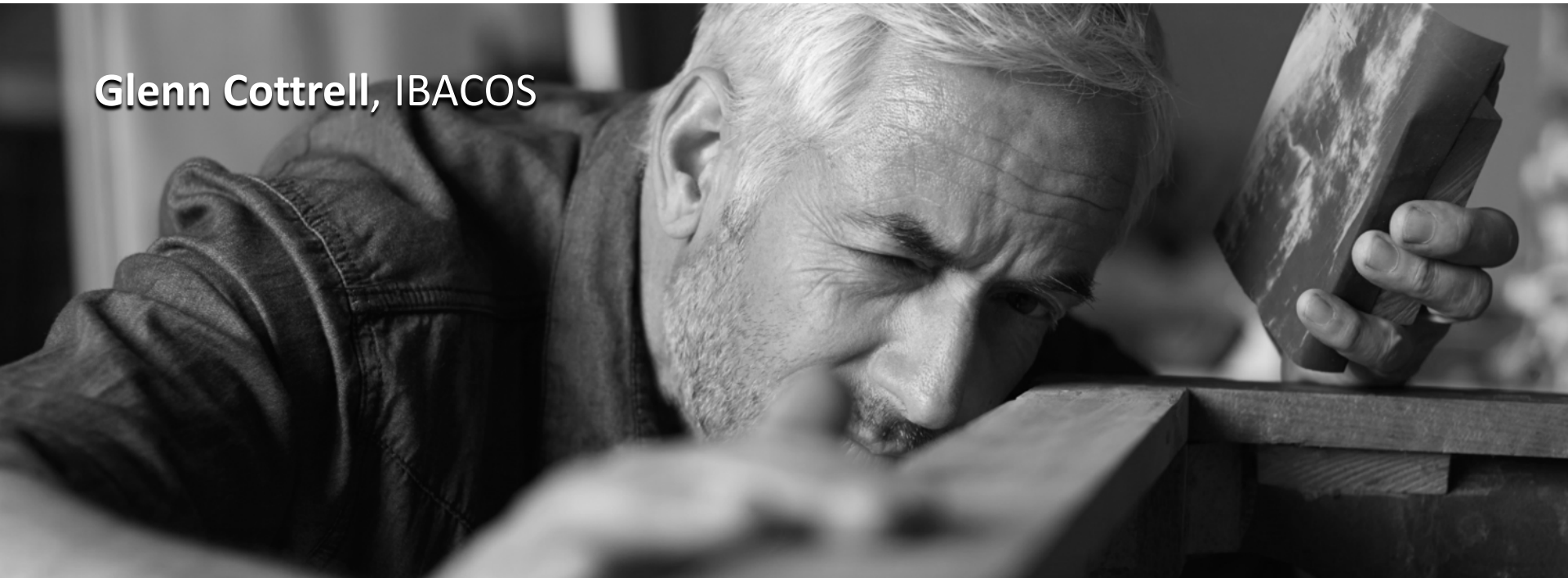


Understanding the Cost of Quality

Glenn Cottrell, IBACOS



What defines Quality?



Quality Spend



Cost of Quality: Defined



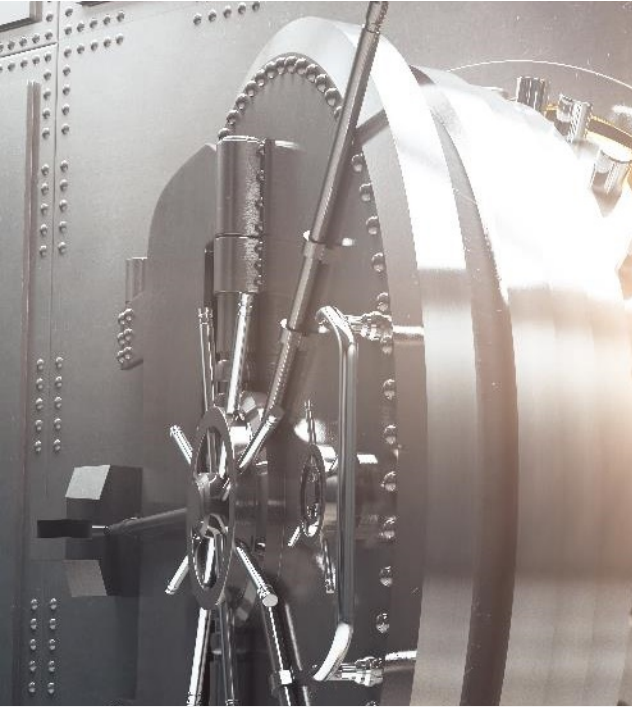
ASQ

AMERICAN SOCIETY
FOR QUALITY™

A methodology that allows an organization to determine the extent to which its resources are used for activities that prevent poor quality, that appraise the quality of the organization's products or services, and that result from internal and external failures.

What dollars are spent and why?


Failure Costs?



Insight: *What are you setting aside in accruals?*

New Homes & Building Materials Warranty Report,
Warranty Week

- 2007-2013 trend of new homebuilder accruals at 1.1% of sales (May 8, 2014)

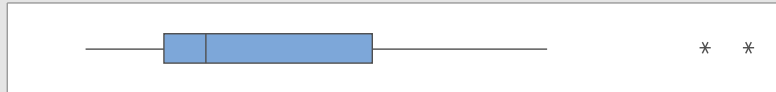
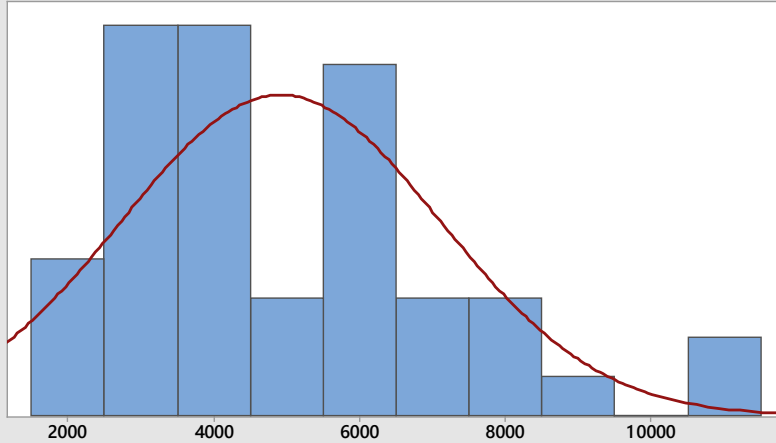
Theresa Weston 

- Mean accrual per unit study across 13 public builders (2012-2016 data)

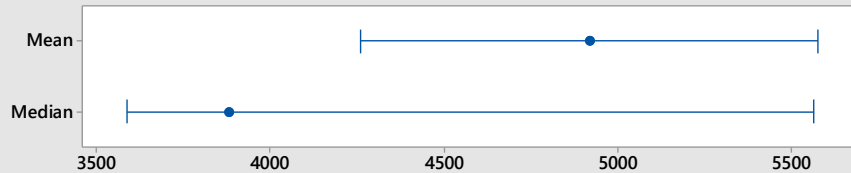
Warranty Accruals

- Costs are accrued based upon historical experience
- Factors that affect the Company's warranty liability include
 - the number of homes sold,
 - historical and anticipated rates of warranty claims, and
 - cost per claim

Summary Report for Warranty Accruals/Closings



95% Confidence Intervals



Anderson-Darling Normality Test

A-Squared 1.37
P-Value <0.005

Mean 4919.3
StDev 2187.6
Variance 4785574.1
Skewness 1.08786
Kurtosis 0.94721
N 45

Minimum 2237.5
1st Quartile 3321.5
Median 3883.6
3rd Quartile 6181.9
Maximum 11325.6

95% Confidence Interval for Mean

4262.0 5576.5

95% Confidence Interval for Median

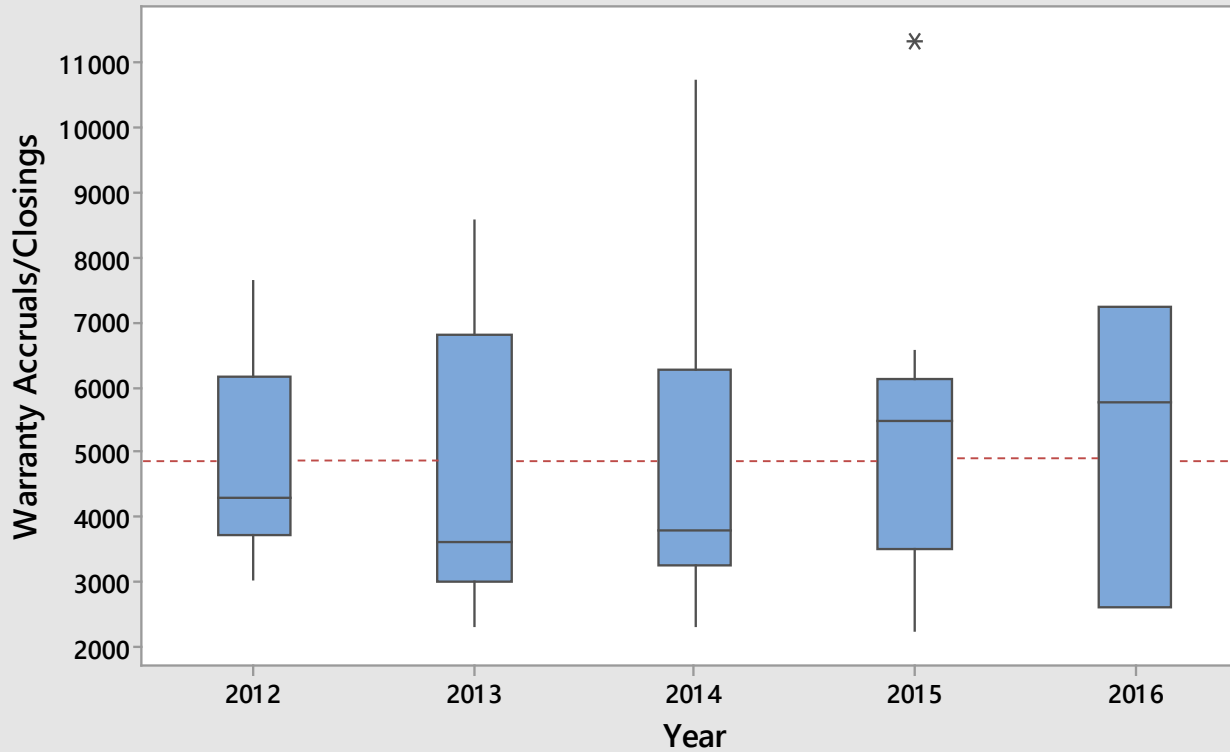
3588.1 5563.9

95% Confidence Interval for StDev

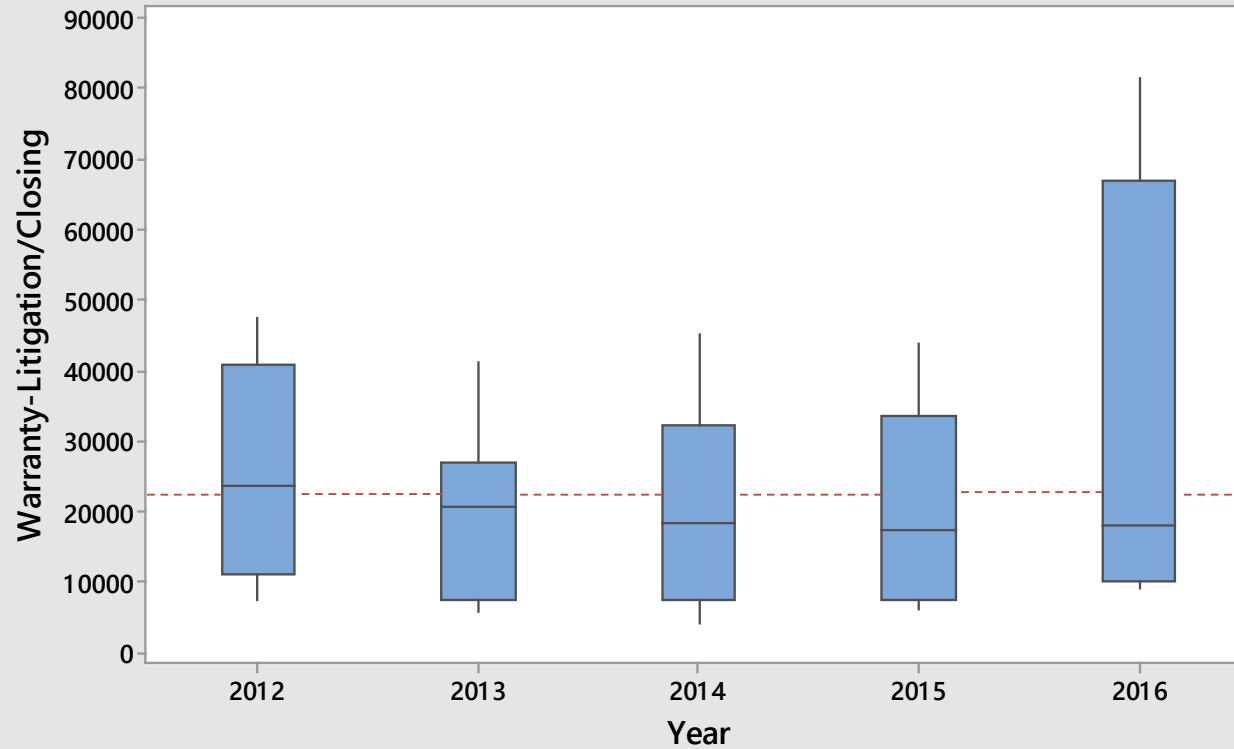
1811.0 2763.4



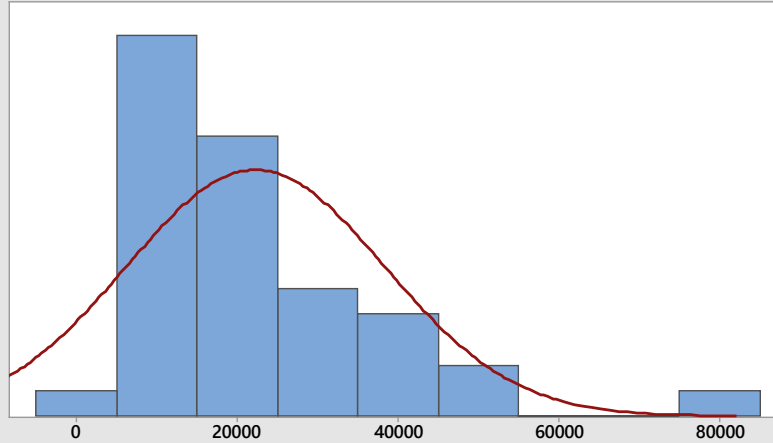
Boxplot of Warranty Accruals/Closings



Boxplot of Warranty-Litigation/Closing



Summary Report for Warranty-Litigation/Closing



Anderson-Darling Normality Test

A-Squared 1.19
P-Value <0.005

Mean 22278
StDev 16061
Variance 257965410
Skewness 1.51068
Kurtosis 3.41148
N 39

Minimum 4071
1st Quartile 8042
Median 18684
3rd Quartile 31769
Maximum 81571

95% Confidence Interval for Mean

17071 27484

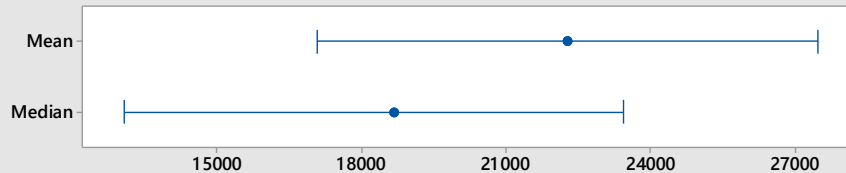
95% Confidence Interval for Median

13072 23456

95% Confidence Interval for StDev

13126 20699

95% Confidence Intervals



Understanding the Cost of Quality



Cost of Quality: Failure Spends

Cost-overruns

Rework

Delays

Turnover

Dissatisfaction

Warranty

Fines

Waste

Litigation

Cost of Quality: Prevention Spends

Compensation

Recognition

Contracting

Specification

Documentation

Training

Engagement

Value Engineering

Expectations

Cost of Quality: Appraisal Spend

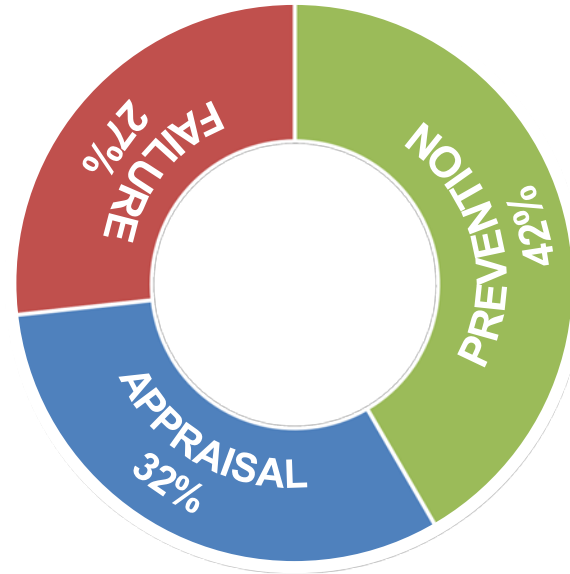


Audits
Commissioning
Inspections
Supervision
Surveying
Testing



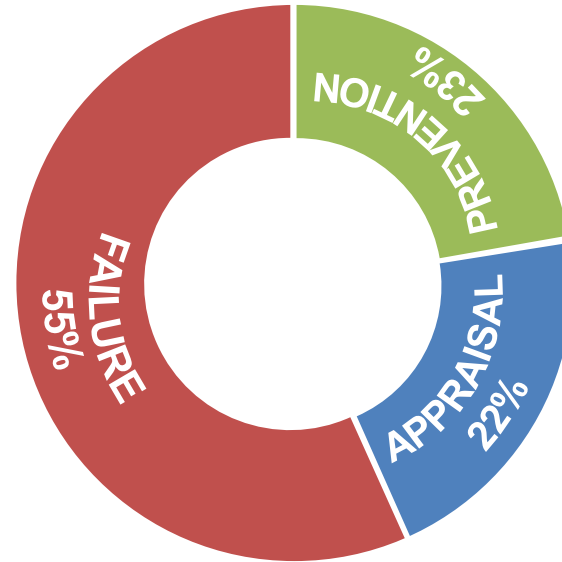
Cost of Quality: IBACOS Survey

**PAF PROFILE:
HOMEBUILDER
PERCEPTION**



Cost of Quality: Pheng & Ke-Wei Study

PAF PROFILE: CONSTRUCTION INDUSTRY



*Pheng, L.S & Ke-Wei, P (1996)
A Framework for Implementing TQM
in Construction, The TQM Magazine,
Vol 8 No 5, pp 39-46*

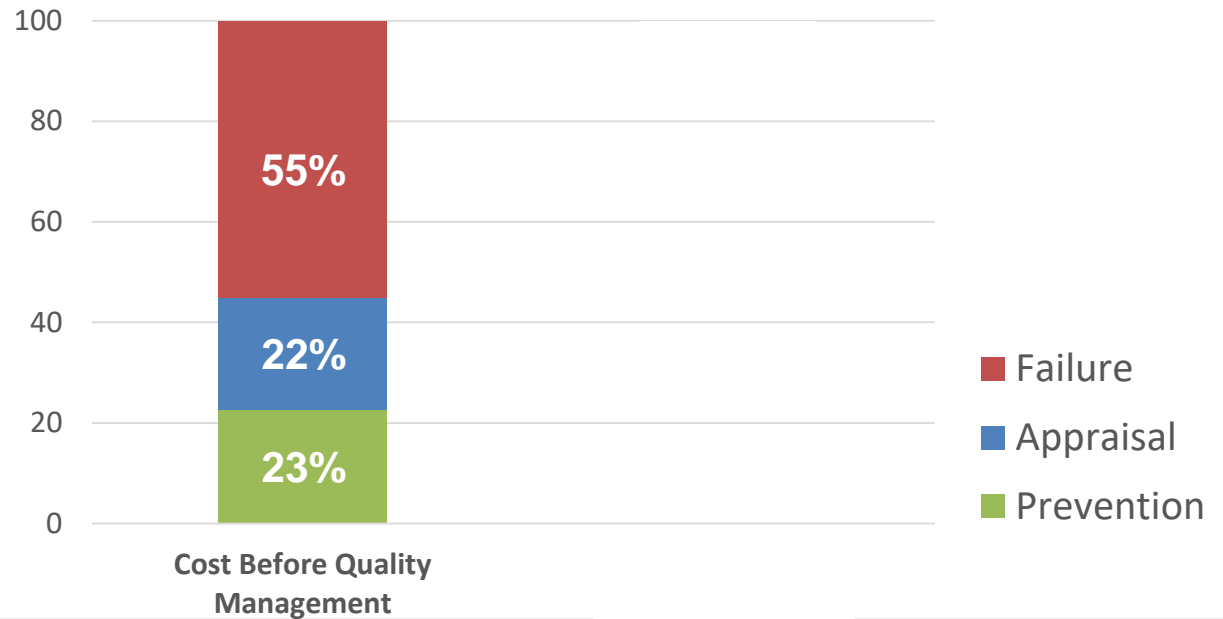
The Shift



Cost of Quality: Pheng & Ke-Wei Study

PAF PROFILE: CONSTRUCTION INDUSTRY

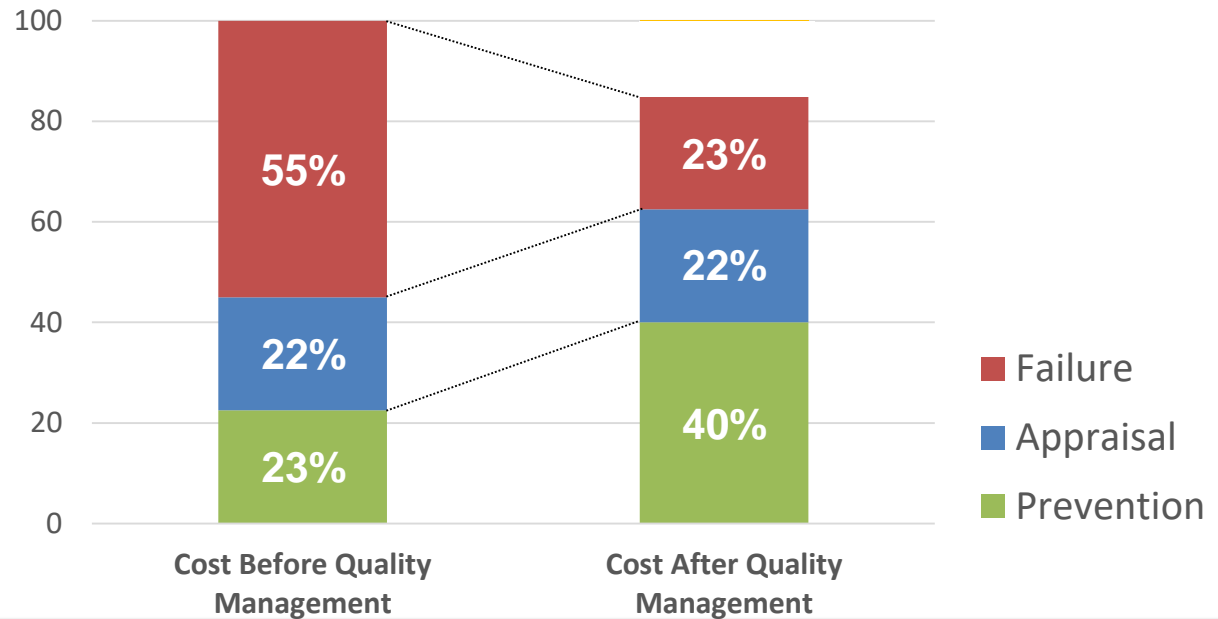
*Pheng, L.S & Ke-Wei, P (1996)
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Vol 8 No 5, pp 39-46*



Cost of Quality: Pheng & Ke-Wei Study

PAF PROFILE: CONSTRUCTION INDUSTRY

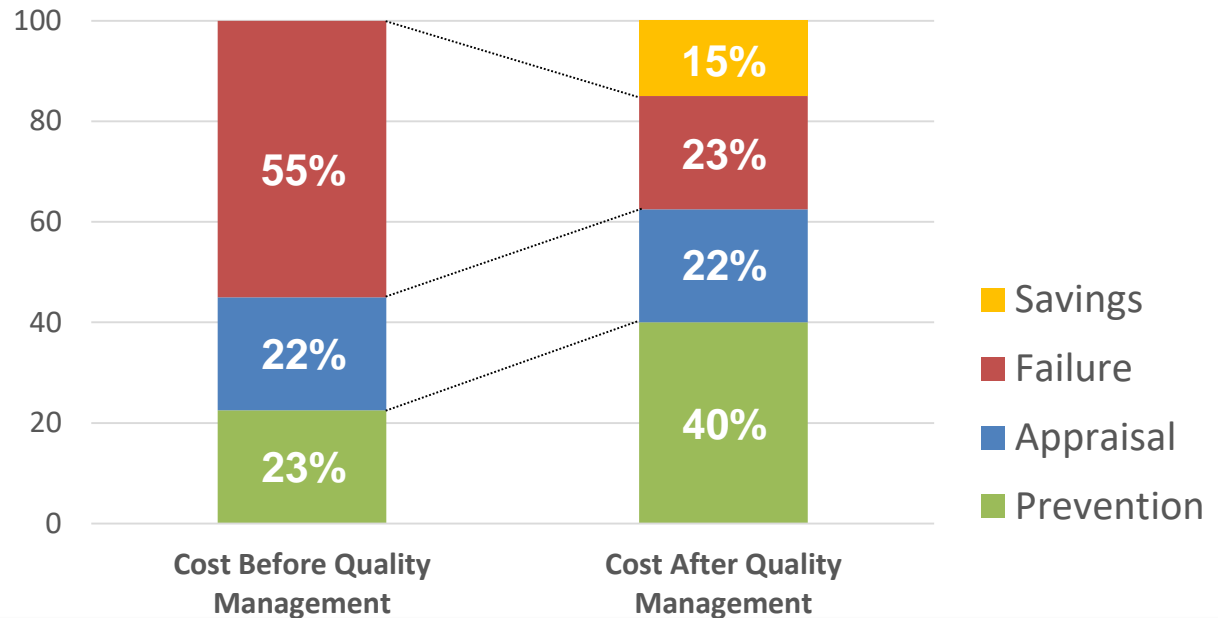
Pheng, L.S & Ke-Wei, P (1996)
*A Framework for Implementing TQM
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Cost of Quality: Pheng & Ke-Wei Study

PAF PROFILE: CONSTRUCTION INDUSTRY

Pheng, L.S & Ke-Wei, P (1996)
A Framework for Implementing TQM
in Construction, *The TQM Magazine*,
Vol 8 No 5, pp 39-46



Mmmmmm... Bacon!



Rol: Benchmark Study

PARTICIPANTS

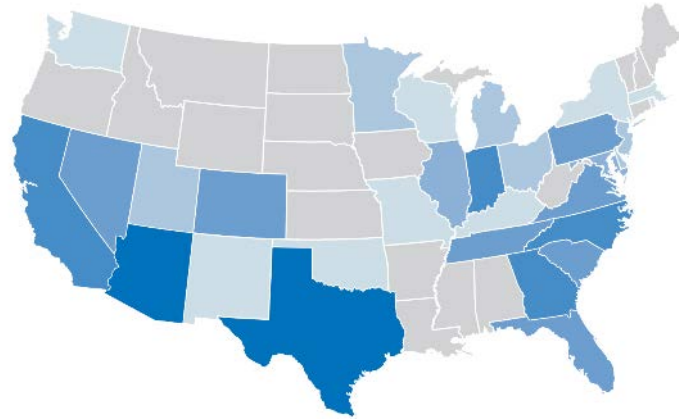
21 Completed surveys

Single-family builders (Primary business)

Diverse range in volume

- 4 @ less than 200 homes
- 6 @ 200 – 500 homes
- 6 @ 501 – 1000 homes
- 1 @ 1001 – 5000 homes
- 4 @ More than 5000 homes

9.6% of U.S. closings



Rol: Benchmark Study

DATA POINTS

- % Revenue on construction
- \$ Superintendent compensation
- # of Homes carried
- % Turnover of construction staff
- # Days in cycle time (target and actual)
- # of Wasted days in cycle
- % Construction cost overruns
- # Dumpsters for construction waste
- \$ Dumpster haul fees
- # Warranty claims
- \$ Spent on warranty

Rol: Benchmark Study

“BENCHMARK” BUILDER

	Low	High	Avg.
• # Homes Carried	5	45	15.1
• Turnover (construction)	<5%	>20%	10.5%
• Target Cycle Time (days)	55	135	89.5
• Actual Cycle Time (days)	55	152	101
• Wasted Days	<1	>5	2.9
• Warranty Items	<2	>10	5.1



Rol: Benchmark Study

METRICS

Cost Variance

Construction Oversight

Customer Delight

Cycle Time

Documentation

Employee Engagement

Execution

Incentives

Jobsite Waste

Training

Value Engineering

Warranty

Rol: Benchmark Study

METRICS

Cost Variance

Construction Oversight

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Jobsite Waste

Training

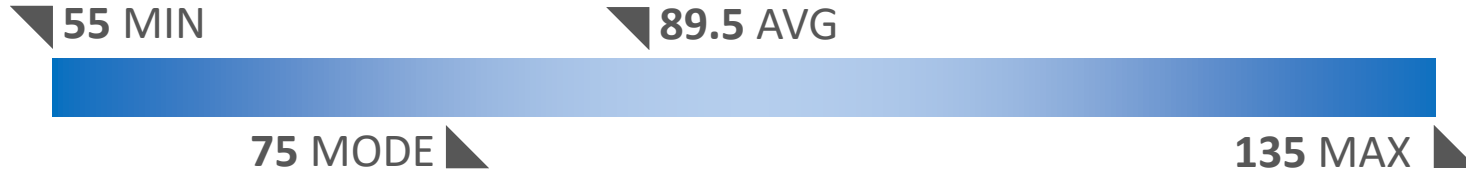
Value Engineering

Warranty

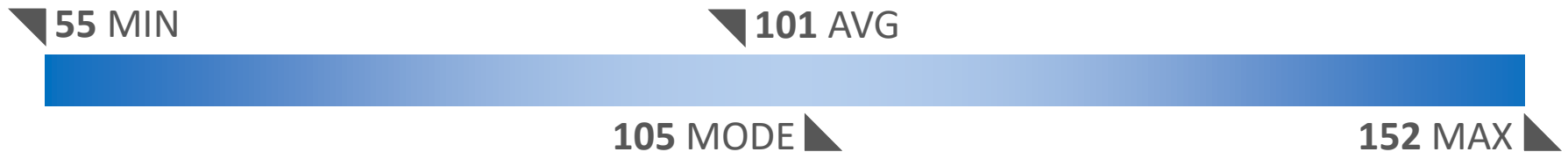
Rol: Cycle Time

SURVEY RESULTS

What is your target cycle time per home in working days?



What is your actual cycle time per home in working days?



Rol: Cycle Time

EXPERT INTERVIEWS +

Eric Timmis, TrueNorth Development

- 1 day saved in construction = \$500+ thru effective use of overhead (resources)

George Casey, Stockbridge Associates

- 5% reduction in build cycle =
 - \$250 savings thru effective use of working capital (less \$ tied up in WIP), OR
 - \$950 added margin thru increased volume using same working capital constraints

Division Purchasing Lead, Top 20 Builder

- Easily several hundred \$ savings from trades efficiency

Rol: Cycle Time

OPPORTUNITY

ASSUMPTIONS

- 101 day build cycle
- 2% cycle time reduction by eliminating dry runs, appropriate crew sizes, etc.

Rol: Cycle Time

OPPORTUNITY = \$1,680 Savings per home

(# of days in actual build cycle) x (fully loaded carry costs / day) x
(% possible reduction) = **\$ Savings per home**

PLUS

(# of additional homes delivered using same working capital) x
(\$s added margin per home) ÷ (total # of homes delivered annually) =
\$ Savings per home



Rol: Cost Variance

SURVEY RESULTS

What is the amount spent per home on cost over construction budget?



What is your cost variance as a % of hard construction costs ?



Rol: Cost Variance

EXPERT INTERVIEWS +

Noelle Tarabulski, Builder Consulting Group

- Implementing Variance Purchase Orders (VPOs) can reduce hard construction costs:
 - 1% immediately (just because you're asking why)
 - 3-4% overtime (identifying and addressing waste)

ARC Document Solutions

- 1/3rd of construction cost overruns due to poor documentation / document control (Research study results; published February 11, 2015)

Rol: Cost Variance

OPPORTUNITY

ASSUMPTIONS

- Hard cost overruns per unit = \$1,800
- Reduce overall hard cost by 0.5% through VPOs
- Reduce cost overruns by 20% through improved documentation/ document management

Rol: Cost Variance

OPPORTUNITY = \$1,300 Savings per home

(\$s average selling price) x (% spent on hard construction costs) x
(% possible reduction) = **\$ Savings per home**

PLUS

(\$s spent on cost overruns per unit) x (% possible reduction) =
\$ Savings per home

\$2,980



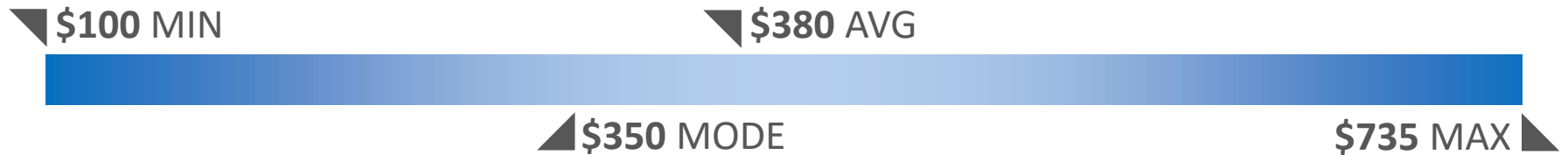
Rol: Jobsite Waste

SURVEY RESULTS

How many dumpsters are used during construction of a single home?



What is the “haul fee” per dumpster?



Rol: Jobsite Waste

EXPERT INTERVIEWS +

NAHB

- Average # of dumpsters = 3+ per unit
- Average waste removal costs = \$1,200 per unit

Scott Sedam, TrueNorth Development

- Job-site waste = \$300-\$500 usable material per dumpster

Rol: Jobsite Waste

OPPORTUNITY

ASSUMPTIONS

- 33% jobsite waste reduction thru:
 - Upfront design
 - Accurate take-offs / Trade partnering

Rol: Jobsite Waste

OPPORTUNITY = \$590 Savings per home

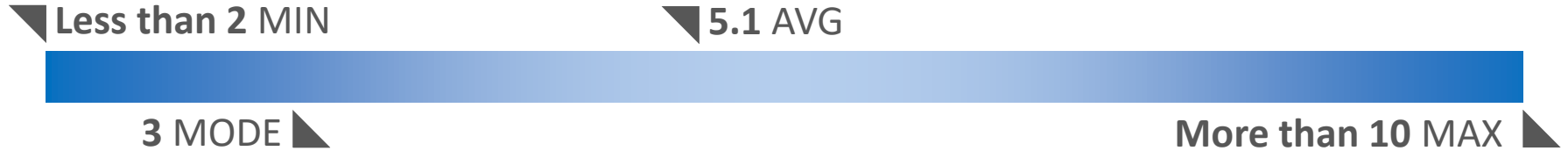
(# of dumpsters per home) x [(\$ haul fee per dumpster) +
(\$s of usable materials thrown away per dumpster)] x
(% possible reduction) = **\$ Savings per home**



Rol: Customer Delight

SURVEY RESULTS

How many legitimate service/ warranty items are reported per home following closing?



Rol: Customer Delight

EXPERT INTERVIEWS +

Paul Cardis, Avid Ratings

- Every 1 (%) point decrease in customer satisfaction results in an average 8% increase in customer service requests the following year
- Average # of service requests per home = 15
- Product Satisfaction is the strongest predictor of customer referrals

President, NHQ Gold Award Winner

- Responding to a single service requests costs \$250

Rol: Customer Delight

EXPERT INTERVIEWS + (cont.)

JD Power and Associates (2006)

- A 1 (%) point increase in customer satisfaction levels can yield 0.17 additional recommendations per homebuyer
- 20% of overall customer satisfaction is driven by the builders' warranty / customer service => Their experience living in their new home

Rol: Customer Delight

OPPORTUNITY

ASSUMPTIONS

- 1 (%) point increase in overall customer satisfaction resulting in:
 - 8% fewer service requests
 - 0.17 extra recommendations per buyer
- 5% conversation of additional recommendations to sales

Rol: Customer Delight

OPPORTUNITY = \$360 Savings per home

(# warranty items per home) x (\$s to respond to each item) x
(% possible reduction) = **\$ Savings per home**

PLUS

(overall customer satisfaction %) x (% possible improvement) x
(# added recommendations per customer) x (# of customers) x
(% conversion rate) = (# added sales)...
(# added sales) x (\$s profit per sale) ÷
(total # of homes delivered annually) = **\$ Savings per home**



Rol: Opportunity?

Cycle Time	\$1,680	Construction Oversight	\$ 635
Cost Variance	\$1,300	Documentation	\$ 600
Warranty	\$1,090	Jobsite Waste	\$ 590
Value Engineering	\$ 940	Execution	\$ 565
Incentives	\$ 760	Employee Engagement	\$ 435
Training	\$ 725	Customer Delight	\$ 360

\$10,000 per home opportunity

Thank You

Glenn Cottrell, IBACOS

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