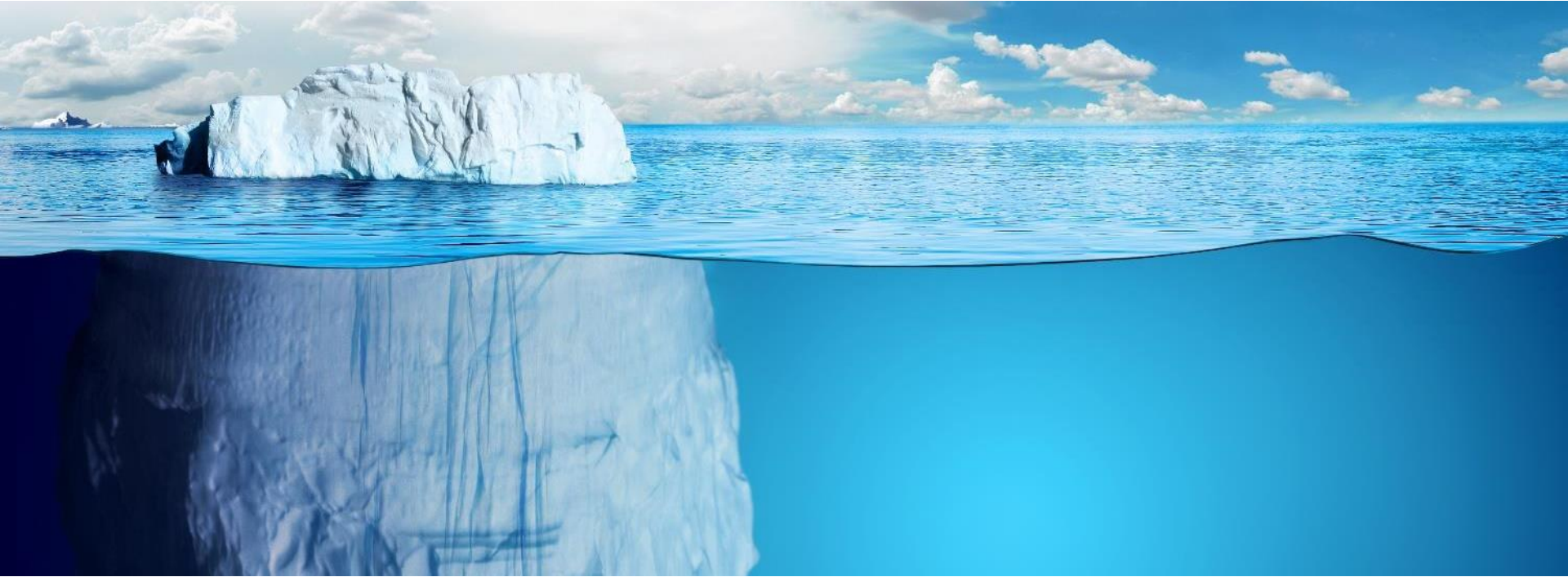


Cost of Quality

Theresa Weston, DuPont Protective Solutions
Glenn Cottrell, IBACOS



Total Cost of Ownership



TCO: Consumer Electronics

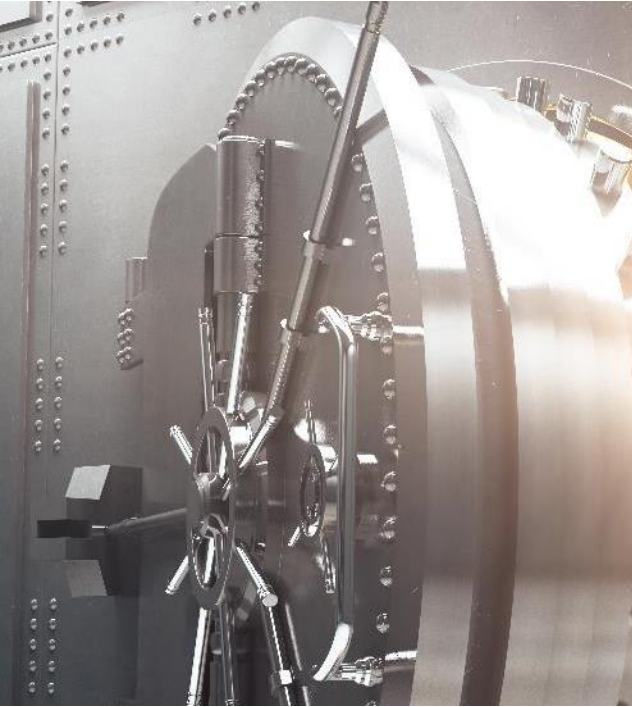
SAMSUNG GALAXY NOTE 7



TCO: Homebuilding




TCO for Your Company?



Answer: What are you setting aside in reserves?

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 

- \$6,600 (average) accrual per unit
- \$3,100-\$15,100 accrual per unit across 13 public builders (2009-2011 data)

WALL SYSTEM COST COMPARISONS						
Project	Wall Area (sq. ft.)	Cost to Rebuild (sq. ft.)	Cost Original (sq. ft.)	Cost Correctly (sq. ft.)	Storeys	Cladding/Framing
Project A	14,000	\$51.70	\$22.50	\$25.85	8	Concrete
Project B	28,300	\$25.72	\$13.25	\$15.50	14	Stucco/Concrete
Project C	10,000	\$26.80	\$9.30	\$11.25	3	Stucco/Wood

Source: Retro Construction Group

Reference: Barrett Report, Vancouver, BC, Canada

Lean Manufacturing

- Waste is
 - any activity that adds costs or time but does not add value
 - consuming more resources (time, money, space, etc.) than are necessary to produce the goods or services that the customer wants
- Pure Waste: Actions that could be stopped without effecting the customer
- Incidental Waste: Actions that need to be done based on how the current system operates but do not add value.

“Homebuilding is subject to home warranty and construction defect claims in the ordinary course of business that can be significant.”

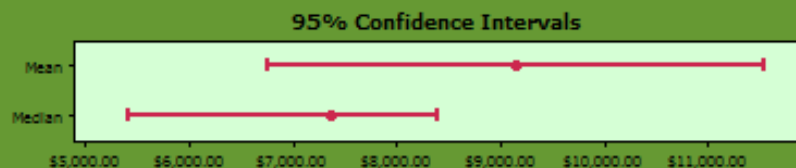
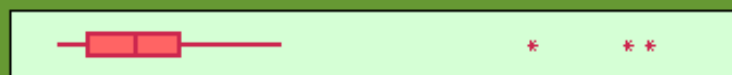
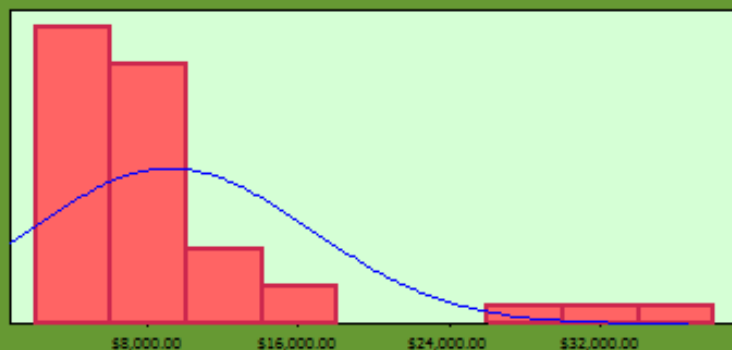
Warranty Accruals

- 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

Annual Report Survey

- 13 Builder Companies
- 3 years (2009, 2010, 2011)
- Normalized to homes closed

Summary for Accruals/Closing



Anderson-Darling Normality Test

A-Squared	4.28
P-Value <	0.005

Mean	9136.1
StDev	7409.5
Variance	54901236.6
Skewness	2.50291
Kurtosis	6.14474
N	39

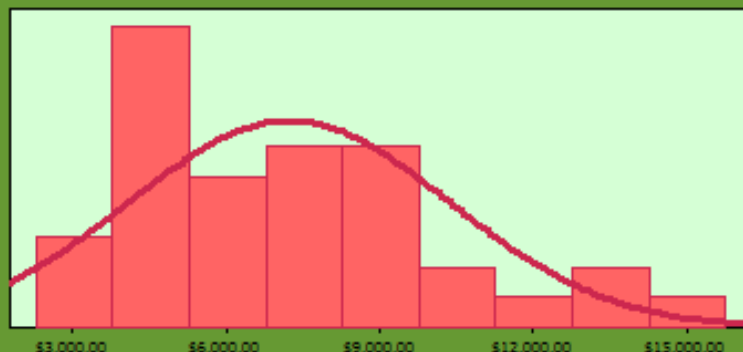
Minimum	3160.6
1st Quartile	4863.0
Median	7352.9
3rd Quartile	9719.6
Maximum	34593.2

95% Confidence Interval for Mean	
6734.2	11538.0

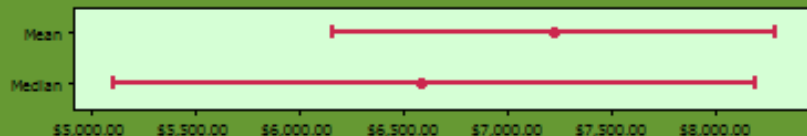
95% Confidence Interval for Median	
5412.4	8375.3

95% Confidence Interval for StDev	
6055.4	9549.2

Summary for Accrual/Closing



95% Confidence Intervals



Anderson-Darling Normality Test

A-Squared	0.85
P-Value	0.026

Mean	7218.7
StDev	3132.8
Variance	9814741.8
Skewness	0.887203
Kurtosis	0.212109
N	36

Minimum	3160.6
1st Quartile	4711.9
Median	6580.6
3rd Quartile	8721.6
Maximum	15095.6

95% Confidence Interval for Mean
6158.7 8278.7

95% Confidence Interval for Median
5104.6 8179.3

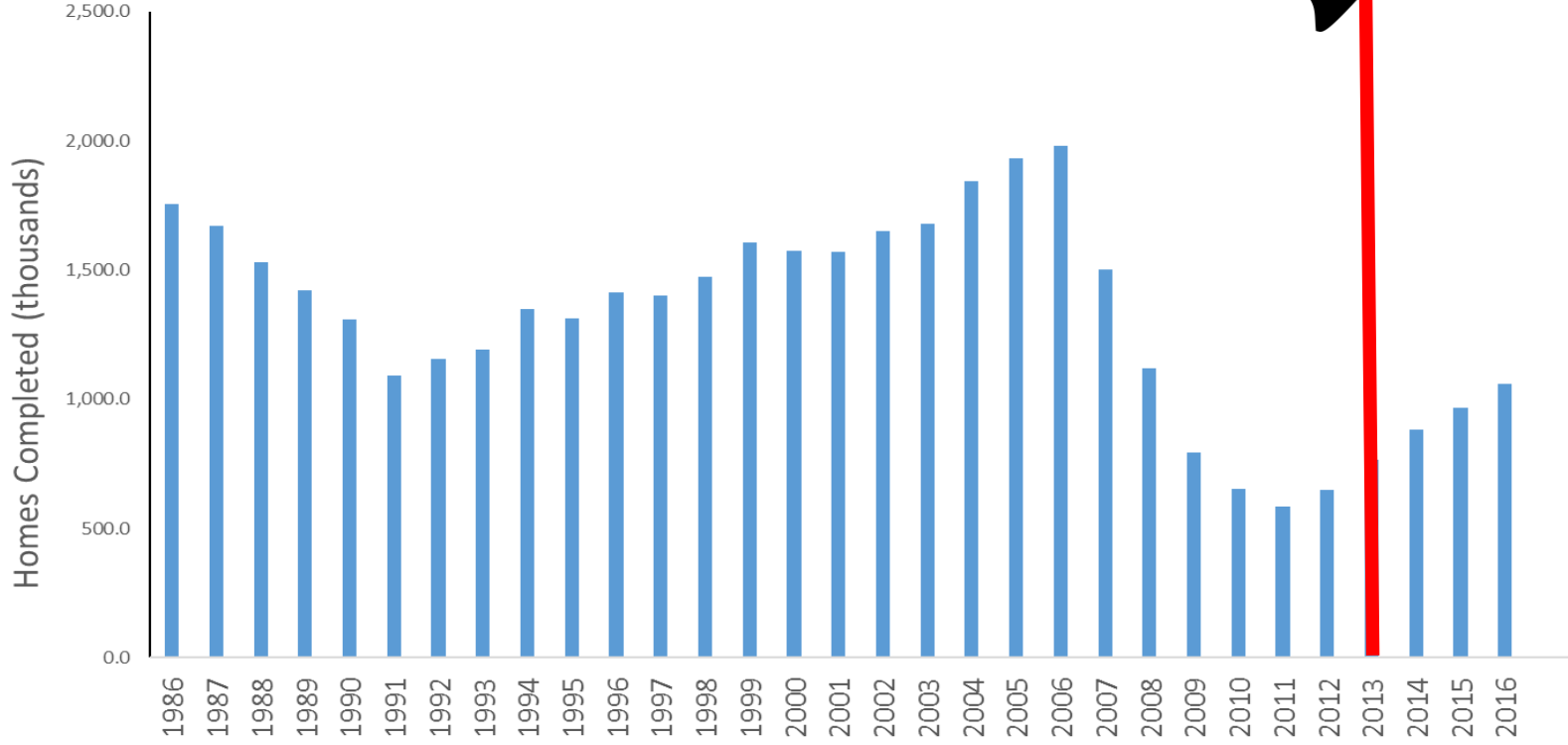
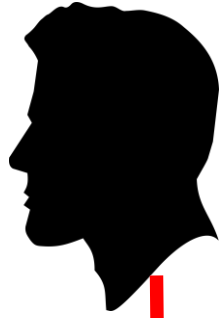
95% Confidence Interval for StDev
2541.0 4086.6

Project: WARRANTY NATIONAL BUILDER.MPJ; Worksheet: Subset of Worksheet 1 Remove outlier;

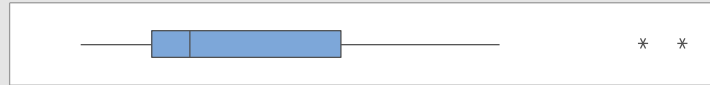
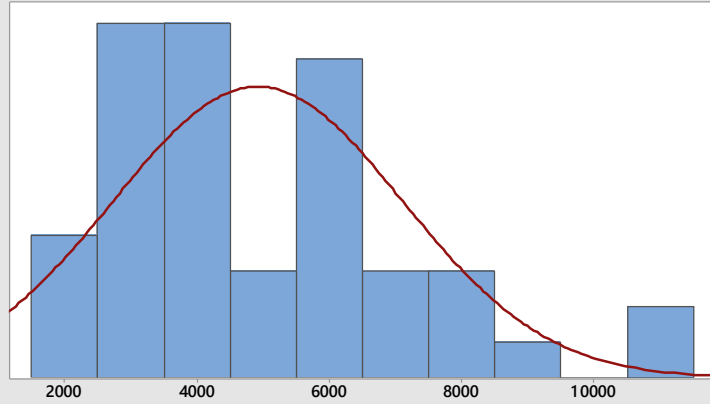
Accrual / Closing by Year



Project: WARRANTY NATIONAL BUILDER.MPJ; Worksheet: Subset of Worksheet 1 Remove outlier;



Summary Report for Warranty Accruals/Closings



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

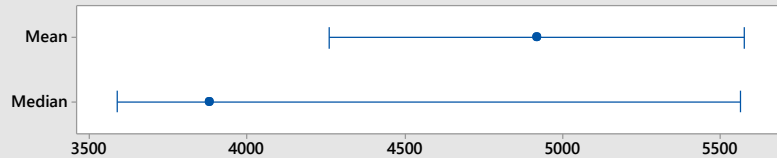
Minimum	2237.5
1st Quartile	3321.5
Median	3883.6
3rd Quartile	6181.9
Maximum	11325.6

95% Confidence Interval for Mean	4262.0	5576.5
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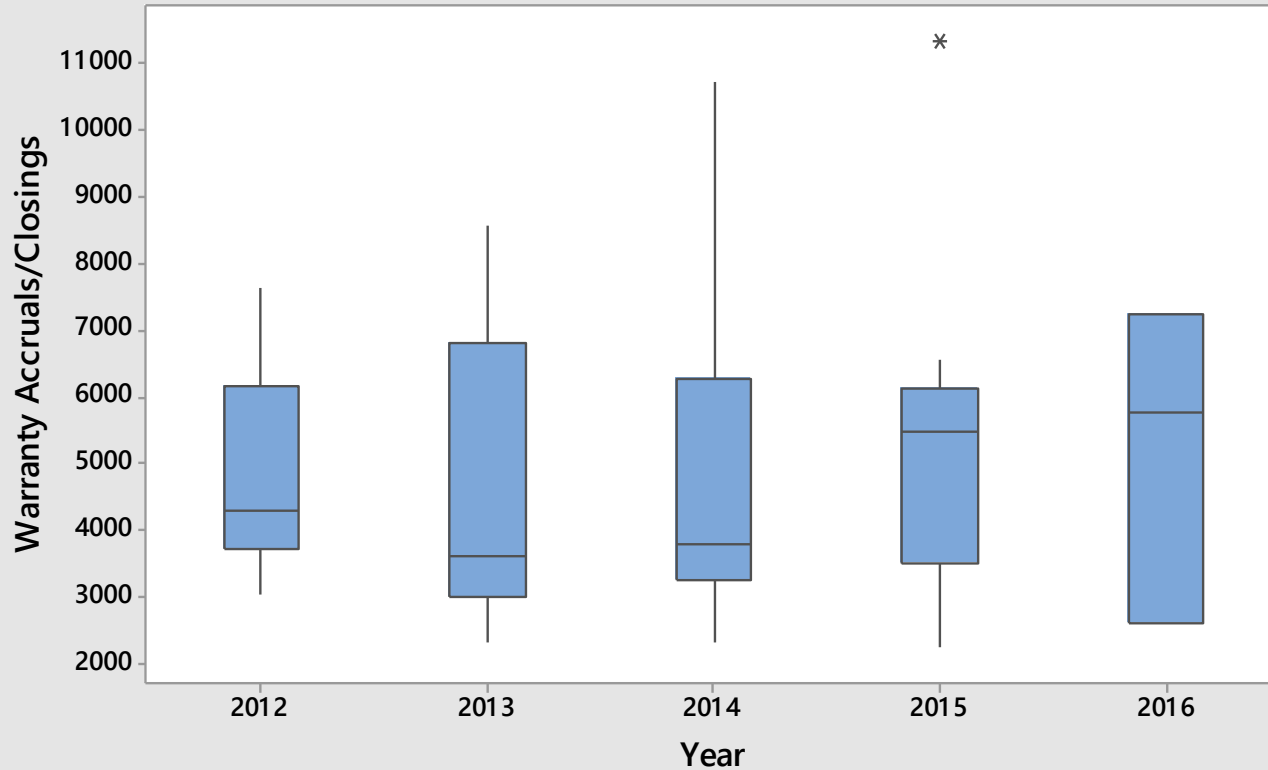
95% Confidence Interval for Median	3588.1	5563.9
------------------------------------	--------	--------

95% Confidence Interval for StDev	1811.0	2763.4
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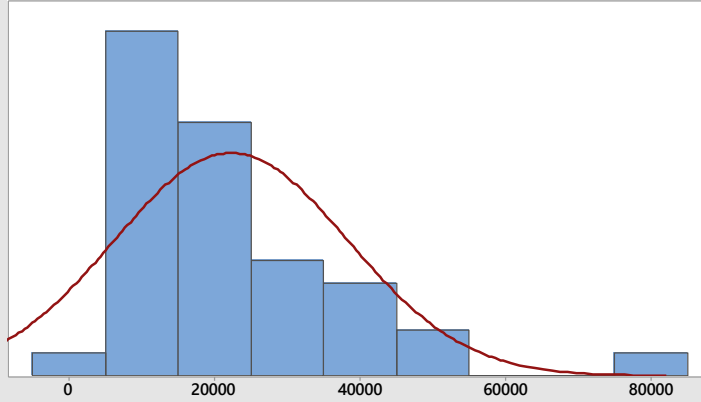
95% Confidence Intervals



Boxplot of Warranty Accruals/Closings



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

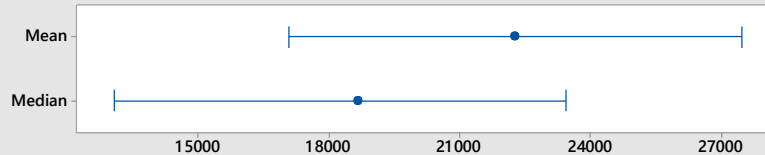
95% Confidence Interval for Median

13072 23456

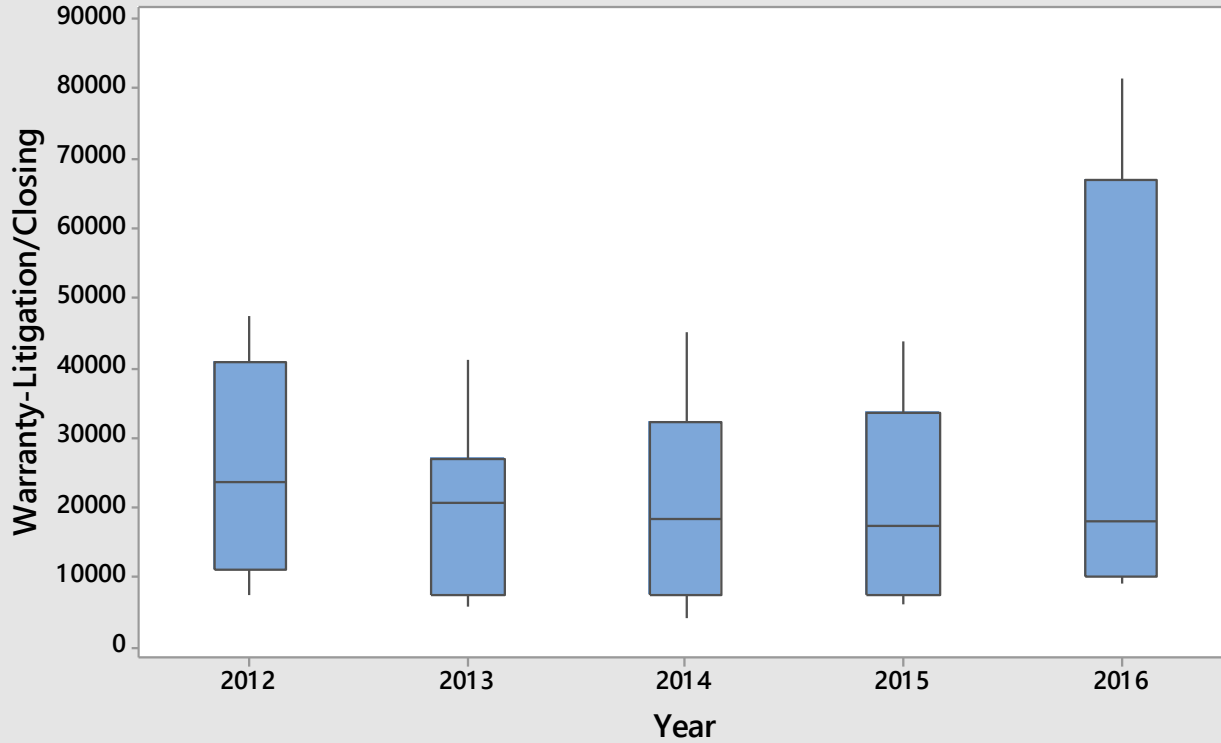
95% Confidence Interval for StDev

13126 20699

95% Confidence Intervals



Boxplot of Warranty-Litigation/Closing





Margins



Warranty + Litigation Accruals (per Closing) = \$22,000

Average Sales Price (ASP) = \$424K

5% Margin Points set aside to pay back

Cost of Quality: Quality Spending



Cost of Quality: Opportunity



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?

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: Failure Spends

Cost-overruns

Rework

Delays

Turnover

Dissatisfaction

Warranty

Fines

Waste

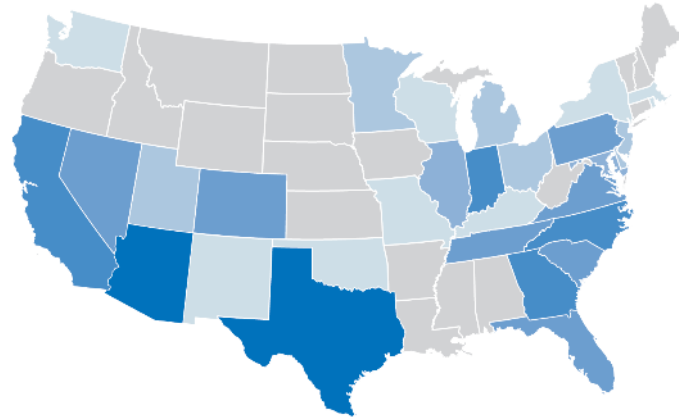
Litigation

Cost of Quality: Benchmark Survey

PARTICIPANTS

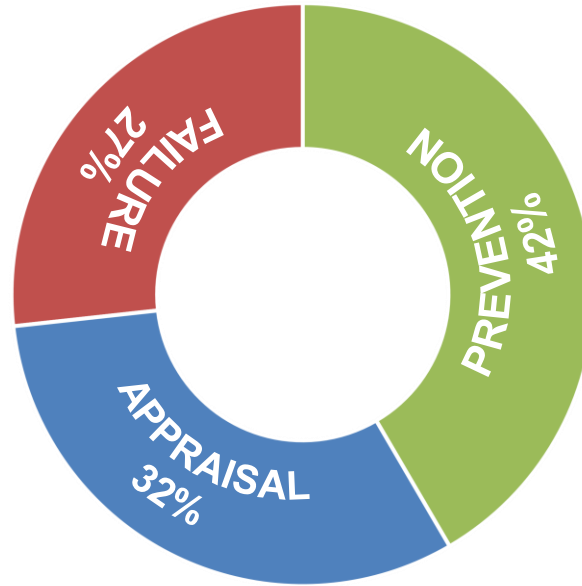
21 Completed surveys (Fall 2015)
Single-family builders (Primary business)
Diverse range in volume (2014 closings)

- 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 in 2014



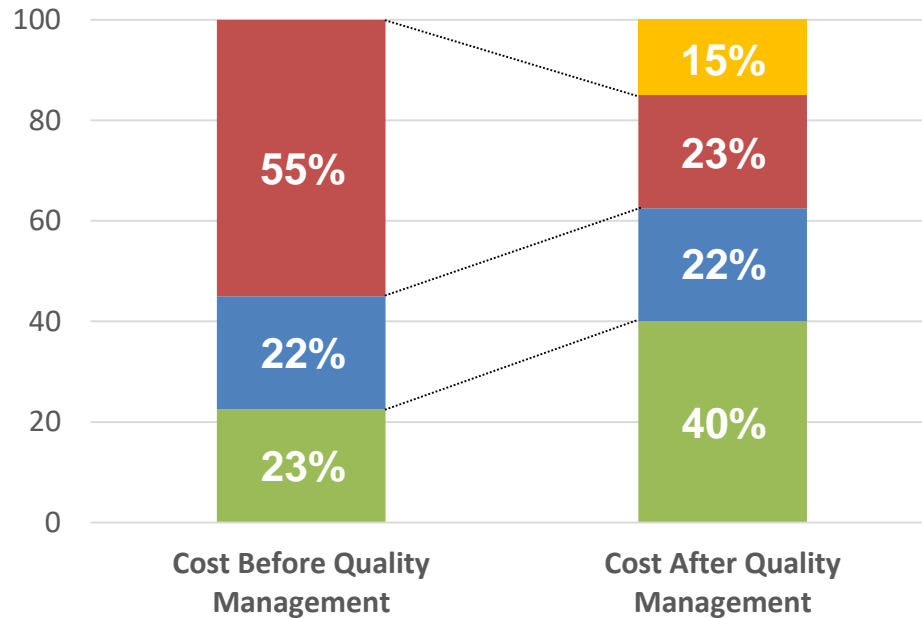
Cost of Quality: Benchmark Survey

PAF PROFILE: PERCEPTION



Cost of Quality: Benchmark Survey

PAF PROFILE: CASE STUDY



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

- Savings
- Failure
- Appraisal
- Prevention

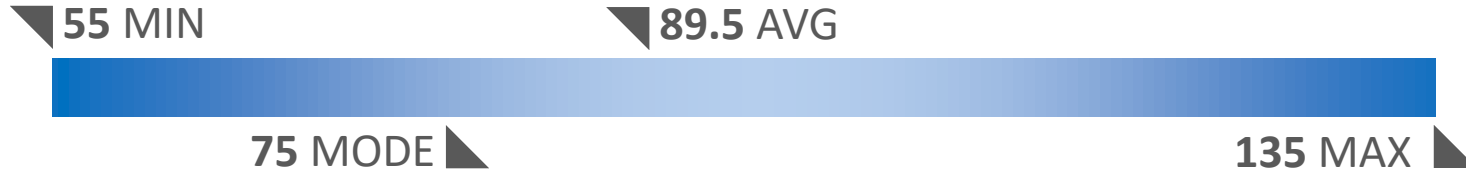
Cost of Quality: Cycle Time



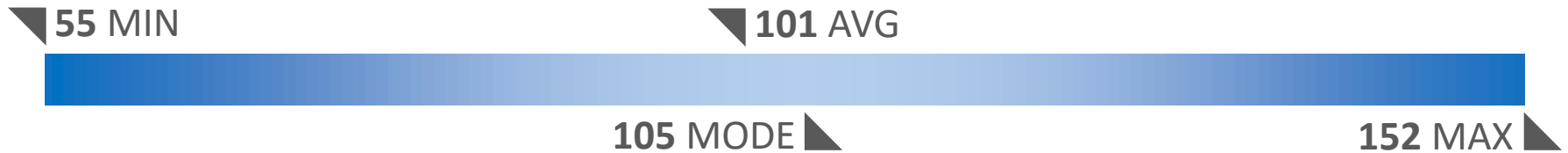
Cost of Quality: Cycle Time

SURVEY RESULTS

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



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



Cost of Quality: Cycle Time

EXPERT INTERVIEWS +

Eric Timmis, TrueNorth Development

- 1 day saved in construction = \$500-\$800 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

Cost of Quality: Cycle Time

EXPERT INTERVIEWS + (cont.)

CFO, Top 20 Builder

- The added assurance of not losing a buyer due to a prolonged build time

Cost of Quality: Cycle Time

OPPORTUNITY

ASSUMPTIONS

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

Cost of Quality: 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

Cost of Quality: Cost Variance



Cost of Quality: 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 ?



Cost of Quality: 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)

Cost of Quality: 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

Cost of Quality: 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

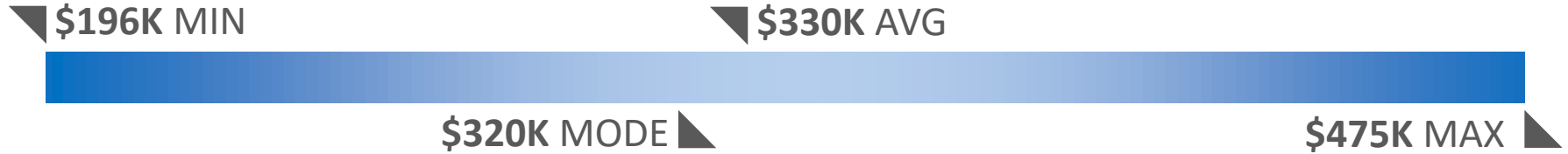
Cost of Quality: Value Engineering



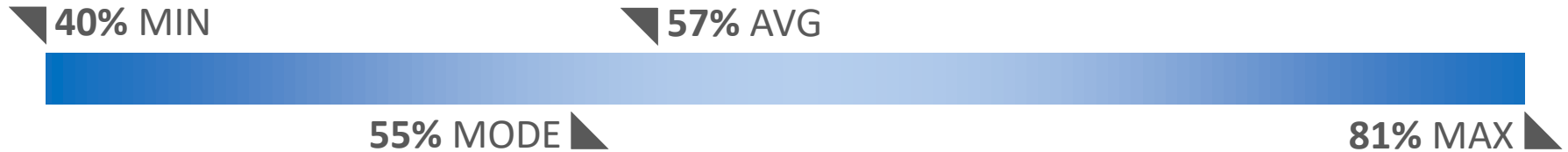
Cost of Quality: Value Engineering

SURVEY RESULTS

What was the average selling price of homes closed last year?



What % of revenue goes towards hard construction costs?



Cost of Quality: Value Engineering

EXPERT INTERVIEWS +

Tim Vermillion, Laing Associates

- Average (per plan) hard cost savings = 5%
- Major opportunities in concrete and framing

Division Purchasing Lead, Top 20 Builder

- Multi-year focus / commitment to “partner” with trades and share in the win
- Over 3 year period, reduced construction “waste” (thru VE and addressing poor take-offs) > \$15K per unit
- Results go beyond cost savings => Better overall home for the customer

Cost of Quality: Value Engineering

OPPORTUNITY

ASSUMPTIONS

- 0.5% hard cost savings per plan through VE and better take-offs

Cost of Quality: Value Engineering

OPPORTUNITY = \$940 Savings per home

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

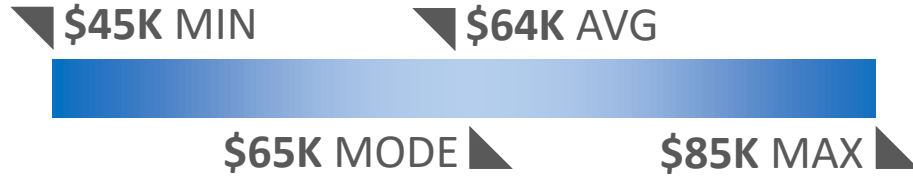
Cost of Quality: Construction Oversight



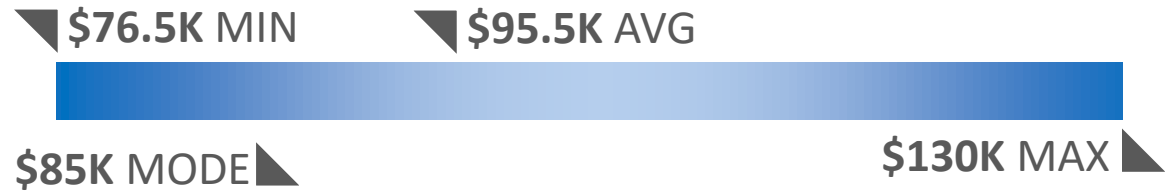
Cost of Quality: Construction Oversight

SURVEY RESULTS

What is your LOW END annual salary + benefits for a site supervisor?



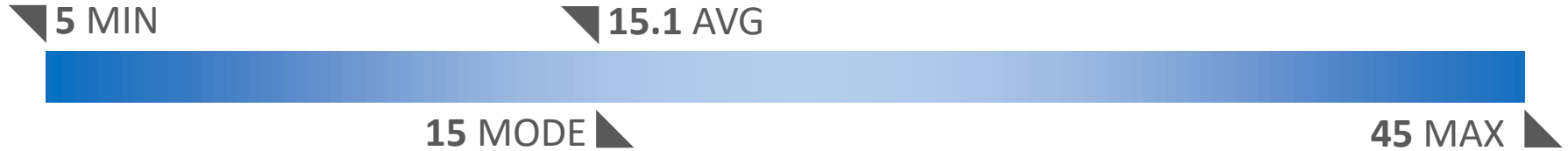
What is your HIGH END annual salary + benefits for a site supervisor?



Cost of Quality: Construction Oversight

SURVEY RESULTS (cont.)

How many homes does each site supervisor oversee at any time?



How much do you spend per unit on 3rd-party “quality” inspections?



Cost of Quality: Construction Oversight

EXPERT INTERVIEWS +

Division Purchasing Lead, Top 20 Builder

- Average # of homes carried by site supervisor = 25 versus 15-20 for others in the local market

Steve Baden, RESNET

- Average HERS Rating cost to the builder = \$450

Alan Mooney, Criterium Engineers

- Average home inspection (sampling) cost to the builder = \$350

Cost of Quality: Construction Oversight

OPPORTUNITY

ASSUMPTIONS

- Site supervisor annual salary = \$80K
- Increase # of units under construction carried per site supervisor by 10%
- Reduce # of 3rd-party field visits by 25%

Cost of Quality: Construction Oversight

OPPORTUNITY = \$635 Savings per home

(total # of homes delivered individually) x (1 + % possible increase in homes carried) ÷
(total # homes delivered company-wide) = (# of needed site supervisors)...

[(current # of needed site supervisors) – (new # needed)] x (\$s annual salary + benefits) ÷
(total # homes delivered company-wide) = **\$ Savings per home**

PLUS

(\$s spent on 3rd-party inspections) x (% possible reduction) = **\$ Savings per home**

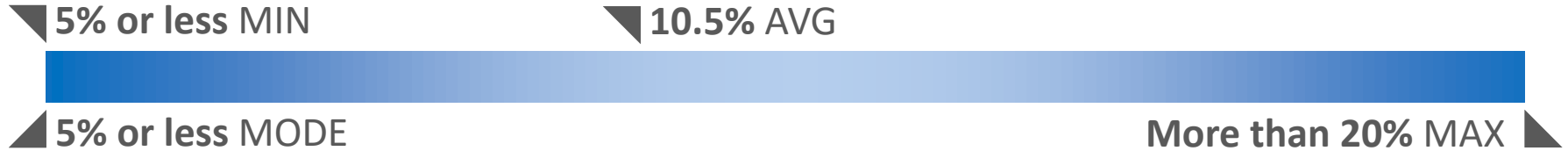
Cost of Quality: Employee Satisfaction



Cost of Quality: Employee Satisfaction

SURVEY RESULTS

What % of site supervisor turnover did you experience last year?



Cost of Quality: Employee Satisfaction

EXPERT INTERVIEWS +

Society for Human Resource Management (SHRM)

- Contributing factors to job satisfaction:
 - #1: Overall compensation
 - Within Top #10: The work itself; Organization's financial stability, Overall corporate culture, Meaningfulness of job

ROI Institute

- Cost to replace (as % of annual salary)
 - Supervisor or Team Lead = 100%-150%

Cost of Quality: Employee Satisfaction

EXPERT INTERVIEWS + (cont.)

Division Purchasing Lead, Top 20 Builder

- “With more than a decade focused on operational excellence we’ve seen an increase in pride across our culture (both job satisfaction and engagement) along with a reduction in turnover.”

Cost of Quality: Employee Satisfaction

OPPORTUNITY

ASSUMPTIONS

- Site supervisor annual salary of \$80K
- 10% annual site supervisor turnover reduced to 5%

Cost of Quality: Employee Satisfaction

OPPORTUNITY = \$435 Savings per home

(# of site supervisors) x (% annual turnover reduction) x
((\$s annual salary) x (% salary replacement costs) ÷
(total # of homes delivered annually) = \$ Savings per home

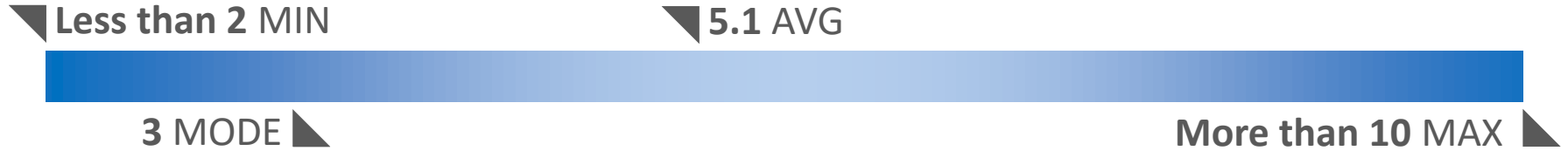
Cost of Quality: Customer Engagement



Cost of Quality: Customer Engagement

SURVEY RESULTS

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



Cost of Quality: Customer Engagement

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

Cost of Quality: Customer Engagement

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

Cost of Quality: Customer Engagement

OPPORTUNITY

ASSUMPTIONS

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

Cost of Quality: Customer Engagement

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**

Cost of Quality: Areas of Study


Cycle Time	\$1,680	Warranty	\$1,090
Cost Variance	\$1,300	Jobsite Waste	\$ 890
Value Engineering	\$ 940	Incentives	\$ 760
Construction Oversight	\$ 635	Training	\$ 725
Employee Satisfaction	\$ 435	Documentation	\$ 600
Customer Engagement	\$ 360	Execution	\$ 565

\$10,000 per home opportunity

Cost of Quality: What's Your Opportunity?

Participate and find out!

Cost Variance	\$1,300
Value Engineering	\$ 940
Construction Oversight	\$ 635
Employee Satisfaction	\$ 435
Customer Engagement	\$ 360



The Cost of Quality in Homebuilding: Builder Benchmark Study

Prepared for:
ExampleBuilder

Prepared by:
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Betsy Scott
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bescott@ibacos.com

Date:
November 15, 2015

IBACOS **Alliance**

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2714 Liberty Avenue • Pittsburgh, PA 15222 • www.ibacos.com

\$1,090
\$ 890
\$ 760
\$ 725
\$ 600
\$ 565

\$10,000 per ho

Cost of Quality: Benchmark Survey

OPEN SOLICITATION FOR ROUND 2 PARTICIPANTS

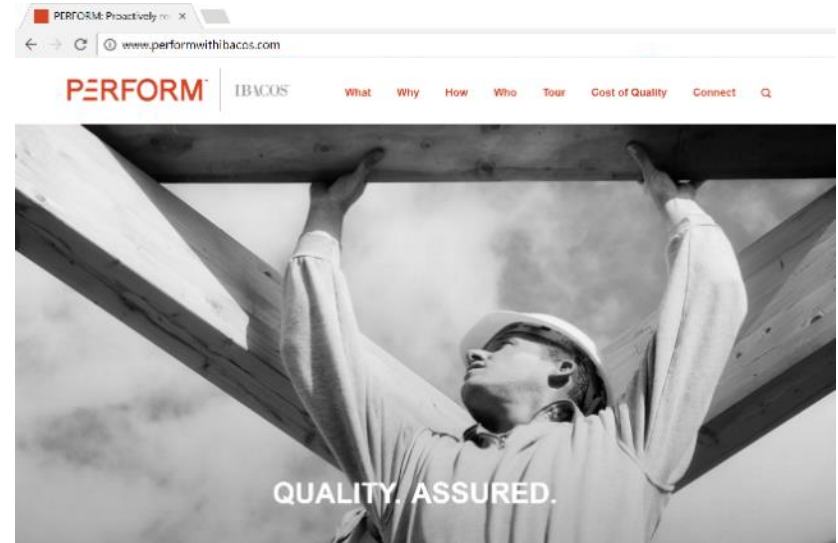


Could you gain \$10K in profit per house? Weigh in and find out.

Visit our home page. Click the banner or search "2016 Cost of Quality" for more details.

www.housinginnovationalliance.com

cost of quality



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Thank You

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