (HOW)
- Howard Community College (HOW)
  - Leadership

[26] Six Sigma is described on the website as "a disciplined, data-driven approach and methodology for eliminating defects…in any process." The objective of the Six Sigma methodology is stated as "the implementation of a measurement-based strategy that focuses on process improvement and variation reduction." (http://www.isixsigma.com)

    - Communication
    - Problem Solving
    - Conflict Resolution
- Has instituted in-house leadership training (WAS)
- Hires individuals with professional training (engineers, architects) as project managers (WAS)
- Employs State of Maryland Master electricians, plumbers, and HVAC mechanics (WAS)

Procurement

- Acquire resources through the contractual bidding process (BACO)

Technical

- Energy Management Systems free funds for other purposes (ALL, DOR)
- Updated standards for all projects (AA)
- Electronic document management programs used during construction by entire team (FRE)
- Pilot programs for new technology finishes, etc. (FRE)
- Issued guidelines on typical deficiencies (PG)
- Meet personally with factory representatives and technicians (TAL)
- Commission as much equipment as possible (TAL)

Interagency Committee on School Construction

In 2008, at the request of the General Assembly the IAC developed "Guidelines for Maintenance of Public School Facilities in Maryland" (May 30, 2008, at www.pscp.state.md.us). In Section V – Recommendations, the IAC addressed the relationship between school construction and maintenance practices. The following is taken from the Guidelines document.

> Since maintenance begins immediately at the moment that a construction project has been given over to the owner, there are several good practices that need to be performed to ensure the integrity of the building from the very beginning:
>
> - Operating staff of the LEA should be on–site for the last 90 - 120 days of construction to familiarize themselves with the placement and identification of all equipment which otherwise would be hidden behind walls and above ceilings.
>
> - Building commissioning should be performed while the maintenance staff is present so that they can gain a precise understanding of how and why the equipment works as it does, as well as an understanding of the proper sequence of operation.
>
> - The maintenance staff should be included in the tabulation and completion of the punch–list, since they will ultimately be responsible for oversight of the quality of the facility.
>
> - Record documents such as Record (As-built) Drawings, Shop Drawings and Specifications, Operations and Maintenance (O&M) manuals, and instructional materials should be retained for future use by the Administration in a central location, and one or more sets of the same documents should be kept in the School Office and in the School Engineers office.
>
> - Due to the large turnover of custodial personnel, a video taping of contractor demonstrations of the mechanical and electrical equipment operations should be

maintained by the facilities office for purposes of training new personnel in the proper operation and use of the equipment at that building.

- In addition to the staff training outlined in Section III [of the Guideline document], the training of new and returning principals in the complete range of their facility responsibilities, from routine maintenance to initiating a major capital project, should be a regular component of the orientation process administered by the school administration.

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