

# ANALYSIS OF THE MAINTENANCE WORK ORDER DATA IN EDUCATIONAL FACILITIES

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## PROBLEM STATEMENT

- Aging buildings
- Insufficient funding of maintenance needs
- Constraints in condition assessment process
- Lack of visual inspection as part of the condition assessment process
- Need for maximizing facility performance, budget allocation and minimizing the negative impacts of failures

## BACKGROUND

### MAINTENANCE WORK ORDERS

Includes information of the maintenance activities which may lead a preliminary understanding of buildings conditions.

### MAINTENANCE ACTIVITIES

Architectural, carpentry, electrical, HVAC, mechanical, plumbing, structural, etc.

### LACK OF USE OF THE MAINTENANCE WORK ORDER DATA IN THE CONDITION ASSESSMENT PROCESS

## DATA COLLECTION

Institutions	State	GSF of Buildings	Total # of Buildings	Average Age of Buildings	Time Interval of Work Orders
State #1	Colorado	4,076,953	60	63	2009-2018
State #2	Colorado	12,361,537	748	43	2008-2017
State #3	Colorado	8,186,982	409	67	2013-2017
Private #1	Colorado	3,567,470	74	51	2012-2018
School District #1	Colorado	3,979,365	70	43	2011-2017
Private #2	Connecticut	2,792,464	310	105	2013-2017

### THE MAIN FOCUS OF THE ANALYSIS

Revealing any possible relations between:

- MAINTENANCE ACTIVITIES and BUILDING AGES
- MAINTENANCE ACTIVITIES and BUILDING TYPES

The analysis of this study provides a preliminary understanding of these relations.

## METHODOLOGY AND RESULTS

### MAJORITY OF WORK ORDERS

- ELECTRICAL
- (Heating, Ventilation, and Air Conditioning) HVAC
- PLUMBING

The distribution of work orders for the maintenance activities was relatively estimated for each individual building using below equation.

$$Dwb_i = \frac{1}{Nw} \sum_{i=1}^n Nwb_i$$

**Dwb:** The distribution of work orders for each maintenance activity at building i

**Nw:** The total number of work orders for each maintenance activity

**Nwb:** The number of work orders for each maintenance activity at building i

### MAINTENANCE ACTIVITIES and BUILDING AGES

Higher(H): five percent and greater of total work orders (>5%)

Lower(L): one percent and less of total work orders (< 1%).

Zero (Z): zero work orders (= 0)

Maintenance Activity Type	State #1			State #2			State #3			Private #1			School District #1			Private #2		
	H	L	Z	H	L	Z	H	L	Z	H	L	Z	H	L	Z	H	L	Z
Electrical	36	73	47	53	43	32	49	62	48	51	55	46	38	44	-	53	108	64
HVAC	37	77	44	50	47	34	28	63	52	51	51	53	38	47	-	51	107	104
Plumbing	40	76	45	51	45	32	79	54	44	27	51	55	45	48	-	41	109	141

The analysis does not show that the older buildings receive a higher number of work orders as might be expected.

The average age of the buildings in each cluster is more than the average age of 34.2 years provided on the Sightlines report (2017).

Average Age	H	L	Z
<40	33%	0%	20%
40 - 60	61%	56%	60%
>60	6%	44%	20%

### MAINTENANCE ACTIVITIES and BUILDING TYPES

Maintenance Activity Type	H				L				Z															
	State #2 (%)				Private #1 (%)				State #2 (%)				Private #1 (%)											
	C	O	R	OT	C	O	R	OT	C	O	R	OT	C	O	R	OT	C	O	R	OT				
Electrical	0	33	33	34	100	0	0	0	7	21	12	60	7	9	1	83	0	14	5	81	0	1	0	99
HVAC	33	33	0	34	100	0	0	0	12	30	15	43	4	15	3	78	1	9	6	84	0	0	0	100
Plumbing	25	0	25	50	0	0	100	0	8	26	11	55	8	9	3	80	1	7	10	82	0	0	0	100

Classroom, office and research building types receive a higher number of work orders.

## CONCLUSIONS

### THE HIGHEST NUMBER OF WORK ORDERS ARE:

- ELECTRICAL
- HVAC
- PLUMBING

### THE STUDY DOES NOT REVEAL A SPECIFIC RELATION BETWEEN:

- MAINTENANCE ACTIVITIES and BUILDING AGES
- MAINTENANCE ACTIVITIES and BUILDING TYPES

### THE STUDY PROVIDES A PRELIMINARY UNDERSTANDING OF:

- THE FREQUENT MAINTENANCE ACTIVITIES IN THE DATA SETS WITH THEIR RELATIONS OF BUILDING AGE AND BUILDING TYPE.

### THE DATA SETS NEED THE SUBCATEGORY\* OF THE MAINTENANCE ACTIVITIES THAT:

- MAY INCREASE THE EFFECTIVE USE OF WORK ORDER DATA IN THE CONDITION ASSESSMENT PROCESS.

\*Subcategories of the electrical maintenance activities can be light bulb changing, electrical panel issues, outlet/switch issues, etc.