

**G**  **RDIAN**®  
Building knowledge



# Using Credible Data for Life Cycle Costing & Budgeting



# Agenda

- Discuss current cutting-edge uses of construction, life cycle and predictive data
- How to apply credible data today and predict future costs
- Explore data trends and how predictive data enables more profitable business decisions
- Discuss insights in the world of construction data

# Facilities Cost Data: Simple in Theory

- Material costs are based on commodities and manufacturing costs and profits
- Labor and labor cost is based on supply and demand
- Construction is a combination of material, labor and equipment costs rolled up with productivity

# Cost Estimating Challenges



- How does an estimator convert a scope of work to material, labor, equipment quantification and apply other factors to estimate accurately?
- Factors that influence future estimating accuracy:
  1. How far in the future?
  2. Location of project and local market activity?
  3. Contracting method?
  4. Global commodity price influences?
  5. Context Scope
  6. Process Scope

# Budgeting Cost Data Options

Budgeting can be accomplished using several cost data options:

**Owners' current  
data**

**Vendor and  
"favored contractor  
information"**

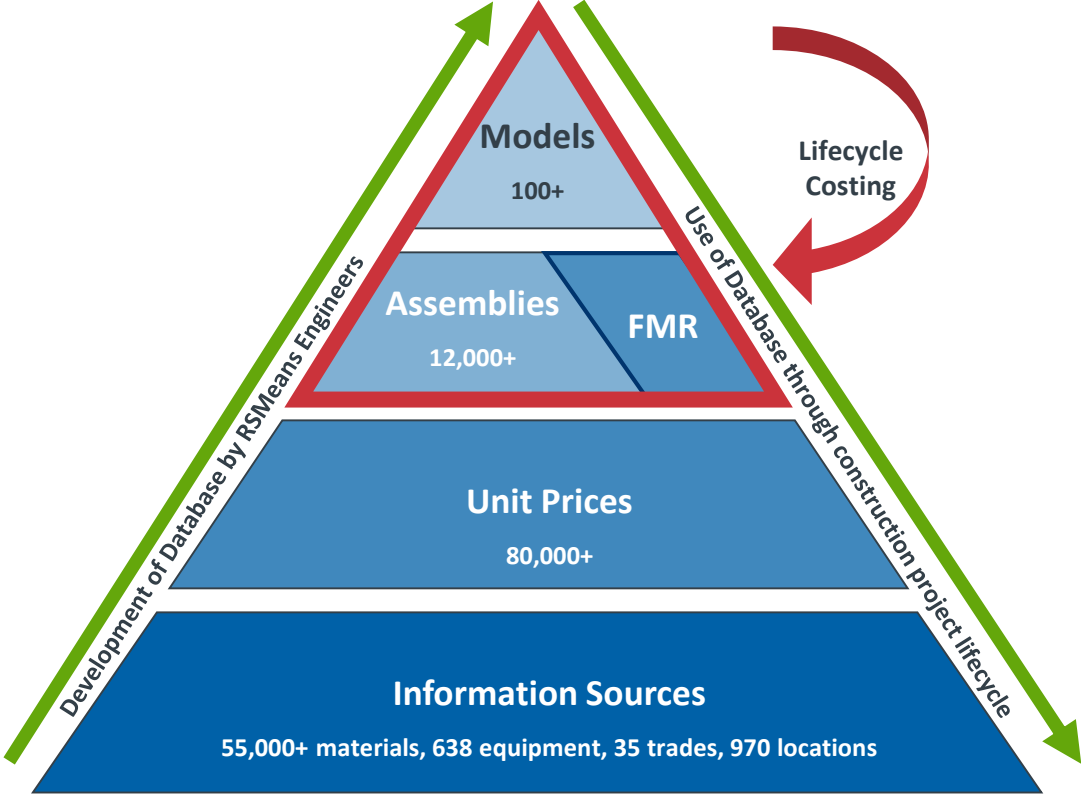
**Published cost  
data**

# How Cost Data Can Help

- Forecast building life cycle costs
- Quantify existing deferred maintenance liabilities
- Provide a basis for efficiently modeling Current Replacement Value
- Provide pricing mechanism for efficient execution

**Different cost data types for different purposes!**

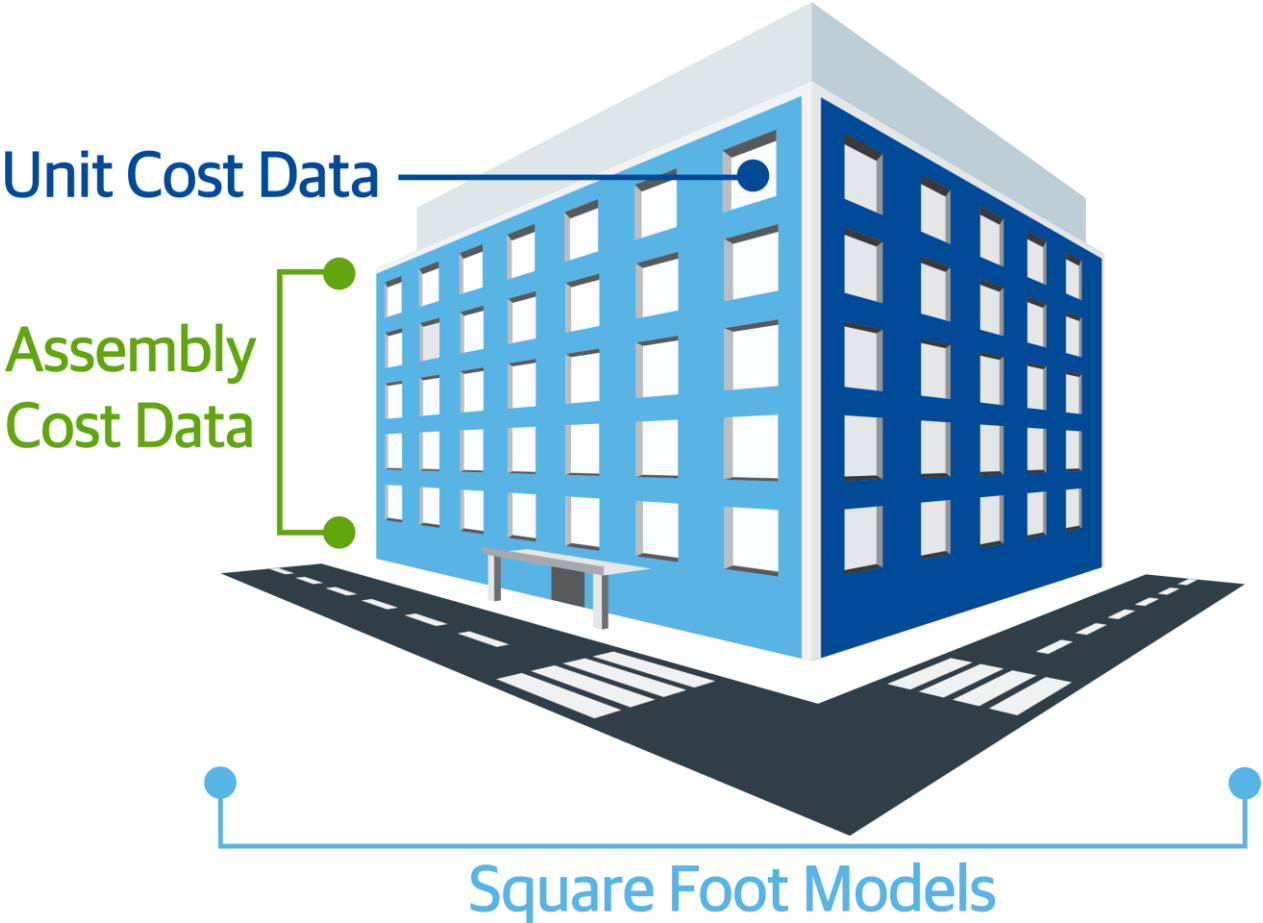
# Review of RSMeans Database Structure





# Structure of RSMeans Database

Localized to >900 North American locations



# Ongoing Investments After Initial Construction

**Preventative  
maintenance**

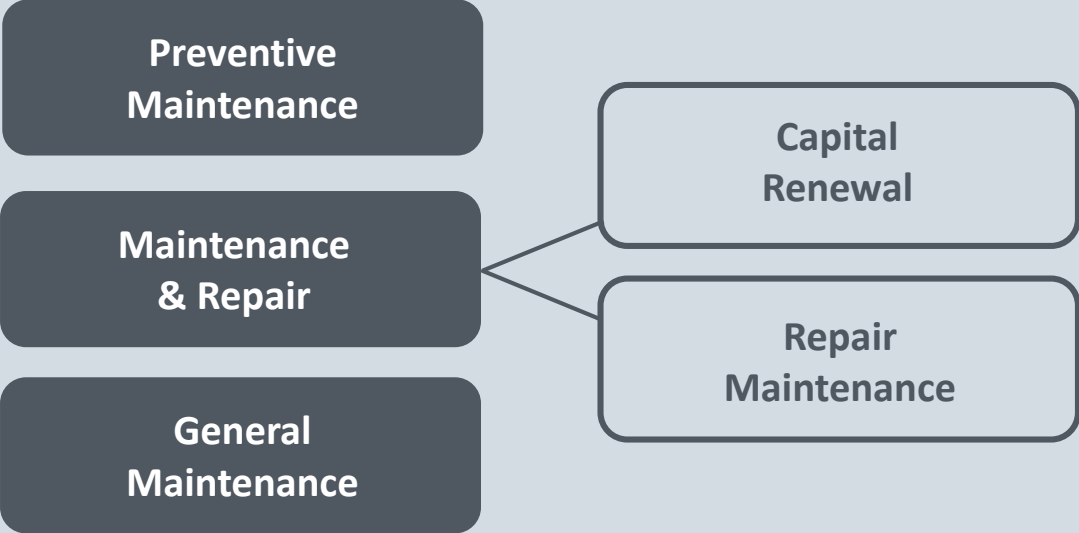
**Repair  
maintenance**

**Capital  
renewal**

**Any of these can be deferred**

# Cost Data for Asset Management

## Facilities Maintenance and Repair



# Repair/Replacement Maintenance

<b>D30 HVAC</b>		<b>D3023</b>		<b>Heat Generating Systems</b>							
<b>D3023 186</b>		<b>Boiler, Gas/Oil</b>									
	System Description	Freq. (Years)	Crew	Unit	Labor Hours	2017 Bare Costs				Total In-House	Total w/O&P
						Material	Labor	Equipment	Total		
2010	Repair boiler, gas/oil, 20,000 MBH	7	Q-5	Ea.							
	Remove/replace burner blower				.600		37.50		37.50	46.50	58
	Remove burner blower bearing				1.000		62.50		62.50	78	97
	Replace burner blower bearing				2.000	65	125		190	227	275
	Remove burner blower motor				.976		55		55	68.50	85.50
	Replace burner blower motor				1.951	271	110		381	435	510
	Remove burner fireye				.195		12.15		12.15	15.15	18.95
	Replace burner fireye				.300	248	18.70		266.70	296	340
	Remove burner ignition transformer				.333		21		21	26	32.50
	Replace burner ignition transformer				.667	75.50	41.50		117	135	159
	Remove burner ignition electrode				.267		16.60		16.60	20.50	26
	Replace burner ignition electrode				.444	14.20	27.50		41.70	50	61
	Remove burner oil pump				.500		31		31	39	48.50
	Replace burner oil pump				2.602	168	146		314	365	435
	Remove burner nozzle				.167		10.40		10.40	12.95	16.20
	Replace burner nozzle				.571	9.10	35.50		44.60	54.50	67
	Remove burner gas regulator				1.300		73		73	91	114
	Replace burner gas regulator				2.600	2,300	146		2,446	2,700	3,100
	Remove burner auto gas valve				5.195		300		300	375	465
	Replace burner auto gas valve				8.000	6,075	460		6,535	7,250	8,325
Remove burner solenoid valve	2.600		156		156	195	243				
Replace burner solenoid valve	10.399	4,000	625		4,625	5,175	5,975				
Repair controls	.600		37.50		37.50	46.50	58				
<b>Total</b>					43,266	13,225.80	2,547.85		15,773.65	17,701.60	20,509.65
2050	Replace boiler, gas/oil, 20,000 MBH	30	Q-7	Ea.							
	Remove boiler				1527.360		90,280		90,280	113,000	141,500
	Replace boiler, gas/oil, 20,000 MBH				3156.840	273,800	187,220		461,020	535,000	634,000
<b>Total</b>					4684.200	273,800	277,500		551,300	648,000	775,500
<b>D3023 198</b>		<b>Blowoff System</b>									
	System Description	Freq. (Years)	Crew	Unit	Labor Hours	2017 Bare Costs				Total In-House	Total w/O&P
						Material	Labor	Equipment	Total		
1010	Repair boiler blowoff system	10	1 STPI	Ea.							
	Repair leak				1.000		62.50		62.50	78	97
<b>Total</b>					1.000		62.50		62.50	78	97

# Preventative Maintenance

D20 PLUMBING		D2025 190	Water Heater, Solar					
PM Components		Labor-hrs.	W	M	Q	S	A	
<b>PM System D2025 190 1950</b>								
<b>Solar, closed loop hot water heating system, up to 6 panels</b>								
1	Check with operating or area personnel for deficiencies.	.035				✓	✓	
2	Inspect interior piping and connections for leaks and damaged insulation; tighten connections and repair damaged insulation as necessary.	.125				✓	✓	
3	Check zone and circulating pump motors for excessive overheating; lubricate motor bearings.	.077				✓	✓	
4	Check pressure and air relief valves for proper operation.	.030				✓	✓	
5	Check control panel and differential thermostat for proper operation.	.094				✓	✓	
6	Clean sight glasses, controls, pumps, and flow indicators on tanks.	.127				✓	✓	
7	Check system pressure on closed loop for loss of fluid.	.046				✓	✓	
8	Check fluid level on drain-back systems; add fluid as necessary.	.029				✓	✓	
9	Test glycol strength in closed systems, as applicable; if required, drain system and replace with new fluid mixture.	.222				✓	✓	
10	Check heat exchanger for exterior leaks.	.077				✓	✓	
11	Clean strainers and traps.	.181					✓	
12	Check storage and expansion tanks; for leaks and deteriorated insulation.	.077					✓	
13	Inspect all collector piping for leaks and damaged insulation; tighten connections and repair as required.	.133				✓	✓	
14	Inspect collector glazing for cracks and seals for tightness; tighten or replace seals as necessary.	.124				✓	✓	
15	Wash/clean glazing on collector panels.	.585					✓	
16	Inspect ferrule around pipe flashing where solar piping runs through roof; repair as necessary.	.086				✓	✓	
17	Check collector mounting brackets and bolts; tighten as required.	.094				✓	✓	
18	Clean area.	.066				✓	✓	
19	Fill out maintenance checklist and report deficiencies.	.022				✓	✓	
<b>Total labor-hours/period</b>						1.165	2.230	
<b>Total labor-hours/year</b>						1.165	2.230	
		<b>Cost Each</b>						
		<b>2015 Bare Costs</b>					<b>Total In-House</b>	<b>Total w/O&amp;P</b>
		<b>Labor-hrs.</b>	<b>Material</b>	<b>Labor</b>	<b>Equip.</b>	<b>Total</b>		
1900	Wtr. htng. sys., solar clsd. lp., up to 6 panels, annually	2.230	245	133		378	435	515
1950	Annualized	3.395	246	203		449	525	625

# Location Factors By Division

Division

Location

DIV. NO.	BUILDING SYSTEMS	ALABAMA														
		BIRMINGHAM			HUNTSVILLE			MOBILE			MONTGOMERY			TUSCALOOSA		
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL
A	Substructure	104.4	81.3	90.3	96.3	76.8	84.4	100.1	69.6	81.5	101.8	63.7	78.5	98.9	69.4	80.9
B10	Shell: Superstructure	103.9	86.4	97.0	104.2	82.1	95.5	103.9	78.1	93.8	103.4	74.5	92.0	104.1	77.7	93.7
B20	Exterior Closure	98.8	77.1	88.4	99.1	68.2	84.3	101.1	56.9	80.0	99.7	52.9	77.3	98.6	67.7	83.8
B30	Roofing	99.6	82.1	93.0	96.6	77.6	89.4	97.6	71.7	87.8	97.8	67.7	86.4	96.7	73.0	87.7
C	Interior Construction	99.6	75.2	89.4	100.2	71.2	88.0	97.4	54.6	79.4	98.1	47.3	76.8	100.2	51.7	79.9
D10	Services: Conveying	100.0	90.1	97.3	100.0	87.1	96.5	100.0	87.1	96.5	100.0	84.5	95.7	100.0	86.2	96.2
D20 - 40	Mechanical	100.0	70.4	88.1	100.0	61.6	84.5	99.9	60.7	84.1	100.0	34.2	73.4	100.0	34.0	73.4
D50	Electrical	99.0	61.6	79.3	95.3	64.9	79.3	95.7	59.1	76.3	96.3	60.9	77.6	94.8	61.6	77.3
E	Equipment & Furnishings	100.0	75.1	98.7	100.0	71.6	98.5	100.0	52.6	97.6	100.0	42.7	97.1	100.0	44.9	97.2
G	Site Work	97.2	93.6	94.7	89.1	92.5	91.5	95.8	87.8	90.3	95.9	87.8	90.4	89.7	92.7	91.8
A-G	WEIGHTED AVERAGE	100.6	76.7	90.2	99.8	72.1	87.8	99.9	65.4	84.9	99.9	57.1	81.2	99.8	61.2	83.0

DIV. NO.	BUILDING SYSTEMS	ALASKA									ARIZONA					
		ANCHORAGE			FAIRBANKS			JUNEAU			FLAGSTAFF			MESA/TEMPE		
		MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL	MAT.	INST.	TOTAL
A	Substructure	134.0	119.9	125.4	131.6	120.1	124.6	132.2	119.9	124.7	93.4	77.4	83.7	97.7	78.5	85.9
B10	Shell: Superstructure	117.7	109.9	114.7	121.0	110.0	116.7	119.5	109.9	115.7	96.5	73.6	87.5	94.7	74.9	86.9
B20	Exterior Closure	160.5	123.0	142.6	147.6	123.0	135.9	155.2	123.0	139.8	117.4	64.1	91.9	107.2	64.2	86.6
B30	Roofing	160.0	117.2	143.8	167.3	118.5	148.8	168.8	117.2	149.2	96.2	69.2	85.9	101.3	65.7	87.8
C	Interior Construction	133.4	120.9	128.1	130.4	121.3	126.6	131.7	120.9	127.2	102.8	60.4	85.0	98.6	65.4	84.7
D10	Services: Conveying	100.0	112.0	103.3	100.0	112.0	103.3	100.0	112.0	103.3	100.0	85.8	96.1	100.0	86.0	96.1
D20 - 40	Mechanical	100.3	105.0	102.2	100.2	108.0	103.4	100.3	105.0	102.2	100.2	79.0	91.6	100.0	79.0	91.5
D50	Electrical	117.7	117.8	117.7	130.0	117.8	123.5	119.9	117.8	118.8	103.4	61.3	81.1	94.2	61.3	76.8
E	Equipment & Furnishings	100.0	119.0	101.0	100.0	119.0	101.0	100.0	119.0	101.0	100.0	64.1	98.2	100.0	69.0	98.4
G	Site Work	127.9	130.1	129.4	120.7	130.1	127.2	138.4	130.1	132.7	86.5	96.1	93.1	89.5	95.8	93.8
A-G	WEIGHTED AVERAGE	121.1	115.6	118.7	121.0	116.4	119.0	121.3	115.6	118.8	101.3	71.8	88.4	98.6	72.8	87.4

# Cost Models with RSMeans data

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- Owner's own instance of the RSMeans software built around your process, plans, designs, unique costs (additives) and specifications
  - New construction
  - Renovation/FMR
  - Lifecycle costing
- Alternative data access
  - Custom RSMeans data integration using our API



# Cost Model Benefits

## Business Planning

- Accurate, localized cost data to enhance
  - Business case(s)
  - Site selection
  - Budgeting

## Estimating

- Built to owners' specifications
- Saves time/money & reduces the number of staff required to generate estimates
- More accurate estimates up to three years in advance (predictive analytics)

## Design & Construction

- “Manage to the Budget”
- Better visibility to contractor costs
- Enhanced negotiations with contractors
- Reduce cost overruns

## Continuous Improvement

- Real benchmarking
  - Predictive data & analytics to establish costs
  - Reporting to fuel insight into GC and contractor efficiency
  - Metrics & insight into best practices & improvement opportunities



# Online Estimating with RSMeans data


Search Data Manage Estimates Square Foot Estimator Life Cycle Cost Cost Alerts and Trends Reference Items ☆ My Favorites

Creating quick conceptual estimates is easy with RSMeans Online's powerful Square Foot Estimator  
With more than 100 commercial and residential models available, you can develop cost estimates and reports in minutes for virtually any location in the U.S. and Canada

### Square Foot Estimator

Calculate Building Cost Quick View Save Estimate Customize/View Report Clear All Life Cycle Cost Create Alert

Model: Apartment, 1-3 Story with Brick Veneer / Reinforced Concrete

	<b>\$3,348,141.78</b> Building Cost	GREENVILLE, SC Location	3 Stories (Ea.)	No Basement
	\$148.81 Cost per S.F.	22,500 Floor Area	10.00 Story Height	\$0.00 Additive Cost

#### Estimate Header Information

Building Category: Commercial New Construction	Labor Type: Open Shop	Release: Year 2017 Quarter 2	Location: GREENVILLE (296)
*Estimate Name: <input type="text"/>	Client Name: <input type="text"/>	Folder: Personal Folder:Current Estimates	Estimate Address: <input type="text"/>
State/Province: <input type="text"/>	City: <input type="text"/>	Zip/Postal Code: <input type="text"/>	Notes: <input type="text"/> 300 characters max

Forecast Data

# Online Estimating with RSMMeans data

**Life Cycle Cost Estimator** Save Estimate Export

**Cost Details** \* Required Fields

**Sustainment Model**

Source:  Model:  Stories:

\* Year Built:  Gross Square Feet:  Story Height:

\* Start Year:  \* Time Period:  Replacement Value: \$

Calculate Life Cycle Cost

**Assembly Information**

Customized	Quantity	Unit	Line Number	Description	Replacement Cost	Frequency (in years)	Year of Last Major Repair	M&R Task	M&R Task Cost	PM Task	Annual Cost	2017	2018	2019	2020	2021	2022	2023
<b>A10 Foundations</b>																		
	400.0000	L.F.	A10101051560	Foundation wall, CIP, 4' wall height, direct chute, .1...	\$24,921.40													
	400.0000	L.F.	A10101103100	Strip footing, concrete, reinforced, load 14.8 KLF, s...	\$14,831.00													
	24.0000	Ea.	A10102107700	Spread footings, 3000 PSI concrete, load 200K, soi...	\$15,814.44													
	7500.0000	S.F.	A10301202240	Slab on grade, 4" thick, non industrial, reinforced	\$33,159.22													
	502.5000	S.F.		Minor repairs to concrete floor unfinished		15		A10331100010	\$25,853.62									
	75.0000	C.S...		Replace unfinished concrete floor		75		A10331100020	\$50,154.00									
				<b>Total A10</b>	<b>\$88,726.06</b>				<b>\$76,007.62</b>									
<b>A20 Basement Construction</b>																		
	7500.0000	S.F.	A20101104560	Excavate and fill, 10,000 SF, 4' deep, sand, gravel, ...	\$1,649.25													
				<b>Total A20</b>	<b>\$1,649.25</b>													
<b>B10 Superstructure</b>																		
	632.0000	V.L.F.	B10102049913	Cast-in-place concrete column, 12", square, tied, ...	\$32,889.56													
	15000.0000	S.F.	B10102205100	Cast-in-place concrete beam and slab, 7.5" slab, t...	\$215,679.75													
	720.0000	V.L.F.	B10107203750	Fireproofing, gypsum board, fire rated, 3 layer, 1.5...	\$23,509.19													
	7500.0000	S.F.	B10207257000	Roof, concrete, beam and slab, 25'x25' bay, 40 PSF...	\$95,349.38													
				<b>Total B10</b>	<b>\$367,427.88</b>													

Editable columns  M&R costs  Repair costs  Preventive costs

Save Estimate Export

# Online Estimating with RSMeans data

**Life Cycle Cost Estimator** Save Estimate Export

**Summary Table**

**Sustainment Model**

Source:  Model:  Source:

Year Built:  Gross Square Feet:  Story Height:

Start Year:  Time Period:  Replacement Value:

Labor Inflation:  % Replacement Inflation:  % Preventive Sustainment Factor:

M&R Sustainment Factor:  Replacement Sustainment Factor:




Calculate

**Summary Information**

Year	Preventive Cost (Current Year)	M&R Cost (Current Year)	Replacement Cost (Current Year)	Sustainment Cost (Current Year)	Sustainment Ratio (Current Year)	Preventive Cost (Indexed Year)	M&R Cost (Indexed Year)	Replacement Cost (Indexed Year)	Sustainment Cost (Indexed Year)	Sustainment Ratio (Indexed Year)
2016										
2017	\$8,971.47	\$8,575.70		\$17,547.17	0.425%	\$9,285.47	\$8,875.85		\$18,161.32	0.419%
2018	\$8,971.47	\$8,853.54		\$17,825.01	0.432%	\$9,510.46	\$9,484.13		\$19,094.60	0.420%
2019	\$8,971.47	\$8,639.45		\$17,610.92	0.427%	\$9,246.83	\$9,578.71		\$19,525.54	0.409%
2020	\$8,971.47	\$18,953.54		\$27,925.01	0.677%	\$10,294.97	\$21,749.62		\$32,044.59	0.639%
2021	\$8,971.47	\$24,459.88		\$33,431.35	0.810%	\$10,555.29	\$29,050.66		\$39,705.96	0.754%
2022	\$8,971.47	\$8,917.29		\$17,888.76	0.433%	\$11,028.23	\$10,961.63		\$21,989.85	0.398%
2023	\$8,971.47	\$8,705.75		\$17,677.22	0.428%	\$11,414.22	\$11,076.15		\$22,490.36	0.387%
2024	\$8,971.47	\$19,049.16	\$89,031.25	\$117,051.88	2.836%	\$11,813.71	\$25,084.11	\$131,539.70	\$168,437.52	2.763%
2025	\$8,971.47	\$12,684.45		\$21,655.92	0.525%	\$12,227.19	\$17,287.60		\$29,514.80	0.461%

■ M&R costs ■ Repair costs ■ Preventive costs

Save Estimate Export

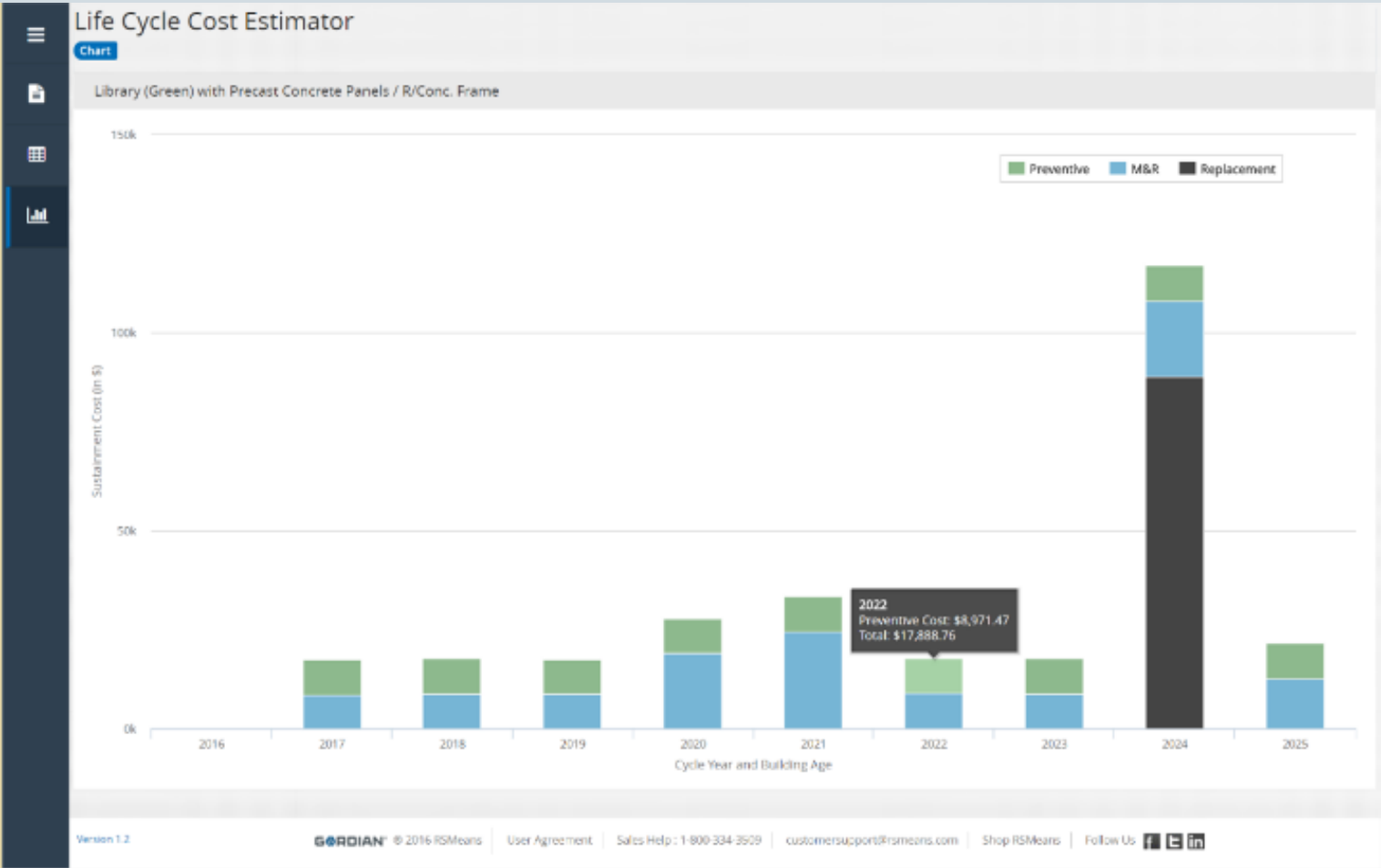
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# Purpose of Facility Condition Index (FCI)

The principal values of an FCI rating include:

- Assisting in **resource allocation** decisions amongst the buildings in a portfolio
- Determining the annual **reinvestment rates** to prevent further accumulation of deferred maintenance
- Calculating **catch-up costs**
- Providing a KPI for **resource allocation** decisions
- Helping track the extent of **condition drift** over time

# Online Estimating with RSMeans data



# What's New in Data?

How many people have heard the latest buzz words “big data”?

## Multivariate Analysis



Risk  
Premiums  
Care  
Diagnosis



Volatility  
Interest  
Creditworthiness

## One-to-One Analysis

- Construction & Facilities
  - Risk
    - Historic Records
    - Tribal Knowledge
  - Budgets
    - Published Data
    - Historic
    - Factors

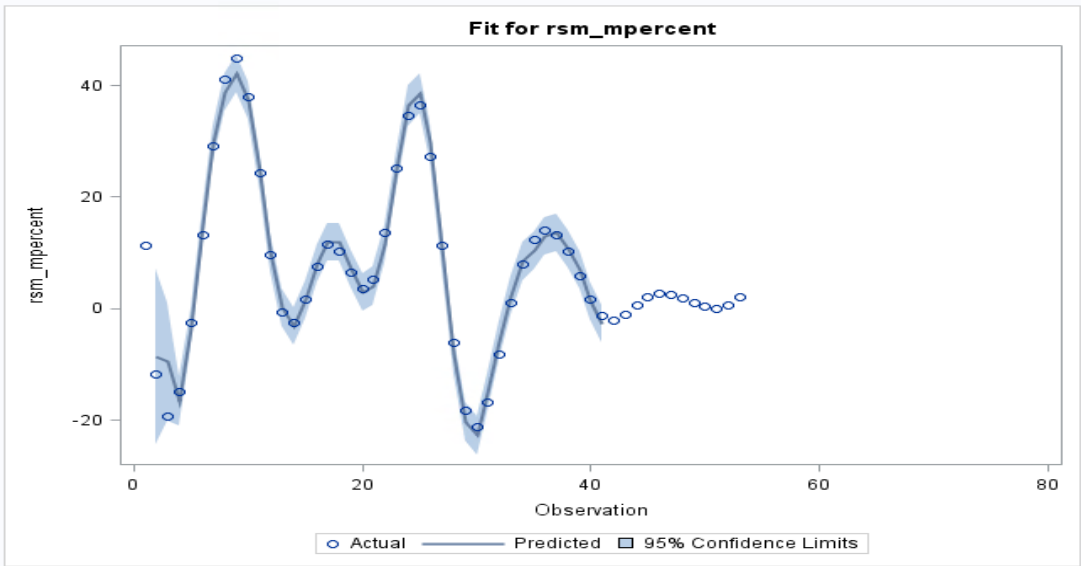
# Predictive Data

How does your planning change with a 3 year window into future costs?

National indexes

Global predictors

Unit level custom algorithms

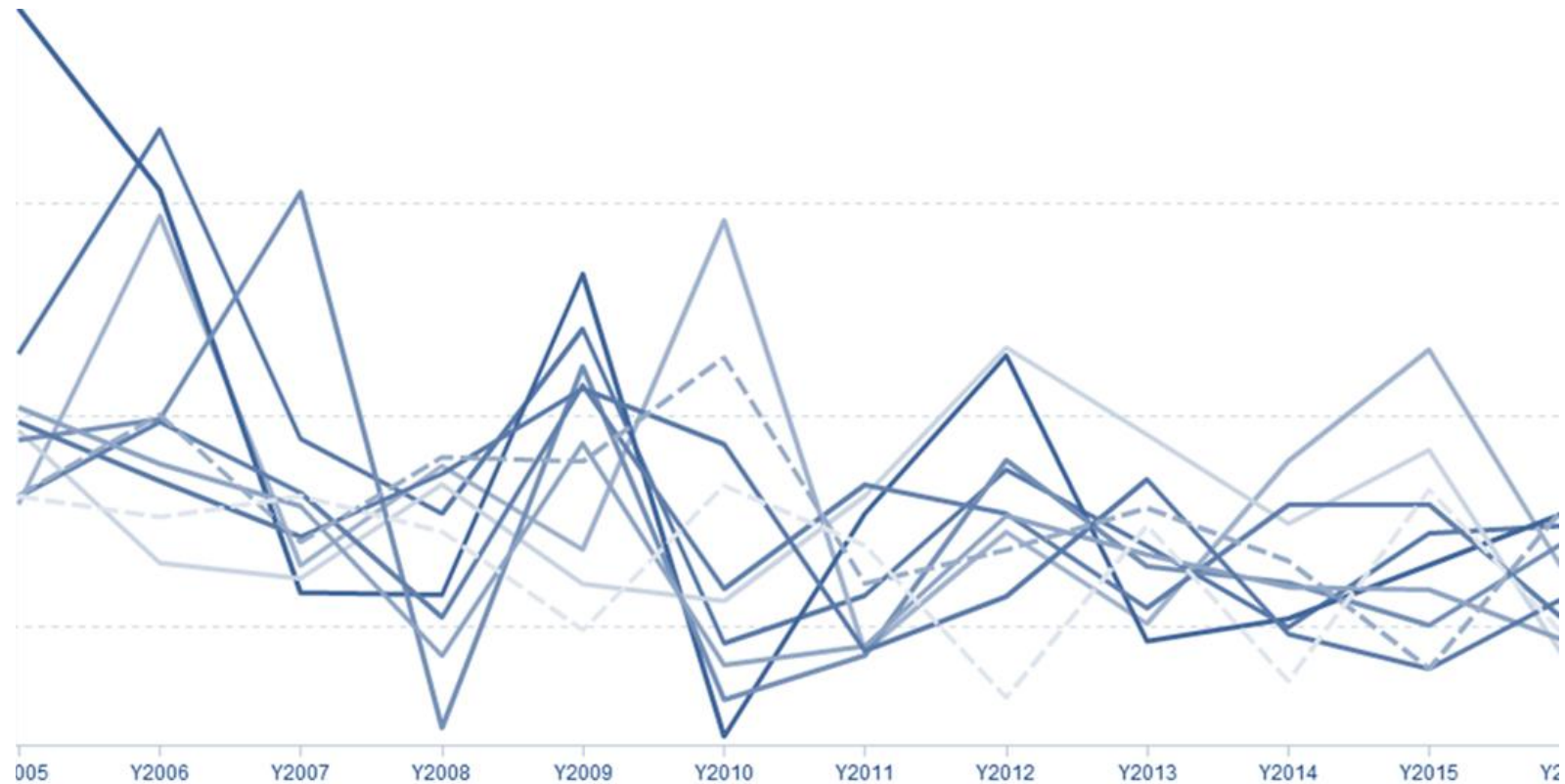


Y Axis is Year-over-Year Percent Change in Price of Material  
X Axis is the Number of Quarters, Starting with 2002Q1

*\*Note the volatility of change*

# Predictive Construction Cost Data: Complex in Application

- Commodity-driven prices are volatile and do not move in tandem
- Labor costs are market-specific and slow to respond to increased demand
- Technology change and site conditions drive productivity
- Construction market is very cyclical





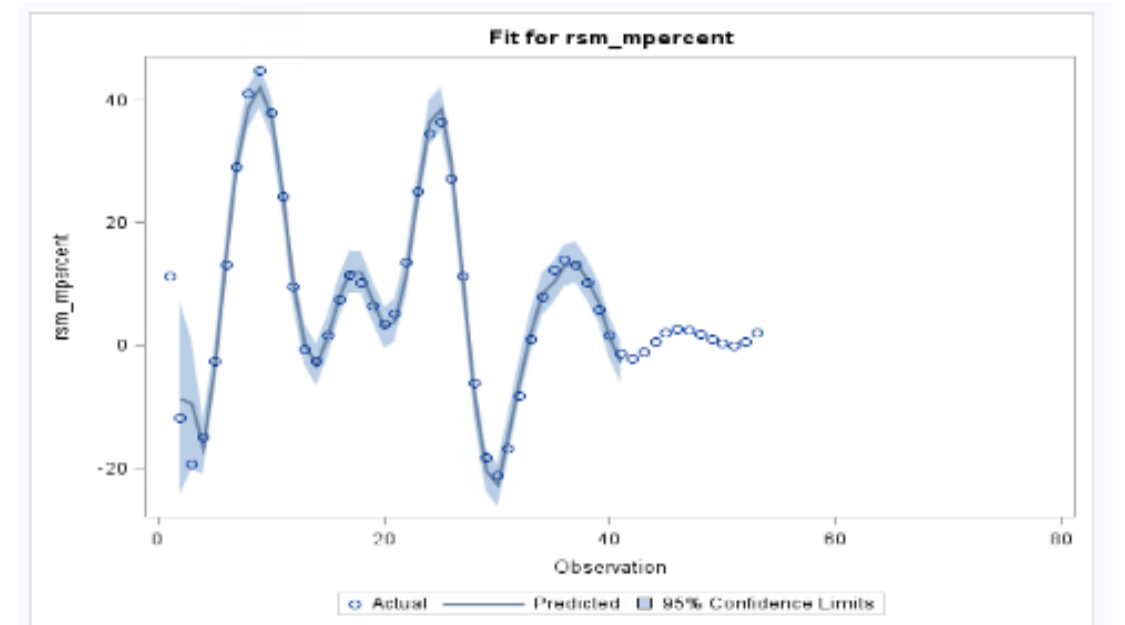
# Applying Predictive Analytics to Traditional Cost Data

## Predictive Cost Model of Specific Material

Supports predictive maintenance

Project maintenance and repair activities

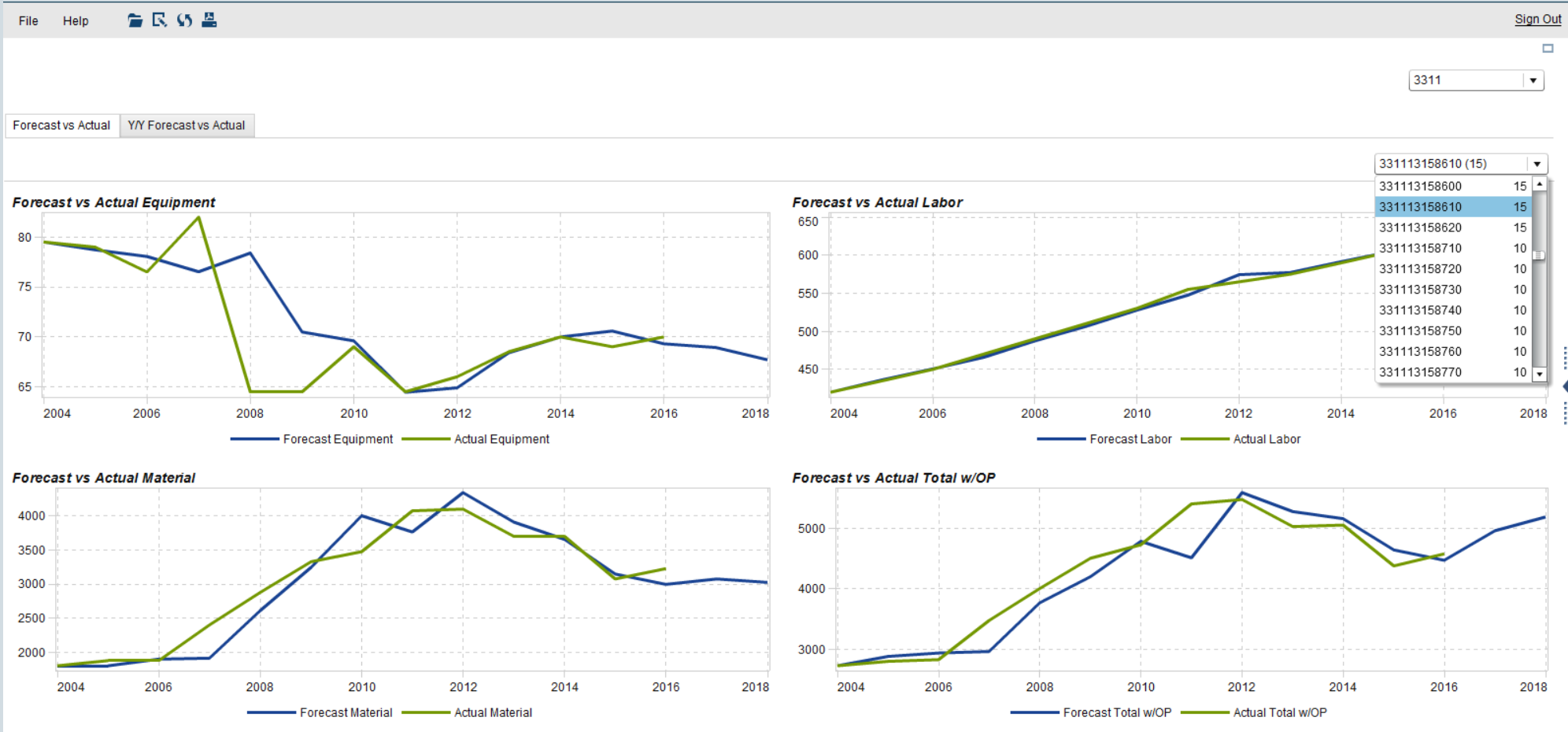
Inform project timing



Y Axis is Year-over-Year Percent Change in Price of Material  
X Axis is the Number of Quarters, Starting with 2002Q1

*\*Note the volatility of change*

# Predictions Applied to 60,000 Unit Line Items



# RSMMeans Predictive Model

- Factors are applied with specific weighting and lead/lag, based on tested algorithms.
- Different predictive models are needed for each material type.

Model Results

year: quarter	rsm_mpercent actual	rsm_mpercent predicted	difference actual - predicted
2008:01:00	36.36	38.54	-2.18
2008:02:00	27.23	29.83	-2.60
2008:03:00	11.21	10.86	0.36
2008:04:00	-6.03	-8.13	2.09
2009:01:00	-18.33	-20.28	1.95
2009:02:00	-21.27	-22.78	1.50
2009:03:00	-16.88	-15.23	-1.65
2009:04:00	-8.32	-5.86	-2.46
2010:01:00	0.94	2.34	-1.40
2010:02:00	7.88	8.48	-0.60
2010:03:00	12.25	10.44	1.82
2010:04:00	14.04	13.04	1.00
2011:01:00	13.23	13.54	-0.31
2011:02:00	10.18	10.69	-0.51
2011:03:00	5.88	6.96	-1.09
2011:04:00	1.57	1.51	0.06
2012:01:00	-1.40	-2.80	1.40

**Predicted market downturn within 2 percentage points 3 years in advance**

2009:01:00 -20.28  
2009:02:00 -22.78  
2009:03:00 -15.23

**Also predicted market recovery within 2 percentage points 3 years in advance**

# Improved Decision Making



**Establish and communicate benchmarks to align the team to the budget**



**Improve visibility to future cost impacts on projects**



**Build defensible budgets**

# Summary

- Estimating/costing through a facilities life cycle
- Use verifiable, defensible cost data when requesting funding
- Utilize appropriate facility management software and cost data
- Be prepared for changing priorities
- Forecast with reliable analytic data



**Thank You!**

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