HAZARD IMPACT STUDY REPORT

This report is in response to a Board inquiry concerning the expected longevity of school-based facilities (i.e., heating and ventilation, plumbing, electrical systems, roofing, and technology). The enclosed report was developed by a team of District staff that included representatives from the Deputy Superintendent's office, the Operational Services Division, the Instruction Unit, the Innovative Teaching and Learning Unit, and the Office of the Chief Financial Officer. The team addressed a specific and narrow question:

> *Which facility failures have the greatest potential to halt or impede teaching and learning or impact the capital or general fund?*

The Clark County School District is not alone in its interest in this question. For instance, a portion of a forthcoming report from The Council of Great City Schools states: "Across the nation, large urban school districts are experiencing premature and rapidly accelerating deterioration of school buildings. Buildings and equipment are deteriorating [and] negatively impacting the core mission of schools: educating children." The report from the Council further states, "The lack of predictive and preventive maintenance increases the rate of decay and significantly increases overall costs."

Findings are in the form of a high-level summary. Absent are life-expectancy estimates for each element of each facility system in each school. That is because this study is a work in progress. The work to date on this study has generated estimates but the study has not yet determined the accuracy or precision of the estimates arising from the calculations. Because this has not yet been determined, caution should be used when interpreting study results.

The following five next steps are envisioned, including:

1. Quantify the accuracy of estimates emerging from the study.
2. Reevaluate the process of facility assessments.
3. Recommend school protocols for mitigating the impact of facility failures.
4. Invite the Board of School Trustees to consider the need for a policy on deferred maintenance.
5. Convene a staff team to formulate recommendations on integrated data systems that enable the District to provide better early warning on facility system failure.

Presentation and discussion on the Hazard Impact Study, is recommended.

Pat Skorkowsky
February 5, 2014

Report from a Study on

Hazard Impact

Produced by:

Kim Wooden, Deputy Superintendent, Educational and Operational Excellence Unit

For

Pat Skorkowsky, Superintendent of Schools

January 17, 2014

“Across the nation, large urban school districts are experiencing premature and rapidly accelerating deterioration of school buildings. Buildings and equipment are deteriorating [and] negatively impacting the core mission of schools: educating children.”

“The lack of predictive and preventive maintenance increases the rate of decay and significantly increases overall costs.”

“It is imperative that urban districts understand facility needs and capture data to support those needs. Consideration should be taken for utilizing current technology and integrating technology platforms to enable enhanced facility planning at all levels.”

Council of Great City Schools
Text of a forthcoming and still draft report by
The Council’s Deferred Maintenance Task Force
Source: 57th Annual Fall Conference, Albuquerque, NM
November 1, 2013

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PREFACE

During an economic downturn, belt-tightening is a reality for individuals and organizations alike, yet nowhere are the effects more apparent than in urban school districts. Forced to juggle competing commitments to instructional programs on one hand and facility maintenance on the other, policymakers face tough choices.

Decisions are difficult because needs are varied. There are facility upkeep obligations, debt service demands, technology requirements, the necessity to attract and select the best and brightest, and the appeal to install more desirable staff-to-student ratios. The list is extensive. How does an organization properly balance competing needs? With little definitive research-based guidance about the proper mix, districts can struggle to find their way forward.

Ensuring that resources are aligned with priorities is central to the work of organizations. The wise exercise of the power to direct and apply resources toward need depends on clarity about a diverse range of needs. No task is more challenging for chief executives and policymakers than to decide on the proper match of resources to needs. Sound decisions must account for the purpose but also the effect of policies and actions. Otherwise, unintended consequences produce greater harm than good.

Public education is not immune from this. Because educating young people is the core function of a school district, it is not surprising that facility needs are often deferred. While accountability demands are rising in school communities across the nation, large urban districts are mobilizing a full court press to educate all students to even higher levels of achievement. Communities throughout the country are searching for approaches that promote safety yet ensure schools are stimulating places that provide every student with opportunity and a pathway to success. Unfortunately, in the rank order of all needs, facility upkeep is increasingly relegated to second tier status during a downturn.

In response to a Board inquiry that arose during a September 4, 2013 meeting of the Trustees, Superintendent Pat Skorkowsky called upon a team of District staff to come up with a way to identify the most significant facility breakdowns that have the potential to halt or impede teaching and learning or which could negatively impact the capital fund or the general fund. The Superintendent's request included some gauge of their estimated impact.

This report provides a response to the Superintendent's request.

EXECUTIVE SUMMARY

This study addresses the question, "Which school facility failures have the greatest potential to halt or impede teaching and learning or negatively impact the capital fund and/or the general fund?"

This study finds that facility failures with the greatest educational or financial impact tend to involve older assets that have required more (or more-costly) maintenance over the years and which are situated at school campuses that have large student populations and a history of over-enrollment.

This conclusion comes with important considerations that limit study usefulness. Because of these, caution should be used when interpreting results. Limitations are cited early because caveats can get in the way of sound bites, and what is published first is usually remembered forever.

- Past records were used to quantify events, yet the past does not perfectly predict the future.

- When many units exceed useful life, a reliable method is unavailable to identify which will fail.

Because of these limitations, decision makers are faced with important questions.

- What attention should be given to a study before the precision of estimates has been quantified?

- If estimate precision cannot reliably be quantified, how widely should results be disseminated?

- Since the intended purpose was not to predict failure, how will results from this report remain separate and distinct from the bond oversight process?

Finally, the greatest benefit of this work may be lessons, knowledge about systems, that emerge from this study.

- The ability to identify and address facility needs is helped or hindered by the interoperability of systems that allow staff to collect and analyze data from different divisions. For instance, estimates of educational or financial impact were developed by drawing on the archive of work order history from the maintenance department. It was also necessary to draw on the records of external facility assessments that are managed by staff working in the area of capital improvement. The ability to responsibly anticipate and manage facility needs depends on the integration of these technology platforms. The challenge of the task increases if data reside in siloes and if department personnel view their work in the same way over time.

- Decisions to defer maintenance or postpone external facility assessments have greatly impacted the ability to utilize up to date data. Also, at what point do we recognize the consequences of decisions to defer maintenance which ultimately accelerates decay, postpones necessary expenditures, and increases cost?

INTRODUCTION

This project called for identifying the most significant facility-related hazards that have the potential to negatively impact the District from an educational or financial point of view. The work described in this report attempts to gauge impact by analyzing facility systems (HVAC, plumbing, electrical, roofing, technology). This is accomplished by linking data on maintenance history of facility components (chillers, air handlers, boilers, etc.) to data on component life expectancy data that is generated by the capital improvement office. The resulting estimates of educational impact reflect the magnitude of expected impact to teaching and learning by taking into account the number of students, classrooms, and schools that are affected by a particular outage.

Questions that this project strives to answer follow. For the facilities at each site:
- What is known about downtime and repair costs from the maintenance records history?
- Given the answer to the above, what is the estimated impact to general fund or capital fund?
- What is the magnitude of the estimated educational impact associated with service interruption?

To address these questions, information is needed that combines:
- The maintenance record of facilities at each site;
- Facility life expectancy based on date the site was built and equipment was installed or replaced;
- External assessments of facilities due every 5 years for a third of facilities (none performed this year);
- The likely educational impact associated with facility down time at a particular site;
- The likely impact to general fund and/or capital fund of a facility failure at any particular site.

This study set out to produce an automated, documented, and repeatable process that acts like an early warning system to identify facility components at sites that are indicating failure by:
- Linking data on maintenance history of facility components to data on component life expectancy;
- Focusing on components that could impede education or negatively impact finances if they fail;
- Gauging the educational impact associated with the failure of a system component;
- Appraising the financial impact (general or capital fund) associated with failure of a component;
- Listing educational and fiscal impact for within- and between-school assets and asset sub-categories.

ASSUMPTIONS AND LIMITS TO THE ANALYSIS

Certain assumptions were used to drive this analysis. From the outset, participants accepted that the work must focus tightly on the charge. Though tempted to take on larger questions, participants accepted a few basics:

- Attention focuses on facility component outages not due to terrorism or forces of nature (tornado, flood, fire)
- Technology was set aside from this analysis for the following reasons:
  - For a growing number of students, content for their learning comes in an electronic form.
    - A total of 15,000 students are now full-time virtual HS students (up from 9,000 last year).
    - CCSD has a goal of providing 100,000 students with a blended learning experience by 2015.
  - For some students who access digital content;
    - The content is housed at the school.
    - The content is hosted by the District.
    - The content is only available via the cloud or Internet, e.g., Cisco Networking curricula.
  - Our system is robust (many fiber lines, mirrored servers); if failure occurs, rerouting happens.
  - A small but real chance exists that multi-site failure may rob full-time virtual students of content.

By design, this study addresses a narrow question. It is vital that the results not be used for unintended purposes. Although clear answers and instant tabulations are desirable (the way a website reports page visits), hard numbers are sometimes hard to come by. Reasons vary.

- The precision of the calculations have not yet been determined.
- Facility use varies widely for similar sites due to differences in enrollment, summer school, etc.
- Preventive maintenance patterns may play a role in the analysis but are sensitive to budget cuts.
- While deferred maintenance may play a role, it is unaccounted for in the analysis.
- External facility assessments should occur every 5 years but tight budgets halted that this year.
- Data on maintenance history that form the basis of this work were never coded or entered so are not readily-comparable to data from a software system that serves capital improvement (note is made that these systems have not until now been designed to be used in this manner).

TERMS, PROCESS, AND PROJECT PARTICIPANTS

Certain terms are used in this report.

- In this context "hazard" is a source of danger, risk, or threat.
- In this context, "significant hazard" includes sources of danger, risk, or threat that could:
  - Cause happen in the foreseeable future
  - Cause substantial harm
  - Impact a large area or a large number of students and schools
- In this context, "HVAC" refers to heating, ventilation, or air conditioning.
- In this context, "HVAC facility components" are limited to chillers, controls, and air handlers.
- In this context, "plumbing" includes boilers.
- The term "useful life" refers to lifecycle standards (Building Owners and Managers Association)
- The term "remaining useful life" is based on the system installation date less the current date.
- Facility Condition Index (FCI) tells how much of an asset's current value is needed to repair/renew it. As a formula, FCI is calculated by dividing the sum of the near term renewal and requirements costs, by the Current (in-kind) Replacement Value (CRV) of the asset (building or system). The lower the FCI, the less work is due, and the better the overall condition of an asset.
- In this context, Z scores is a statistical measurement describing the distance between a raw score and the mean of the population. A Z-score of 0 means the raw score is the same as the population mean. The distance of a raw score from the mean is expressed in standard deviation units.
- According to a forthcoming report from the Council of Great City Schools, the tem "deferred maintenance" generally means a measure of the preventive and regular maintenance as well as the minor and capital repairs/replacement that are needed to meet the projected life expectancy of a facility but which have been postponed to an indeterminate future date.

To undertake this work, the Deputy Superintendent for the Educational and Operational Excellence Unit convened a cross-functional team of representatives from the Instruction Unit, Maintenance Department, Capital Improvement Office, Technology Office, and the Office of the Chief Financial Officer. Meetings were held on September 16, 20, and 23 and October 1, 7, and 14. Team participants included:

Mike Barton	Jeremy Hauser	Felicia Nemcek
Andre Denson	Carlos McDade	Lisa Pitch
Jhone Ebert	Jim McIntosh	Kirsten Searer
Joyce Haldeman	Brenda Larsen-Mitchell	Staci Vesneske

Lending advice was Karlene McCormick Lee. In addition, three other individuals were on hand to provide needed perspectives; they were Ruby Alston and Rory Lorenzo from Finance and Cyndi Atterberry from Maintenance. As well, Dan Wray represented the technology perspective. And finally, Brett Campbell assisted with model construction and analysis. Special thanks goes to Lisa Pitch who conducted analysis and interpreted findings. Lending support was project manager Ken Turner.

MODEL DEVELOPMENT

At the outset of this work, the team that assembled to take on the task considered whether the machinery is currently in place to accomplish the task and answer the questions posed by the Superintendent. At its first gathering, a consensus was reached that there is a need for this committee. The team concluded that existing processes do not adequately address the charge.

- External assessment of facilities do not account for the increased impact of technology on learning.
- Many District facility systems either have exceeded useful life or are nearing that point.
- Rating facilities is problematic when unfunded needs are large and many systems exceed useful life.
- The Facilities Condition Index (FCI) does not take into account disruption to teaching or learning.
- Once systems exceed their useful life, indices like FCI lose their utility and relevance.

At the request of the Board of School Trustees and at the direction of the Superintendent, a team of District staff was assembled to examine ways to identify facility failures at District schools that could halt or impede learning. The discussion focused on ways to develop measures to identify facility components at schools which would cause disruption or impede learning if they failed. After examining some risk assessment models from other domains, it was decided the best way to assess school facility failures in the District would be a model that uses two main types of available data, while taking into account other factors that also contribute to facility component failure. The two measures that were generated were a historical measure and a life expectancy measure. Figure 1 (next page) provides an overview of the conceptual model used to quantify the educational and financial impact associated with a facility outage.

Figure 1: Conceptual model used to quantify educational & financial impact associated with a facility outage

FIGURE 1: OVERVIEW OF CONCEPTUAL MODEL USED TO QUANTIFY THE EDUCATIONAL AND FINANCIAL IMPACT ASSOCIATED WITH A FACILITY OUTAGE

Historical Maintenace Index is an assessment of failure likelihood based on the maintenance history of facility sub-system components at each site (data hosted by Maintenance Team)

Maintenance Team – Uses Maximo to set work priorities

- Priority 1: <u>Immediate effect</u> on life, health, safety for a school site
- Priority 2: <u>Serious impact</u> expected in 24 hours in 10+ classes
- Priority 3: <u>Limited impact</u> on occupants of 1 or 2 classrooms, etc)
- Priority 4: <u>Preventive</u> maintenance that has no immediate impact

The failure likelihood for a facility sub-system is based chiefly on a combination of:

- Maintenance dollars spent
- Sum of 1 or 2 work priorities

Life Expectancy Index is an assessment of failure likelihood based on the life expectancy of facility sub-system components (dataset maintained by Capital Improvement Team)

Capital Improvement Team – Uses the Vanderweil Facilities Assessment Software (VFA) to generate a Facilities Condition Index (FCI). Regulation 7112 describes how FCI is computed. FCI estimates whether an facility should be a replacement candidate. FCI is the ratio of renovation cost (sum of deferred maintenance plus capital renewal costs for a site) to current replacement value for a facility.

The Life Expectancy Index for a facility sub-system is based on information about the particular craft (HVAC vs Plumbing vs Electrical etc.) and the information that proves most useful in estimating the life expectancy index of a particular sub-system element, e.g., chiller vs boiler vs controls in an HVAC system.

Composite Hazard Index links historical maintenance data and forecasts of life expectancy (capital improvement) to generate an indicator of the likelihood of impending failure for facility sub-system components at sites

Educational Impact

Based on:

- **Effect magnitude (how many)**

Capital Fund Impact

Based on:

- **Replacement cost (district mean value for the facility sub-system in question)**

General Fund Impact

Based on:

- **Same figure as reported for capital fund (if failure occurs in a fiscal year that does not provide sufficient capital funds then the burden falls to general fund)**

DATA SOURCES AND DESCRIPTIONS

There are two centrally-located but separately-operated District databases that contain data used for the analysis in this project. One of the databases is related to facility life expectancy. The other contains historical data on upkeep of school facility components. Life expectancy data is generated from the *Vanderweil Facilities Assessment Software* (*VFA*). The historical data is generated by and maintained within a software system called *Maximo*. It serves as a way to manage Maintenance Shop work orders and cost.

Maximo is an Enterprise Asset Management System that is dedicated to lifetime management of physical assets. The purpose of *Maximo* is to track and manage the records of maintenance work orders and cost over time on critical systems (HVAC, roof, electrical, plumbing). Included within *Maximo* are total cost of labor for each work order, total cost of material for each work order, planned craft (if used), the work order reported date, the location's name, the site number, year the site was built, the type of facility, and the supervisor on the work order (if any). *Maximo* is used by the maintenance department to maintain the historical maintenance record of work orders on critical system assets. It records costs associated with work performed on system assets. It also generates work order priorities by assigning 4-level rankings:

- Priority 1: Immediate effect on life, health, safety for entire school (no air conditioning, etc.)
- Priority 2: Serious impact expected in 24 hours in 10+ classrooms (non-functioning plumbing, etc.)
- Priority 3: Limited impact on occupants of 1 or 2 classrooms, etc.)
- Priority 4: Preventive work has no immediate impact but threatens systems if ignored (air filters)

By contrast, *VFA* allows staff to manage the facilities replacement needs that are a component of the District Capital Master Plan. Using *VFA*, staff members within the finance office are able to gauge whether, where, and why renovation or replacement is needed. *VFA* manages the information related to the Master Plan for Capital Projects. These data inform capital improvement choices of District decision-makers. Once every 5 years, an outside assessment is performed at one-third of District sites; the assessment focuses on critical assets (HVAC, electrical, plumbing, roof) at each site. While this was due to occur every 5 years at one-third of sites, due to budget constraints the assessment did not occur in 2012-2013. These results are fed into *VFA*. *VFA* is used to generate a Facilities Condition Index (FCI). District Regulation 7112 describes how a school-level FCI is computed (see Appendix A on page 20).

MODEL SPECIFICATION

Combining historical factors (from records in the Maintenance Department) and forecast factors (from the Capital Improvement Process) can produce a way to predict the impact associated with the failure of a school's facility components. This approach takes into account historical information and forecast estimates to provide a holistic approach.

Importantly, the approach taken in this project also folds in factors that have not previously been considered but which – it is speculated - play a role in the wear on facilities in a building. One such factor is the overall number of students in the building. This project hypothesizes that if more students are enrolled in a school than expected (that is, exceeds the maximum capacity), then the wear on the facility components will rise and the risk for component failure will increase. Conversely, if less than the expected numbers of students enroll, the rate of wear may decrease and consequently the risk for failure of a component will potentially decrease.

The Historical Maintenance Index was created by using two types of historical data from records housed by the Maintenance Department. The *number of work orders* averaged over the past three years for each school facility component was combined with the *costs of those work orders* averaged over the past three years. An additive index was created using both types of data. To create equivalence for additive purposes, the average scores for both number of work orders and costs of work orders was standardized first by converting them to Z-scores. After z-scores were created they were standardized along equivalent scales. Once these were standardized, the scores were added to create the historical maintenance index (see Figure 2 below).

Figure 2: Formulation of the Historical Maintenance Index

The Life Expectancy Index is based on a set of assumptions of the Facility Condition Index (FCI) that estimates (among other things) how near or far facility components are from end of useful life. The index was derived using data drawn from and maintained by the Capital Improvement Team. The purpose of the index is to more-accurately estimate the lifetime of each system. A separate index was calculated for each of the seven components to account for component specific structures. The "seven components" include HVAC chillers, HVAC controls, HVAC VAV (or air handlers), Plumbing boilers, Plumbing, Electrical, and Roofing.

It was determined that no single model could be used to derive a Life Expectancy Index. The reason is that each of the facility systems varies in its characteristics. For instance, while it is possible to replace sub-elements like chillers for HVAC systems, that is not an option for electrical systems. As a result, different models were employed for each of the "seven components." For three of the components – roof, HVAC VAV, and Plumbing-Boilers, the estimated existing years remaining (from the Facilities Condition Index) proved to be the most reliable indicator. For HVAC Chillers, HVAC Controls, Plumbing, and Electrical, separate models were specified to create a more reliable estimate.

The first step in deriving this index was to identify those factors that influence the average life expectancy for each system. For certain systems factors such as *enrollment* and *age of building* were associated with the life expectancy.

For other systems it proved to be the case that *current years remaining* was the best approach or model to use to derive a Life Expectancy Index. Another way to say that is that the *initial life expectancy* proved to be the best estimate. Those three components include HVAC VAV (Air Handlers), Plumbing Boilers, and Roofing. The other systems (including Electrical, HVAC Chillers, HVAC Controls, and Plumbing), it was determined that either *enrollment* or *age of the building* proved to be an influential factor.

What follows are the models specifications for components that relied on a combination of factors like *age of building*, *number of high priority repairs*, etc.

<u>Electrical</u>

$F_{(3, 293)} = 51.53$ $p < .001$, $R^2 = .26$

$\hat{y} = -.15x_{\beta 1} + -.24x_{\beta 2} + 13.83$

$\beta 1$ = Age of building

$\beta 2$ = Number of high priority repairs on system

F = Predicted Life Expectancy

The estimated life expectancy of the electrical system is negatively associated with the age of the building and the number of high priority repairs required. That is to say, the older a school building is and the more frequent the number of high priority repairs, the faster the expected life of the system tends to expire. In this model, the average (mean) life expectancy for the system differs across systems; in other words, the mean life expectancy for electrical systems is different from the mean life expectancy for roofing or plumbing, etc. High priority repairs include Priority 1 and Priority 2 repairs as identified by the District maintenance department. One question that emerges from this model is whether the need for high priority repairs is in anyway a proxy for the quality of the system or system parts purchased? With respect to the Electrical component, the model displayed here explains about a fourth of the variation in estimated life expectancy ($R^2 = .26$).

<u>Plumbing (not including boilers)</u>

$F_{(1, 324)} = 43.48$ $p < .001$, $R^2 = .19$

$\hat{y} = -.09x_{\beta 1} + 11.86$

$\beta 1$ = Age of building

F = Predicted Life Expectancy

The estimated life expectancy of the plumbing system is negatively associated with the age of the building. That is to say, the older the building the faster the expected life of the system tends to expire. Each system has a separate average (mean) life expectancy. With respect to the Plumbing component, the model explains about a fifth of the variation in estimated life expectancy (R^2 =.19).

HVAC Controls

$F_{(1, 270)}$ = 7.15, p = .008, R^2 = .03

$\hat{y} = -.19x_{\beta 1} + 10.96$

β = Number of high priority repairs on system

F = Predicted Life Expectancy

The estimated life expectancy of the HVAC Controls system is negatively associated with the number of high priority repairs required. The older the building and the more frequent high priority repairs the faster the expected life of the system tends to expire. Each system has a separate average (mean) life expectancy. With respect to the HVAC Controls component, the model explains about three percent of the variation in estimated life expectancy (R^2 = .03).

HVAC Chillers

$F_{(2, 250)}$ = 2.79, p = .06, R^2 = .02

$\hat{y} = -.04x_{\beta 1} + 12.02$

β = Age of building

F = Predicted Life Expectancy

The estimated life expectancy of the HVAC Chillers system is negatively associated with the age of the building. The older the building the faster the expected life of the system tends to expire. Each system has a separate average (mean) life expectancy. With respect to the HVAC Chillers component, the model explains about two percent of the variation in estimated life expectancy (R^2 = .02).

Plumbing-Boilers

The variable *years remaining* from current Facility Condition Index was used.

HVAV VAV

The variable *years remaining* from current Facility Condition Index was used.

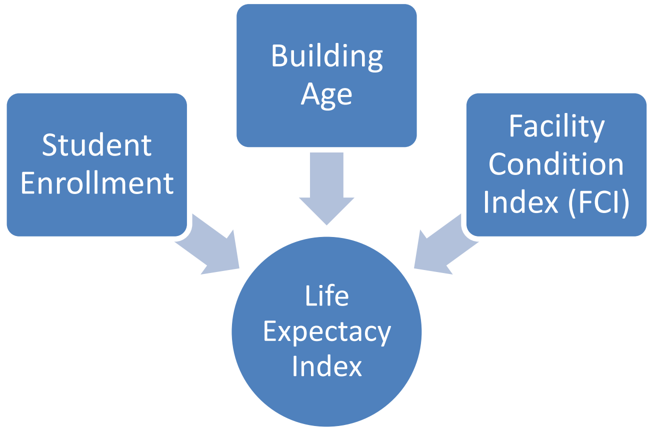
Roof

The variable *years remaining* from current Facility Condition Index was used.

For roofing, HVAC-VAV, Plumbing-Boilers, and Roofs, the most reliable measure proved to be the following. That is, the years remaining that was derived from the Facility Condition Index. By contrast, for HVAC Chillers, HVAC Controls, Plumbing, and Electrical, a combination of factors was used to inform the Life Expectancy Index. That combination included age of building, number of priority repairs, and total number of students served at a site.

Taken together, for each facility system and sub-system, those factors that had an impact were used to calculate a presumably-more accurate estimate of life expectancy of that system or sub-system element (see Figure 3 below). Ordinary Least Squares regression was used to generate estimates. The resulting adjusted estimate became the Life Expectancy Index.

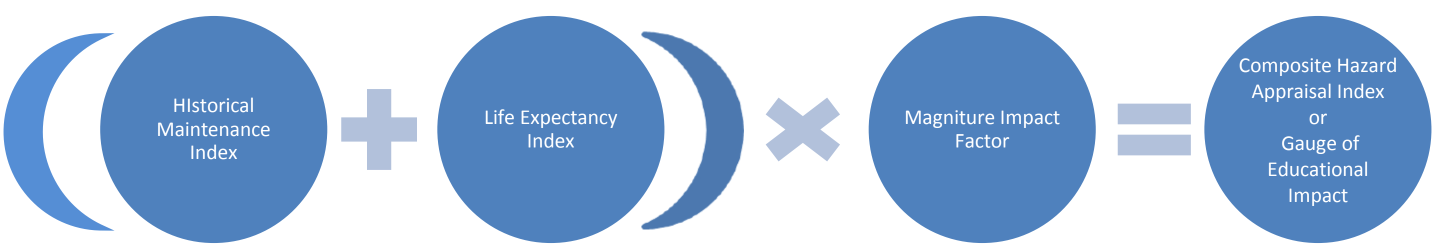
Figure 3: Formulation of the Life Expectancy Index



These two constructs (Historical Maintenance Index on one hand and the Life Expectancy Index on the other hand) were then combined with a factor that reflects over- or under-enrollment at the school site. It is assumed that there are many more factors that impact the risk of failure of school facility components that could bias the life expectancy and historical maintenance indexes. One of the more critical factors is wear at a school site that occurs when there are more numbers of students at a site. With more students, it is hypothesized that a facility component will move towards failure more rapidly. To account for this, the percent of students attending a facility that was over the maximum ideal enrollment at that site was calculated. Percent over enrollment was calculated as number enrolled divided by maximum enrollment. This factor is referred to as the <u>Magnitude Impact Factor</u>.

The <u>Composite Hazard Appraisal Index</u> is an indicator of and a euphemism for <u>Gauge of Educational Impact</u>. It combines the Historical Maintenance Index, the Life Expectancy Index, and the Magnitude Impact Factor to create the composite hazard appraisal score (see Figure 4 below). Within the limits of the available data, this generated a score that quantified the impact on teaching or learning associated with a facility system failure. A higher score means that a failure of that facility component is more apt to halt or impede teaching and learning at the site.

Figure 4: Formulation of the Composite Hazard Appraisal Index (or Gauge of Educational Impact)



FINDINGS (DESCRIPTION AND FORMAT) AND MITIGATING EDUCATIONAL IMPACT

Enclosed are two sets of results. One is a tabular listing of results by school (see Table 1 below and the "Table of Results" that appears on page 24).

Table 1: Estimates of educational and fiscal impact associated with a facility outage for <School Name>

	Historical Maintenance Index *Historical View of Priority 1 & 2 Work* *Links Work Orders and Cost*	*Life Expectancy Index* *Estimates End of Life* *Links Facility Condition & Age*	*Magnitude Impact Factor* *Total Over- or Under-Enrollment* *Links Rate of Wear Factors*	*Composite Hazard Index* *Educational Impact Appraisal* *Links Available Relevant Info*	*Estimated* *Financial* *Impact*
HVAC Chiller					
HVAC Controls					
HVAC Air handlers					
Plumbing Boilers					
Plumbing Other					
Electrical					
Roofing					

Other results that are attached include "Horizontal Bar Charts" (see page 25). The school-by-school display is designed to use bars to illustrate the educational impact associated with failure of facility elements for each school. Blue bars represent the mean value for that facility system for the District. The red horizontal bars represent the estimated value (of educational impact) for that facility system for the school in question. For a school that has a red bar that is longer than the blue bar it indicates a situation where it is estimated that a facility failure will have a greater negative impact on teaching and learning.

To prepare for the possibility of facility failures, schools develop contingency plans. Principals work closely with facility representatives and Academic Managers to develop these plans. The plans that are developed include strategies that take into account the nature of the failure, the expected duration of the outage, the percentage of students affected, and the feasibility of alternative arrangements that may be available (either on-site or off-site). Mitigating strategies may include but are not limited to moving students from one area of the school to another, the temporary removal of students from the school site to another school site, double sessions at a school site to accommodate two schools, etc. In situations where an outage is significant and protracted, certain options arise. These might arise in the event of a critical system failure resulting in a school site being deemed uninhabitable:

- Convert nearby schools to year-round schedules; divide impacted students among the schools.
- Disperse the impacted students to surrounding area schools (but with no calendar change).
- Create double-sessions at a surrounding area school.
- Create a portable school campus.

DISCUSSION

Considerations that arose during the production of this report bear mention.

- Why has one trend emerged for older structures (fewer maintenance problems arising) and another trend for newer buildings (more outages)?
  - In *Maximo*, maintenance does not reset when a school has had a major facilities overhaul. To the extent this is true, it may help explain why there may be a long record of maintenance work orders at sites where there are newer facilities (because older work orders are actually associated with facilities elements that have been replaced in recent years).
  - To what extent is there greater tolerance for and acceptance of service interruption among staff at older facilities? If those who work at older schools are simply more accepting of facility outages, then it might also help explain why newer schools may simply not be as accepting of problems because the site is younger. This may explain why there are more work requests from the newer schools.
- Deferred maintenance is drawing attention nationally. The Council of Greater City Schools is preparing a study on the subject. It asks, "In large urban districts, how much should be spent yearly for capital projects and maintenance?" Because deferred maintenance impacts general fund, early drafts of the study claim that facility issues should garner the same attention as academic issues.
- To the extent that only a portion of deferred maintenance needs are actually funded in CCSD, then facilities may be decaying at an accelerating pace and the pace of facility failures may increase.
- It was not the purpose of the team doing this work to address the question "If we have a restricted level of funds, what is the priority?" Presumably that is the work of a bond oversight committee.

If there is sufficient interest, it is conceivable that work could be extended to address the following.

- What can be done to account for technology issues given FCI does not sufficiently address the topic?
- What mitigation strategies exist for each school to prepare for the possibility of facility failure?
- Is a process checklist needed to identify what to do if failure occurs and school must be relocated?
- How can empirical data be used to quantify the precision of the estimates provided in this report?
- What guidance is needed, given that a cessation or delay of external facility assessments impedes the District's ability to gauge replacement needs, erodes the administration's ability to manage scarce fiscal resources, and interferes with teacher instruction and student learning?

The team that contributed to this report faced challenges. Among them were these questions:

- How accurate are the estimates in this report?
- How wise it is to assign worth to estimates of impact when many systems exceed useful life?
- When computing a hazard index, are all factors accorded the same weight (should they be)?
- How can data in disparate systems be coded to enhance data portability and inter-operability?
- What refinement(s) are needed to establish a repeatable process?

APPENDIX A: CLARK COUNTY SCHOOL DISTRICT REGULATION 7112

R-7112

SCHOOL FACILITY REPLACEMENT

I. Determining cost effectiveness of facility replacement versus facility renovation shall be a component of the district's Capital Master Plan (CMP).

A decision to renovate or replace a facility shall be based upon an analysis of the facility's physical condition, ability to support the curriculum and a comparison of the costs and feasibility of building a new facility versus the costs and feasibility of renovating the existing facility. Physical condition is defined as the current physical state of a facility as described by observation of its individual component systems.

All analyses shall strive to have every school facility, whether replaced or renovated, effectively and efficiently support current and projected educational requirements, conform to life safety and other applicable code requirements, and be cost effective to operate and maintain.

II. Procedure

A. Step One: Facility Condition Assessment

The Facilities Division shall conduct annual facility assessments and incorporate the data into a Facility Condition Database which shall be used to screen all facilities over forty years old or those in need of extensive repair. Special consideration shall be given to the historical significance of the existing facility in the community being served. Historical significance is defined as the existence of an official national, state, or local designation that governs modifications to a particular facility.

The Facility Condition Database will generate condition and cost data that will be used during Data Analysis to determine if:

1. The facility should be renovated.

2. The facility should be replaced.

3. The historical significance of the existing facility mandates renovation in lieu of replacement.

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B. Step Two: Data Analysis

Data Analysis consists of three stages. The conclusions of each stage will determine if it is necessary to advance to the subsequent stage.

1. Physical Condition Analysis. This analysis determines and compares current replacement value and forecasted renovation costs to ascertain whether an existing facility should be replaced, renovated, or examined further. The relationship between current replacement value and renovation costs is expressed as an index as shown in the following formula:

   Facility Condition Index (FCI) = Renovation Costs/Current Replacement Value of School Facility.

   A multi-facility campus will receive a FCI rating based on the average value of its individual building FCI ratings. Figure 1 illustrates a typical campus with multiple buildings and individual FCI ratings.

   Renovation costs are the sum of deferred maintenance and capital renewal costs existing for the facility.

   FCI < 0.40 will support a renovation recommendation.
   FCI between 0.40 and 0.60 will require a Program Analysis.
   FCI > 0.60 will support a replacement recommendation.

2. Program Analysis. This analysis is required when FCI is calculated to be between 0.40 and 0.60. Facilities with an FCI in this range will be evaluated for program adequacy. Program adequacy is measured as the cost to build or upgrade space to accommodate current curriculum standards. This cost can be expressed as an index as shown in the following formula:

   Programmatic Index (PI) = Capital Cost to Support Curriculum Standards/Current Replacement Value of School Facility.

3. Site Analysis. This analysis will be conducted when a school facility has been designated as a replacement candidate. A master plan will be created of the current campus to study replacement on the existing site. If it is not feasible to replace the facility on the current site, or expand the current site onto adjacent properties,

possible alternative sites and their costs will be investigated. Replacement options will include total replacement, phased replacement, and combined replacement of two or more schools. In addition, the reuse potential of the existing site(s) will be evaluated.

C. Step Three: Prioritization of Needs

The District CMP working group, consisting of CCSD staff, will develop a prioritized replacement school program that will be added to the Capital Master Plan.

1. The prioritization process will proceed in the following sequence:

   a. School campuses will be ranked initially using a Facility Quality Index (FQI), which is the sum of the FCI and PI indexes. Identical FQI ratings will be sub-ordered by FCI.

   b. All school campuses with a FCI < 0.40 will be checked for recent improvements that may skew the FCI rating downward and conceal the existence of poor facilities. All campuses affected by this situation will be highlighted for discussion by the Bond Oversight Committee and the Board of Trustees.

   c. Annual Operating Costs, expressed as a cost per gross square foot of floor area, will be used to adjust priority between campuses which have identical FQI and FCI scores.

   d. Enrollment trends at each candidate campus will be examined in order to inform the Bond Oversight Committee and the Board of Trustees on conditions which may affect priority.

   e. Parents, staff, and other community members may contact their region superintendent to request replacement consideration for any school campus not meeting the requirements of this regulation. The CMP working group will review the draft replacement program with each region superintendent and obtain input related to exceptions. These exceptions will be presented to the Bond Oversight Committee and the Board of Trustees for review.

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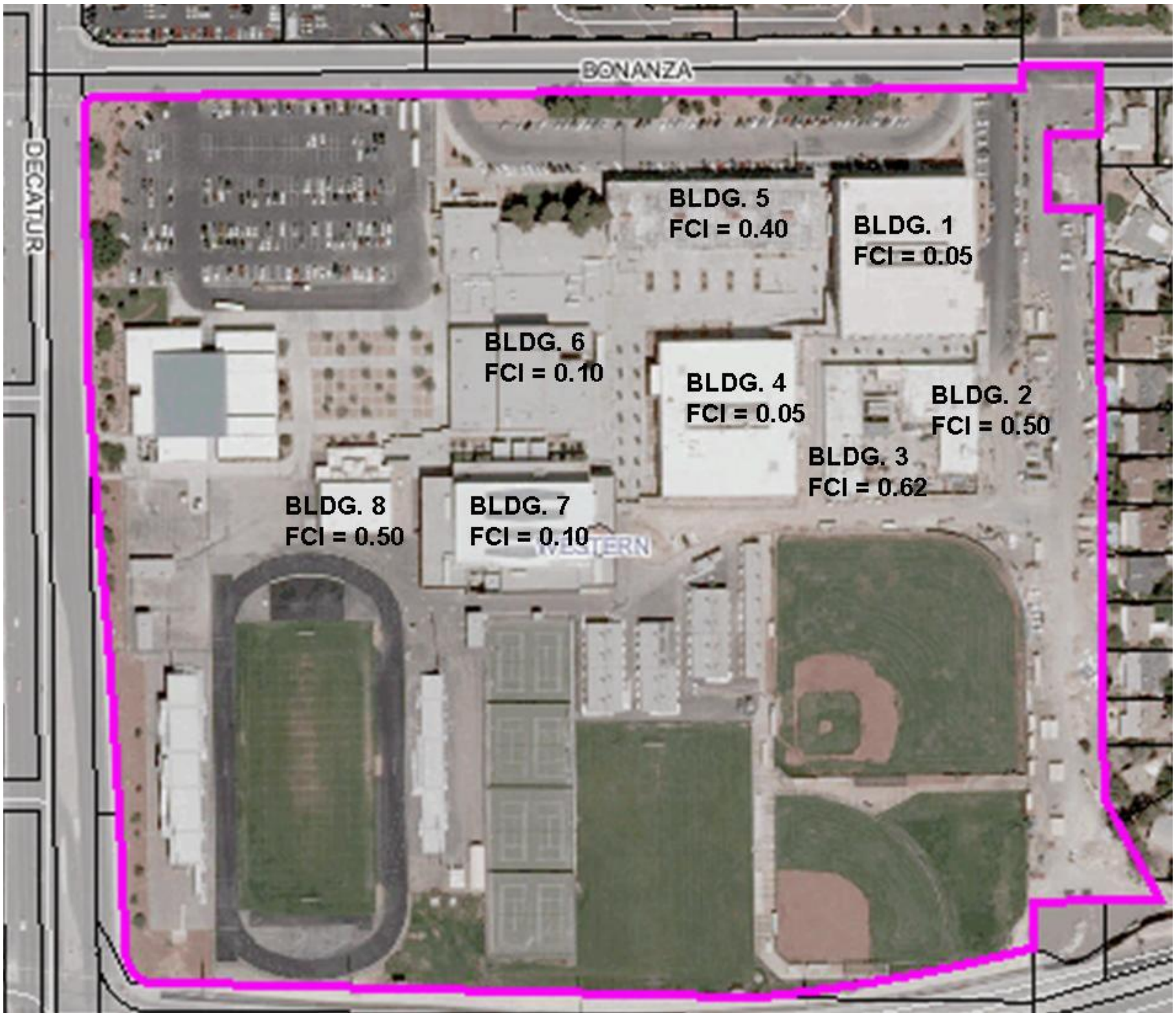

In this example, the average FCI for the eight building campus is 0.27, although 4 out of 9 buildings would merit further examination for replacement consideration.

Figure 1

Review Responsibility: Facilities Division
Adopted: [7/22/99]
Pol Gov Rev: 6/28/01
Revised: 6/26/08

TABLE OF RESULTS

School Name	Category	Historical Maintainance Index	Life Expectancy Index	Magnitude Impact Factor: Percent of Student Over or Under Enrollment	Composite Hazard Appraisal Index: Gauge of Educational Impact	Impact on Capital Fund (or General Fund if emergency funding is required)
School B	ELECTRICAL	76.88	56.25	1.37	181.90	570,000
School B	HVACCHILLERS	96.51	57.85	1.37	210.90	420,000
School B	HVACCONTROLS	33.53	55.83	1.37	122.09	200,000
School B	HVACVAV	45.43	51.07	1.37	131.85	3,000,000
School B	PLUMBING	45.82	58.70	1.37	142.80	425,000
School B	PLUMBINGBOILERS	27.00	51.82	1.37	107.69	30.000
School C	ELECTRICAL	65.39	31.03	1.36	130.84	570,000
School C	HVACCHILLERS	87.73	32.50	1.36	163.15	420,000
School C	HVACCONTROLS	67.03	39.83	1.36	145.02	200,000
School C	HVACVAV	24.36	62.83	1.36	118.32	3,000,000
School C	PLUMBING	87.24	34.10	1.36	164.67	425,000
School C	PLUMBINGBOILERS	52.86	65.88	1.36	161.13	30,000
School C	ROOF	37.38	42.19	1.36	107.97	720,000

HORIZONTAL BAR CHARTS