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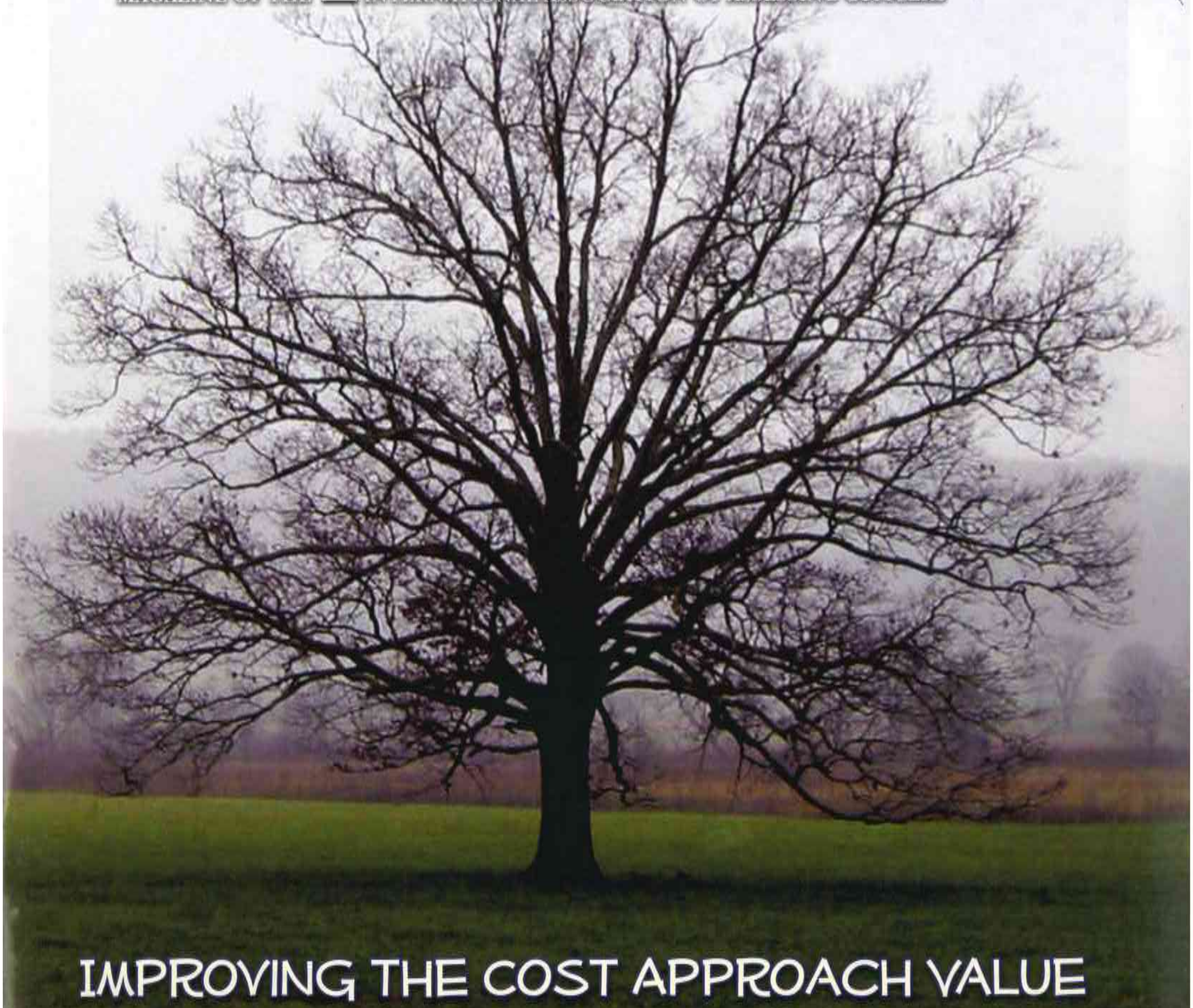
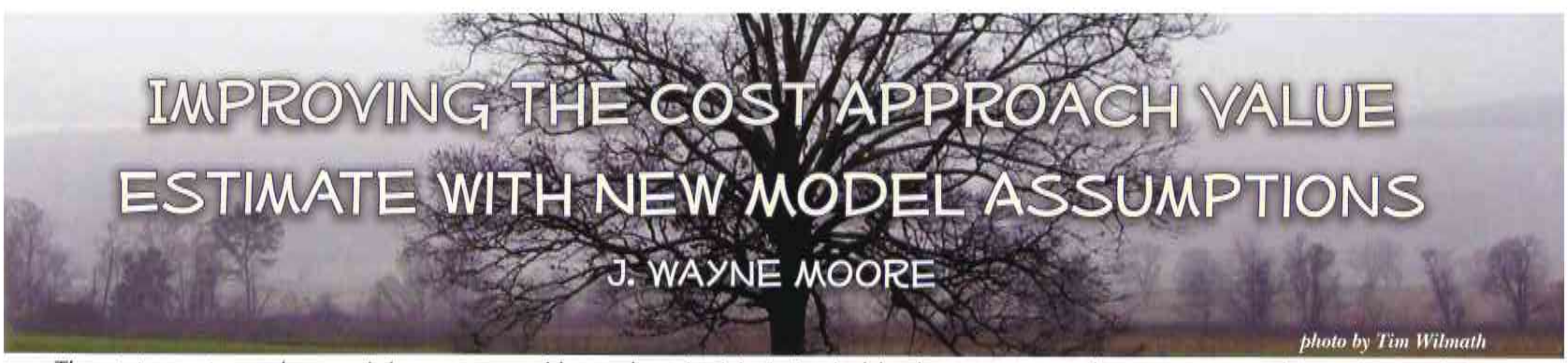


IMPROVING THE COST APPROACH VALUE ESTIMATE WITH NEW MODEL ASSUMPTIONS

J. WAYNE MOORE



Improving the Cost Approach Value Estimate with New Model Assumptions

J. Wayne Moore

photo by Tim Wilmath

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This article describes an investigation into improving the value estimate of the cost approach. During research on the use of parcel *x–y* location coordinates in geographic-attribute weighted regression (GAWR), a GIS-based modeling technique that is yielding excellent residential price estimates, it was found that replacement cost new (RCN) and RCN less depreciation (RCNLD) were important variables for improving GAWR model estimates (Moore and Myers 2010). A logical extension of this discovery was that improvement of the accuracy of the RCN estimate should improve the accuracy of the GAWR model estimate. Hence, the cost approach improvement project described in this article was undertaken in 2010.

During the past three decades much attention has been focused on the improvement of value-estimating accuracy by using regression-based automated valuation models (AVMs), while little attention has been directed to cost models and their underlying assumptions. Some practitioners dismiss the cost approach for residential valuation as a relic of the past, while others still use the cost approach calibrated with market adjustment factors by neighborhood. Frequently practitioners use branded sources of national cost data, accepting the accuracy of the published costs without question. The final value conclusion relies heavily upon the market correlation and adjustment processes in computer-assisted mass appraisal (CAMA) software.

The branded sources of national construction cost data used in this study are Craftsman Book Company, Marshall & Swift, and R.S. Means. Two of these publish data for the construction industry to help builders estimate job costs; the third publishes data to assist the appraisal and insurance industries in placing value estimates on properties. The construction industry uses these cost data as a basis for determining pricing for construction contracts, because its costs on individual projects must be more accurate and detailed than time and fees would allow for appraisers to render value opinions. Building contractor survival and profitability depend upon the accuracy of project estimates.

The main difference between the estimating procedure used by a builder and that used in the appraiser or assessor's cost approach estimate involves preparing a single job estimate in great detail versus estimating the cost for a specified classification or type of real property. A contractor uses a specific building plan to estimate the cost for one property, whereas an assessor must estimate the *typical* cost for a variety of sizes of a specific type or category of property. The concept of defining what is *typical* for a specific class of property involves creating a *model* that describes that class of property and the construction characteristics usually found within that class or type of property. The actual cost model and its assumptions are extremely important for achieving accurate value estimates for large numbers of properties with minimum appraiser time.

For the investigation described here, construction cost data used by building contractors, which should be very accurate, were combined with improved models with greater estimating accuracy, thus achieving greater overall accuracy in the new cost schedules. The branded source of cost data used for developing the new tables was the Craftsman Book Company. Current books of cost data were purchased from R.S. Means and Marshall & Swift to compare costs for the same test properties. The results are interesting and are covered in more detail in this article.

Development of Cost Model Assumptions

Models require assumptions such as the perimeter for each size within the typical size range, wall height, materials, design complexity, quality, and other typical features. A builder's blueprint is very specific, and nothing is assumed. On the other hand, an assessor's model for a property class or use type is developed mostly from assumptions. When cost manuals were first developed 30 to 80 years ago, building design, materials, and building codes were different. During the past 30 years research to improve appraisal accuracy has focused on new techniques such as regression modeling, but there has been very little research on the cost approach.

One important task in the development of new cost schedules was to study and realign the underlying cost model assumptions to conform to today's building designs and materials. Appraiser or assessor cost estimates are for the construction of new buildings with the same functional utility as existing buildings, but not necessarily for exact replacements of existing structures. The new structures would use current building materials, design, and technology to provide a functionally equivalent building. This is the concept that underlies RCN.

The cost approach provides an estimate based on the cost to build a similar structure, which, when added to the land value, gives an initial total value estimate against which the assessor then applies market or other adjustment factors in order to arrive at the final total value estimate. The objective of valuing property is to accurately estimate market value. The cost estimate is useful for establishing an initial market value because newly constructed properties compete with existing properties for buyers. In theory, according to the economic *principle of substitution*, the cost to construct a new building sets an upper limit on improvement value.

The final value estimate should always consider evidence from local market transactions in addition to published costs, and assessors must be aware that in volatile economic times with high unemployment, nationally published cost data may not be based on the most current local market wage rates. A major factor in determining the total market value of a property is the land value estimated by using the market approach, which can be volatile in difficult times. However, highly accurate estimates of improvement costs are very helpful in establishing land market value because the abstraction method is used to find the land residual of improved property sales.

The importance of the *cost model* itself is best illustrated by considering the result of using exactly the same source of cost data with different cost model assumptions. The *2011National Building Cost Manual* (Ogershok 2010) contains tables organized by house size and quality of construction; the rates in the tables are based upon Craftsman model assumptions. The *2011 National Construction Estimator* (Ogershok and Pray 2010) contains unit-in-place construction costs in great detail, but does not contain tables from which construction costs of structures can be estimated; that is, it does not use models and assumptions to pull the detailed unit costs together into any kind of a square-foot rate table for estimating total building cost.

During the course of this project, 28 floor plans of one-story and two-story homes from four major homebuilders that might be classified as economy or average quality were analyzed and their 2011 selling prices obtained from builder Web sites. These homes were used to test the accuracy of new building costs. When the *2011 National Building Cost Manual* was used to estimate the construction cost of these homes, the median ratio of construction cost to the advertised price was 1.26 and the coefficient of dispersion (COD) was 7.30. After careful research and determination of new model assumptions, the unit costs in the *2011 National Construction Estimator* were used to populate the new cost model system. The median ratio of construction cost to the advertised price was 1.36 (which included the published location adjustments), but the COD was reduced to 4.99.

Further research and analysis determined that the location labor rates in the *2011 National Construction Estimator* were too high for current market conditions, and a locally derived verified economic modification (VEM) factor was determined and applied within the model. After the VEM was applied, the median ratio of construction cost to the advertised price was 1.06 and the COD was further reduced to 4.75. These computed value estimates were from the same unit-in-place cost publications, yet they produced very different CODs, ranging from 4.75 to 7.30. These results clearly illustrate how the model and its assumptions may be more important than the specific source of the published cost data.

A wide range of cost models have been used for appraisals over the past century (Moore 2009). Table 1 contains some examples of the model structure and organization of existing cost manuals (Moore 1995).

Table 1. Structure and organization of traditional cost manuals

	Cost Table Organization			Quality Adjustment	
Cost Manual	Styles	Floor Level	Size	Separate Table	Multiplier
A. Marshall & Swift Residential Cost Handbook	X		X	X	
B. Iowa & Illinois Manuals*	X		X		X
Missouri/ Hunnicutt			X		X
Oregon Manual		X	X	X	
Indiana Manual		X	X		X

** Most other cost manuals published by mass appraisal firms use method B.*

Methodology for Creating Residential Cost Models and Tables

The residential cost model developed during this project contains 38 key assumptions at 15 benchmark size points up to 5,000 square feet per floor level. At each size these assumptions define such elements as the exterior wall perimeter; pitch of modern roof, attic, and half-story; number of exterior doors and windows; number of interior doors by floor level; linear feet of interior wall partitions; and many other residential construction features. These assumptions were defined by careful analysis and documentation of the characteristics for 269 modern floor plans of one-story, one and one-half story, and two-story homes pulled from a national home plans database containing more than 18,000 modern floor plans, as follows:

- 91 one-story house plans including 13 from local homebuilders
- 70 two-story first-floor plans including 16 from local homebuilders
- 73 two-story second-floor plans including 16 from local homebuilders

- 35 half and three-quarter story upper-level floor plans.

A natural and basic starting point for determining the assumptions for residential construction was to gather information on typical sizes of one- and two-story houses. Descriptive statistics were gathered from nearly 4,000 typical homes built in the past 10 years. The size data for average-quality homes are given in table 2. Note the first floor differences between one- and two-story homes.

In the jurisdiction from which the data are drawn, homes rated "avg" are typical, either *economy* or *average* quality; "avg+1" and "avg+2" are somewhat above typical but are not good quality; and "avg–1" homes are below typical but not enough so to be rated lower quality. The percentile distribution shows that 94 percent of the one-story homes are between 1,071 and 2,080 square feet and that their median size is about 1,450 square feet, whereas the first-floor sizes of two-story homes are about one-third smaller. There are numerous differences between one- and two-story homes that must be recognized within the cost model assumptions in order to achieve accurate cost estimation results.

Model assumptions are formed from real-world observation. From the home size statistics that were gathered, the following *benchmark house sizes* were chosen to fit the real world data:

400 600 800 1,000 1,200 1,300 1,400 1,500 1,600 1,800 2,400 3,200 4,000 5,000

From the new home floor plans, construction characteristics for each floor level were determined as follows:

- Average perimeter linear feet at each benchmark house size
- Average linear feet of interior walls by floor level at each benchmark house size
- Number of single window equivalents by floor level at each benchmark house size
- Number of exterior doors and interior doors by floor level at each benchmark house size
- Average linear feet of attached garage common wall
- Typical roof pitch for each house type including half-story.

Table 2. Size statistics for average quality homes built during the past 10 years

Typical Residential Descriptive Statistics Report - Floor Size Comparison for Average Quality - Age < 10 yrs												
Total	**1 Story**				**2 Story—1st Floor**				**2 Story—2nd Floor**			
3979	**Avg −1**	**Avg**	**Avg +1**	**Avg +2**	**Avg −1**	**Avg**	**Avg +1**	**Avg +2**	**Avg −1**	**Avg**	**Avg +1**	**Avg +2**
Count	217	405	393	277	611	904	873	299	611	904	873	299
Mean	1434	1499	1504	1643	1052	1010	1300	1239	1392	1232	1542	1314
Median	1410	1454	1432	1505	1024	968	1304	1176	1354	1204	1522	1272
Mode	1510	1252	1264	1264	974	654	1606	557	1191	517	2002	none
Min	911	824	915	1030	557	557	557	557	480	64	225	56
Max	2962	3158	2812	3325	1850	2035	2186	3047	2159	2339	2770	2288
Range	2051	2334	1897	2295	1293	1478	1629	2490	1679	2275	2545	2232
	Percentile				**Percentile**				**Percentile**			
99	2458	2670	2730	3056	1702	1750	2096	2260	2096	2039	2496	2272
95	1875	2080	2163	2469	1588	1600	1925	1911	1970	1935	2377	2032
90	1814	1912	1946	2287	1500	1506	1782	1648	1820	1787	2189	1911
85	1753	1796	1819	2137	1347	1364	1744	1585	1704	1681	2150	1810
80	1592	1722	1765	2050	1313	1322	1656	1547	1657	1598	2002	1693
75	1542	1691	1705	1955	1250	1249	1606	1473	1610	1518	2002	1600
70	1510	1632	1623	1809	1216	1208	1606	1424	1537	1407	1861	1566
65	1510	1577	1541	1700	1151	1147	1493	1347	1506	1354	1717	1488
60	1510	1522	1496	1620	1117	1064	1428	1300	1461	1303	1636	1404
55	1476	1505	1457	1549	1062	989	1347	1256	1405	1250	1602	1326
50	1410	1454	1432	1505	1024	968	1304	1176	1354	1204	1522	1272
45	1358	1423	1408	1458	974	927	1227	1140	1316	1190	1400	1224
40	1317	1371	1327	1419	940	864	1158	1081	1253	1142	1335	1195
35	1275	1323	1285	1386	876	812	1095	1039	1211	1088	1259	1140
30	1262	1278	1264	1327	851	767	1029	1022	1210	1020	1197	1092
25	1237	1252	1253	1264	825	706	974	1000	1191	951	1186	1020
20	1199	1230	1239	1264	806	663	927	968	1140	937	1126	961
15	1198	1207	1214	1240	746	654	860	918	1086	755	1080	926
10	1130	1183	1198	1212	706	654	805	816	1082	732	955	823
5	1066	1071	1170	1202	627	629	706	756	948	517	813	643
1	971	936	978	1096	557	557	557	557	669	504	374	280

Each of the 269 house plans was studied in detail, and features such as building perimeter and interior partition lengths were measured and windows and doors counted, as illustrated in figure 1.

The plans from the national home plan database were selected to be as close to the designated benchmark sizes as possible. The assumption data collected from each plan were summarized in Excel® spreadsheets that corresponded to the benchmark sizes, as shown in table 3.

The residential cost model developed in this project contains 38 key assumptions at 15 benchmark size points up to 5,000 square feet per floor level that had been determined from the house plan analysis described above. These assumptions were placed in the cost model worksheet to drive calculations at each benchmark size, as illustrated in table 4.

The driving assumptions are used within the spreadsheet to control the calculations that determine the costs of all components of a residential structure throughout the full range of possible sizes. Note that the source of the cost data has not yet been mentioned

Figure 1. Example of how residential cost model assumption data were gathered from home plans

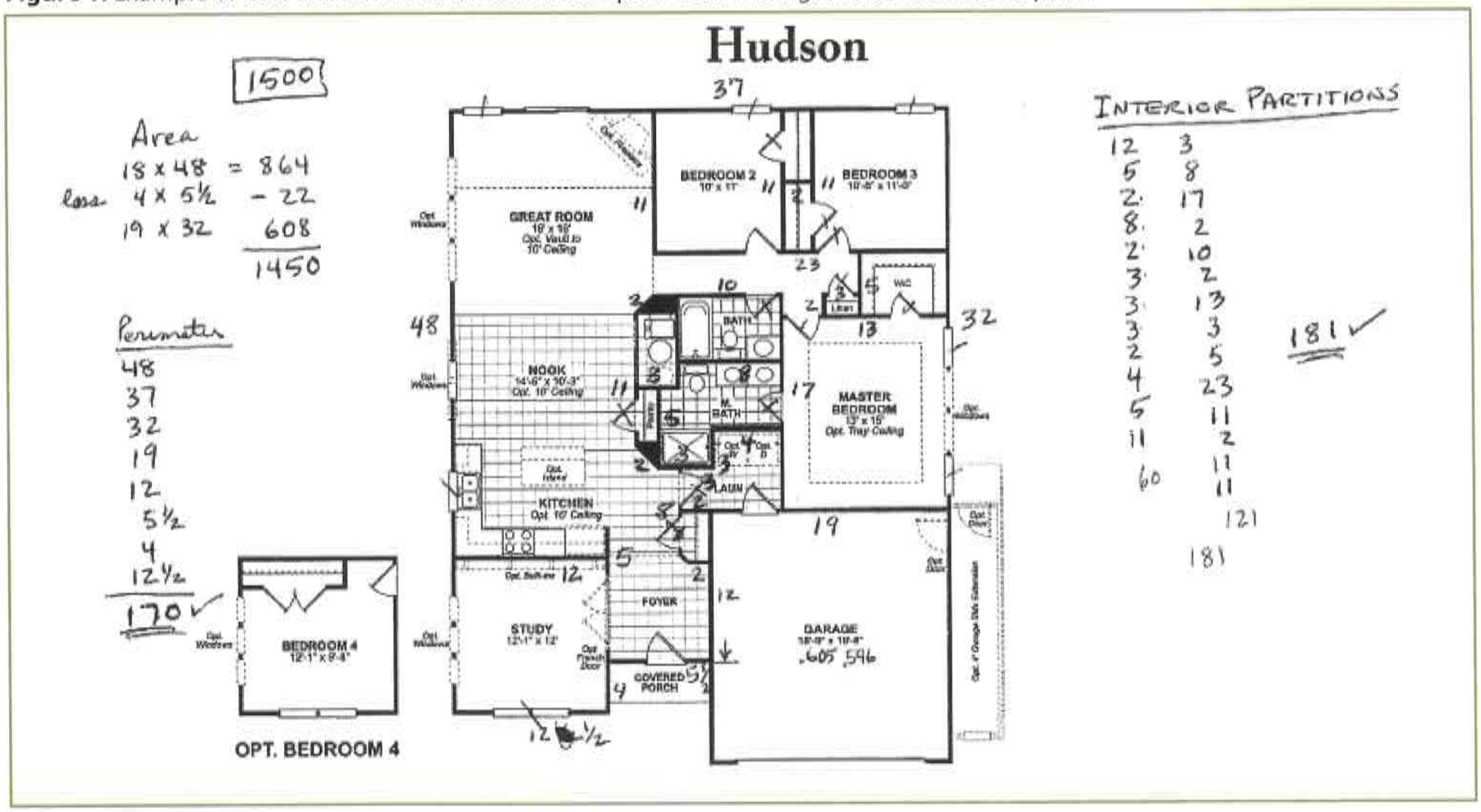


Table 3. Collection of real world residential assumption data in spreadsheet form

A	B	C	D	E	F	G	H	I	J	L	M	N	O	P	R	S	T	U
				CONSTRUCTION STATISTICS FOR ONE STORY RANCH STYLE HOMES							1200	SQ FT						
	1200SF					Windows				Doors - Entrance plus				Single	Roof	Gable		
#	Total SF	Ratio	Perim	Interior	Ratio	Single	Double	Triple	Total	Std Exterior	French Ext	Sliding	Std Interior	BiFold*	Pitch	Ends	Ct	Avg
1	1184	0.15	183	143	0.78	9	1	0	11	1	0	1	9	6	6	45-45	2	45
2	1200	0.12	144	147	1.02	1	4	1	12	1	0	1	6	8	6	28-28-22	3	26
3	1198	0.13	150	150	1.00	8	1	0	10	1	0	1	9	1	7	28-22-12	3	22
4	1200	0.12	140	120	0.86	5	2	1	12	1	0	0	6	2	6	30-30	2	30
5	1196	0.12	147	154	1.05	5	1	0	7	2	0	0	7	4	7	28-28	2	28
6	1200	0.12	139	124	0.89	3	0	0	3	0	2	0	6	6	8	32-32	2	32
7	1198	0.14	162.5	132	0.81	7	0	0	7	1	1	0	10	0	7	20-20-20	3	20
8	1200	0.12	146	141	0.97	6	1	0	8	2	0	0	8	5	6	30-30-18	3	26
9	1197	0.12	141.5	129	0.91	3	6	0	15	2	0	0	9	3	5	Hip		
10	1200	0.12	145	168	1.16	2	5	0	12	1	0	0	4	5	5	24-30-30	3	28
11																		
avg	**1197.3**	**0.13**	**149.8**	**140.8**	**0.94**	**4.90**	**2.10**	**0.20**	**9.70**	**1.20**	**0.30**	**0.30**	**7.40**	**4.00**	**6.30**		**2.56**	**28.6**
	1200		150	142														
med	**1199.0**	**0.12**	**145.5**	**142.0**	**0.94**	**5.00**	**1.00**	**0.00**	**10.50**	**1.00**	**0.00**	**0.00**	**7.50**	**4.50**	**6.00**		**3.00**	**28.0**
	1200		146	137														
														* or sliding				

600SF | 800SF | 1000SF | **1200SF** | 1300SF | 1400SF | 1500SF | 1600SF | 1800SF | 2400SF | 3200SF | 4000SF

Table 4. Model assumptions placed in the worksheet to drive calculations for each benchmark size

Cost Source: Craftsman Book Co			2011 REPLACEMENT COST NEW (RCN) MODEL WORKSHEET									Craftsman cost date:		3/31/11
2011 National Construction Estimator			Average Quality - "Standard or Normal Construction"											
				COST MODEL ASSUMPTIONS										
Base Floor Size	400	600	800	1000	1200	1300	1400	1500	1600	1800	2400	3200	4000	5000
Half Upper Floor Usable SF @ 59% of Base	236	354	472	590	708	767	826	885	944	1062	1416	1888	2360	2950
3/4 Upper Floor Usable SF @ 78% of Base	312	468	624	780	936	1014	1092	1170	1248	1404	1872	2496	3120	3900
Attic Usable SF @ 40% of Base	160	240	320	400	480	520	560	600	640	720	960	1280	1600	2000
Perimeter Linear Feet	82	106	120	137	156	165	170	178	186	204	234	303	360	425
One Story Perimeter LF shared with Att Garage	20	24	27	27	27	27	27	27	27	27	27	27	27	27
Two Story Perimeter LF shared with Att Garage	20	22	25	32	32	32	32	32	32	32	32	32	32	32
Average Gable End Width	16	24	27	29	30	32	32	32	33	35	36	38	40	40
Number of Gable Ends	2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	4
18" Roof Overhang SF with 12" at Gable Ends	107	135	146	169	197	208	215	227	238	262	306	407	480	558
Standard Roof Pitch	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Half Story Roof Pitch with dormer factor	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Attic Roof Pitch - no dormers	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Standard Gable End Wall Area (pitch=6)	64	144	228	263	281	320	320	320	340	383	405	451	600	800
Gable End Wall Area for Attic (pitch=7)	75	168	266	307	328	373	373	373	397	447	473	526	700	933
Gable End Wall Area for 1/2 Story (pitch=9)	96	216	342	394	422	480	480	480	510	574	608	677	900	1200
Dormer Linear Feet to Base Size Factor	0.0152	0.0133	0.0117	0.0108	0.0093	0.0082	0.0077	0.0073	0.0069	0.0062	0.0050	0.0047	0.0045	0.0043
Linear Feet of Dormer for Half Story	6	8	9	11	11	11	11	11	11	11	12	15	18	22
One Story Home Interior Partitions LF	47	71	94	118	142	154	165	177	188	212	282	366	450	560
1st Floor Interior Partitions of Two Story Home	32	48	64	80	96	104	112	120	130	148	196	262	330	416
Interior Partition LF Adjust of Two Story Home	(15)	(23)	(30)	(38)	(46)	(50)	(53)	(57)	(58)	(64)	(86)	(104)	(120)	(144)
Full Upper Floor Interior Partitions LF	68	98	126	150	176	188	192	204	216	242	316	410	504	620
Half Story Interior Partitions LF	71	103	132	138	151	165	178	190	201	220	245	318	391	481
Attic Interior Partitons LF @ 80% of Half Story	57	82	106	110	121	132	142	152	161	176	196	254	313	385
Exterior Doors Excluding Main Entrance	1	1	1	2	2	2	2	2	2	2	2	2	3	4
Std Interior Doors of One Story Homes	3	4	6	8	9	11	11	11	12	12	14	16	22	30
1st Floor Std Interior Doors of Two Story Homes	2	3	4	5	5	5	6	6	7	7	9	12	16	20
Std Interior Door Adjust of Two Story Home	(1)	(1)	(2)	(3)	(4)	(6)	(5)	(5)	(5)	(5)	(5)	(4)	(6)	(10)
Full Upper Floor Std Interior Doors	4	6	8	10	10	10	10	10	12	14	16	18	21	24

because the building costs are independent of the cost model and change every year, whereas the model and its assumptions change more slowly over time. Again, *published costs and cost computation models are two different things.* Once the model and its assumptions have been determined, the specific unit, assembly, and component costs can come from any of the available published sources. The cost data in published sources vary in comprehensiveness and coverage; some sources provide material, labor, equipment, and total unit cost for each line item; other sources provide only the total cost for each line item; some sources attempt to break out costs into quality categories and others do not. Hence, as is the case for cost computation models, each published cost source has advantages and disadvantages with regard to applicability, license fees, and comprehensiveness.

The cost computation spreadsheet is organized according to the structure of the UNIFORMAT II classification of building elements, a widely used standard in the construction industry and a required format for all federal government construction contracts; see table 5. Table 6 shows cost publisher construction specifications for "average" homes placed in the UNIFORMAT II classification system.

To illustrate how the separate calculation model and unit costs from a published source are put together to give cost estimates by building size, the foundation shown in figure 2 (page 10) was used. A stem wall placed on a spread footing as illustrated in figure 2 is a standard foundation.

The spread footing distributes the weight of the structure over a larger area. A residential footing is usually 18 inches wide and 8 inches deep and normally strengthened with two horizontal bars of steel reinforcement. The spread footing is attached to the stem wall with a keyway and/or steel rebar dowel uprights. The *2011 National Construction Estimator* (Ogershok and Pray 2010) contains the cost data shown in table 7 (page 11). These figures assume the foundation stem wall projects 24 inches above the finished grade and extends into the soil 18 inches to the top of the footing. Costs shown include typical excavation using a 3/4-cubic-yard backhoe with excess backfill spread on site, forming both sides of the foundation wall and the footing, based on three uses of the forms and 2 #4 rebar. A minimum cost for this type of work is $1,200 (Ogershok and Pray 2010, 93). These were the published cost data used to populate the cost calculation model to determine the estimated foundation cost at each benchmark house size. The cost publication shows that an 18-inch-wide × 8-inch-deep footing with a stem wall that is 6 inches thick and 42 inches deep costs $46.39 per linear foot to construct.

Table 8 (page 11) shows how the costs of the foundation wall for the various benchmark house sizes are calculated in the spreadsheet. The typical length of the perimeter of a 1,200-square-foot

Table 5. The UNIFORMAT II Classification of Building Elements for construction cost organization

ASTM UNIFORMAT II - Classification of Building Elements (E1557-97)		
Level 1 & 2 Major Groups	**Level 3 Individual Elements**	**Dwelling Model Specifications for UNIFORMAT II Elements "Base Dwelling" - Typical, most common**
A. SUBSTRUCTURE		
A10 Foundations	A1010 Standard Foundations	8x18′ footing; 8″ conc wall (CIP or block) 42″ deep
	A1010 Foundations Drainage	3″ perforated pipe backfilled with sand
	A1030 Slab on Grade	4″ conc slab on 4″ crushed stone; vapor barrier
	A1040 Crawl Space Foundation	18″ add'l foundation wall with B1010 wood floor
A20 Basement Constr	A2010 Basement Excavation	0.34 cubic yards excavated per sq ft floor area
	A2020 Basement Walls	5-1/2′ add'l 8″ poured concrete or concrete block
	A2020 Basement Features	4″ floor, drain, columns, elec, windows, stairs
B. SHELL		
B10 Superstructure	B1010 Floor Construction	5/8″ subfloor on 2x10″ wood joists 16″ o.c.
	B1020 Roof Framing	2x6″ rafters 16″o.c. at 5/12 pitch
	B1020 Roof Sheathing & Overhang	1/2″ plywood sheathing; 18″ soffit
B20 Exterior Closure	B2010 Exterior Walls: Framing	2x6 studs 16″ o.c. with insulation board sheathing
	B2010 Exterior Walls: Non-masonry	Average of plywood, metal, vinyl, stucco, wood
	B2010 Exterior Walls: Masonry	Common brick 4″ veneer facing, single wythe
	B2020 Exterior Windows	Double hung vinyl low-E window 2′8″x 4′2″
	B2030 Exterior Doors	3 solid-core insulated steel doors, 1 with sidelights
	B2040 Energy Package - Insulation	6″ wall insultion and 6″ attic insulation
B30 Roofing	B3010 Roof Coverings	25 year fiberglass shingles; 15# felt, alum flashing
	B3020 Roof Openings	Dormers on 1-1/2 story homes according to floor SF
C. INTERIORS		
C10 Interior Constr	C1010 Partitions	2x 4 stud walls 16″ o.c., 1/2″ drywall, paint ready
	C1020 Interior Doors	6-panel pre-hung hardboard door 32x80, pre-drilled
	C1030 Specialties - Trim	Base 1/2″x 3-1/2″ all patterns; casings 7/16″x 2-1/2″
	C1030 Specialties - Cabinetry	20 LF avg grade kitchen cabinets, wall & base
	C1030 Specialties - Bath	Avg quality fiberglas tub enclosure; avg vanity
	C1030 Specialties - Counter Tops	Formica or Wilsonart, full wrap front edge
	C1030 Specialties -Appliances	None included
C20 Staircases	C2010 Stair Construction	Straight 36″ oak stair, 13 risers, handrails & balusters
	C2020 Stair Finishes	20 SF finish, 3 coats
C30 Interior Finishes	C3010 Wall Finishes	1/2″ drywall taped, finshed, primed + 2 coats
	C3020 Floor Underlayment	1/2″ plywood on 1x2 sleepers 16″ o.c.
	C3020 Floor Finishes	50% carpet, 30% Prego, 15% vinyl tile, 5% ceramic tile
	C3030 Ceiling Support	2″x 6″ ceiling joists 16″ o.c.
	C3030 Ceiling Finishes	1/2″ drywall taped, finshed, primed + 2 coats
D. SERVICES		
D20 Plumbing	D2010 Plumbing Fixtures - Bath	3 avg quality bath fixtures and faucets
	D2010 Plumbing Fixtures - Kitchen	Avg quality stainless steel sink; avg faucets
	D2010 Plumbing - Hot Water Source	40 gallon natural gas hot water heater
	D2020 Domestic Water Distr	Copper hot & cold water lines
	D2030 Sanitary Waste	Plastic sanitary waste lines
	D2040 Rain Water Drainage	Aluminum gutters and downspouts
D30 HVAC	D3010 Energy Supply	Natural gas
	D3020 Heat Generating Systems	Central forced air furnace; central thermostat
	D3030 Cooling Generating Systems	Not specified in base dwelling - add
	D3040 Distribution Systems	Adequate ductwork for forced air system
D50 Electrical	D5010 Electrical Service & Distr	200 amp service, romex wiring
	D5020 Lighting & Branch Wiring	Avg grade fixtures and adequate outlets
Contractor's Markup	Overhead & Profit	16% markup for 2012

Table 6. Residential "average" dwelling construction specifications

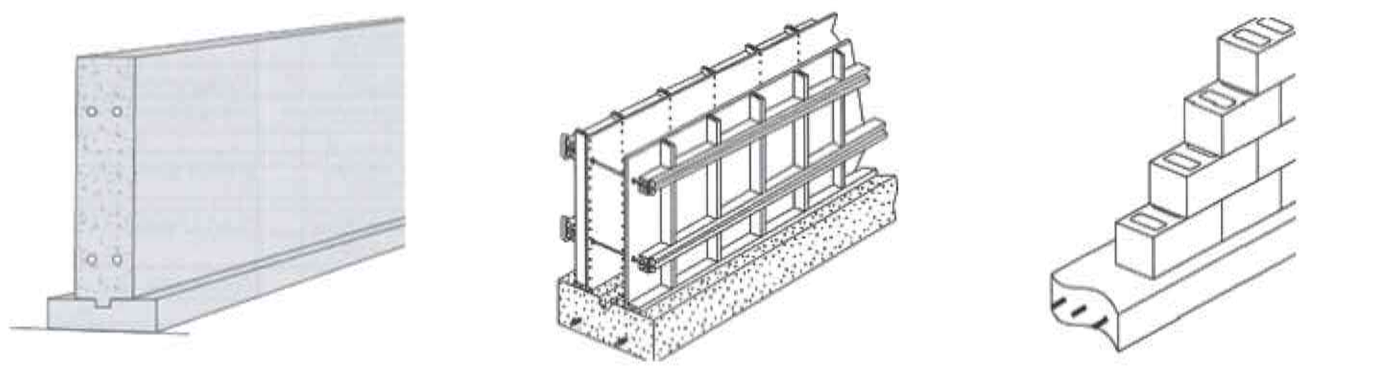
ASTM UNIFORMAT II - Classification of Building Elements (E1557-97)	RESIDENTIAL "AVERAGE" DWELLING CONSTRUCTION SPECIFICATIONS			
Levels 1, 2 & 3 Building Elements Quality Nomenclature:	**Indiana Manual Appendix A Table A-3 (Base Reference) "C" Grade**	**M&S Residential Cost Handbook (RCH) "Average"**	**RS Means Residential Cost Data (RCD) "Average"**	**Craftsman National Cost Manual (NBC) "5 - Avg Std"**
A. SUBSTRUCTURE				
A10 Foundations				
A1010 Standard Foundations	8" poured concrete or 8" concrete block	Description, no specifics	8x18' footing; 8" concrete wall 4' deep	Reinforced concrete or conc block
A1010 Foundations Drainage	Not specified	Not specified	Not specified	Not specified
A1030 Slab on Grade	4" concrete slab on gravel base	Description, no specifics, base cost deduction	4" conc slab on 4" crushed stone; vapor barrier	Slab on grade
A1040 Crawl Space Foundation	Additional foundation wall with B1010 wood floor	Description, no specifics, in base cost	Not specified, table base cost is for slab	Standard wood frame
A20 Basement Constr				
A2010 Basement Excavation	Not specified	Not specified	Not specified, table base cost is for slab	Not specified
A2020 Basement Walls	8" poured concrete or 8" concrete block	Poured concrete or concrete block, 6, 8, or 12" options	Not specified, table base cost is for slab	Poured concrete or concrete block
A2020 Basement Features	Not specified	Slab floor, drain, support columns, elec, windows, stairs	Not specified, table base cost is for slab	Slab floor, drain, min electric, stairs
B. SHELL				
B10 Superstructure				
B1010 Floor Construction	3/4" subfloor on 2x8" or 10" wood joists or wood I-joists	Wood structure, no specifics	5/8" subfloor on 2x8" wood joists 16" o.c.	Standard wood frame
B1020 Roof Framing	Gable, hip, or gambrel; moderate pitch; rafters or trusses	Rafters or trusses; up to 5/12 pitch	2x6" rafters 16"o.c. at 4/12 pitch	Wood frame
B1020 Roof Sheathing & Overhang	7/16" or thicker plywood or OSB; 12"-24" soffit	Plywood or wood sheathing, no other specifics	1/2" plywood sheathing; overhang not specified	Open 24" soffit; sheathing not specified
B20 Exterior Closure				
B2010 Exterior Walls: Framing	2x4 or 2x6 studs 16" o.c. with insulation board sheathing	Stud framed or solid masonry options, no specifics	2x4 studs 16" o.c. with 1/2" plywood sheathing	Wood or steel studs; few offsets
B2010 Exterior Walls: Non-masonry	Composite, aluminum, vinyl or hardboard siding	Cost options for plywood, metal, vinyl, stucco, wood, etc	Beveled wood siding and building paper	Stucco or wood siding
B2010 Exterior Walls: Masonry	Brick or stone veneer	Cost options for masonry veneer, log, concrete block, etc	Not specified, table base cost is for wood siding	Conc block or painted common brick
B2020 Exterior Windows	Double hung wood or vinyl	Std aluminum or wood sash, no specifics	Double hung windows, no specifics	Commodity grade
B2030 Exterior Doors	Solid-core wood or insulated steel doors with sidelights	Not specified	3 flush solid core exterior doors with storms	Commodity grade
B2040 Energy Package - Insulation	Not specified	Std insulation package for a moderate climate	4" wall insultion and 6" attic insulation	Not specified
B30 Roofing				
B3010 Roof Coverings	Fiberglass or composition shingles; aluminum flashing	Medium weight composition shingles or built-up	25 year asphalt shingles; 15# felt, alum flashing	Shingle or built-up roof cover
B3020 Roof Openings	Dormers frequently found on 1-1/2 story homes	Add for dormers per linear foot, finished or unfinished	Add for dormers per square foot	Not specified
C. INTERIORS				
C10 Interior Constr				
C1010 Partitions	Drywall on studs	Drywall on studs	Drywall on studs	1/2" gypsum wallboard
C1020 Interior Doors	6-panel or slab wood, compsition, painted, avg hardware	Medium grade hollow core with standard hardware	Hollow core and louvered doors, no specifics	Sliding mirrored closet doors
C1030 Specialties - Trim	3-1/2" pine baseboard; 2-1/2" casing; mantles	Stock baseboard and casings, no specifics	Painted baseboard and trim	Standard grade molding and trim
C1030 Specialties - Cabinetry	Std grade box cabinets, std hardware	Prefinished plywood kitchen cabinets	14LF avg grade kitchen cabinets, wall & base	Over 10LF stock wall & base cabinets
C1030 Specialties - Bath	Avg quality ceramic tile or fiberglas tub enclosure; avg vanity	Small Pullman or vanity, no specifics	Not specified	Average plastic tub & shower
C1030 Specialties - Counter Tops	Laminated counter tops; cultured marble/ ceramic vanity top	Laminated plastic or ceramic tile	Solid surface counter top	Not specified
C1030 Specialties -Appliances	None included	None included in base cost	None included in base cost	4 std grade kitchen appliances
C20 Staircases				

(table continued on next page)

Table 6. Residential "average" dwelling construction specifications (*continued*)

ASTM UNIFORMAT II - Classification of Building Elements (E1557-97)	RESIDENTIAL "AVERAGE" DWELLING CONSTRUCTION SPECIFICATIONS			
Levels 1, 2 & 3 Building Elements Quality Nomenclature:	Indiana Manual Appendix A Table A-3 (Base Reference) "C" Grade	M&S Residential Cost Handbook (RCH) "Average"	RS Means Residential Cost Data (RCD) "Average"	Craftsman National Cost Manual (NBC) "5 - Avg Std"
C2010 Stair Construction	Oak, poplar, or similar wood with handrail system	Not specified	Not specified	Not specified
C2020 Stair Finishes	Stained or carpeted	Not specified	Not specified	Not specified
C30 Interior Finishes				
C3010 Wall Finishes	Drywall with paint	Taped and painted drywall; some wallpaper or paneling	1/2" drywall taped, finshed, primed + 2 coats	Textured finish
C3020 Floor Underlayment	Not specified	Not specified	1/2" plywood on 1x2 sleepers 16" o.c.	Not specified
C3020 Floor Finishes	Builder's grade carpet and vinyl floor cover	Carpet, hardwood, vinyl not in base cost	40% hardwood, 40% carpet, vinyl 15%, c-tile 5%	Good sheet vinyl & std carpet, some tile
C3030 Ceiling Support	Not specified	Not specified	2x6" ceiling joists 16" o.c.	Not specified
C3030 Ceiling Finishes	Not specified	Not specified	1/2" drywall taped, finshed, primed + 2 coats	Not specified
D. SERVICES				
D20 Plumbing				
D2010 Plumbing Fixtures - Bath	3 avg quality bath fixtures and faucets	6 avg quality bath fixtures and faucets; 1 rough-in	1-lavatory, wall hung; toilet; enameled steel tub	Minimum of 2 3-fixture bathrooms
D2010 Plumbing Fixtures - Kitchen	Avg quality porcelain or stainless steel sink; avg faucets	Not specified (porcelain kitchen sink assumed)	Kitchen sink, type not specified	Not specified (kitchen sink assumed)
D2010 Plumbing - Hot Water Source	Not specified (natural gas hot water heater assumed)	Not specified (natural gas hot water heater assumed)	40 gallon electric water heater	Not specified
D2020 Domestic Water Distr	Copper, iron, or plastic piping	Not specified	Not specified	Not specified
D2030 Sanitary Waste	Iron, or plastic piping	Not specified	Not specified	Not specified
D2040 Rain Water Drainage	Aluminum gutters and downspouts	Not specified	Aluminum gutters and downspouts	Not specified
D30 HVAC				
D3010 Energy Supply	Not specified	Not specified, but implied gas; oil-fired adds cost	Gas-fired	Not specified
D3020 Heat Generating Systems	Central forced air furnace; central thermostat	Central forced air furnace	Forced warm air heat	Not specified
D3030 Cooling Generating Systems	Not specified in base dwelling	Not specified in base dwelling, add cost from table	Not specified in base dwelling	Not specified
D3040 Distribution Systems	Not specified (ducting assumed for forced air system)	Adequate ductwork and outlets for forced air system	Not specified (ducting assumed for forced air)	Not specified
D50 Electrical				
D5010 Electrical Service & Distr	100 amp service, romex cable	Not specified	200 amp service, romex wiring	Not specified
D5020 Lighting & Branch Wiring	Avg grade fixtures and adequate outlets	Avg grade fixtures bath & kitchen; adequate outlets	Incandescant lighting fixtres, switches, outlets	12 lighting fixtures, switch operated
Overhead & Profit	Included in base rates	Included in base rates	14.5% of total = 17% markup	Included in base rates

Figure 2. Types of foundations within UNIFORMAT II level 3 individual element A1010



Footing with keyway

Forms for a poured concrete stem wall

Concrete blocks on footing

home is 156 linear feet, and in the model calculation section under UNIFORMAT II Computational Detail, the unit cost is $46.39, according to the *2011 National Construction Estimator*. The unit cost column of the spreadsheet is the only place where the published cost data are used. If another source had been used, its published unit cost would have been placed in spreadsheet cell. The spreadsheet calculates the foundation cost for the 1,200-square-foot house as 156 linear feet × $46.39 = $7,237; the foundation cost for all the other benchmark house sizes is $46.39 times the perimeter linear feet shown for each house size.

A similar process is used to calculate all the residential components that form a complete house, and the components are summed to arrive at the total estimated cost for each benchmark house size. These costs are then used as data points to form a cost curve for calculating the estimated cost to construct any house in the entire size range. Thus, the columns from A to P form the cost calculation model for this 1,484-row spreadsheet, and only column R contains the unit or assembly cost data from the published source being used.

To test the estimating performance of the new cost model, the 28 one-story and two-story homes in communities under construction by four major homebuilders were analyzed and their 2011 selling prices obtained from builder Web sites. The homes were consistently classified by local assessors as average quality. Table 6 contains a summary of average-quality construction specifications as given in the Indiana assessment guidelines and each of the referenced national cost publications. Table 9 contains the test results for these 28 model homes using the final cost model with the *2011 National Construction Estimator* (Ogershok and Pray 2010) as the source of the cost data after the locally derived VEM had been applied.

In addition to using the new model cost tables from the *2011 National Construction Estimator* (Ogershok and Pray 2010) with the VEM adjustment, costs for the same homes were calculated by using cost tables from the *RSMeans Residential Cost Data 2011* (Mewis, Babbitt, and Baker 2010), the *2011 National Building Cost Manual*, and the *2011 Residential Cost Handbook* (Marshall & Swift 2010). These costs were all compared with the advertised prices of the homes on the builder Web sites. Table 10 shows the statistical results of

Table 7. Assembly: Continuous concrete footing with foundation stem wall

	Craft@Hrs	Unit	Material	Labor	Equipment	Total
Typical cost per cubic yard	B5@.716	cubic yard	156.00	254.00	50.50	463.90
Typical single-story structure, footing 18 in. wide × 8 in. deep, wall 6 in. tall × 42 in. deep (.10 cubic yard per linear foot)	B5@.716	linear foot	15.90	25.40	5.05	46.39
Typical two-story structure, footing 18 in. wide × 10 in. deep, wall 8 in. tall × 42 in. deep (.14 cubic yard per linear foot)	B5@1.00	linear foot	22.30	35.50	7.11	64.91
Typical three-story structure, footing 18 in. wide × 12 in. deep, wall 10 in. tall × 42 in. deep (.19 cubic yard per linear foot)	B5@1.36	linear foot	30.20	48.20	9.67	99.07

Source: Ogershok and Pray 2010

Table 8. Calculation of foundation costs in the cost model spreadsheets

5	Base Floor Size	1000	1200	1300	1400	1500	1600	1800	2400	3200	4000	5000
6	Half Upper Floor Usable SF @ 59% of Base	590	708	767	826	885	944	1062	1416	1888	2360	2950
7	3/4 Upper Floor Usable SF @ 78% of Base	780	936	1014	1092	1170	1248	1404	1872	2496	3120	3900
8	Attic Usable SF @ 40% of Base	400	480	520	560	600	640	720	960	1280	1600	2000
9	Perimeter Linear Feet	137	156	165	170	178	186	204	234	303	360	425

G49 | =ROUND(G$9*$R49,0)

	A	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Cost Source: Craftsman Book Co	1 REPLACEMENT COST NEW (RCN) MODEL WORKSHEET										12/1/2010		
2	2011 National Construction Estimator	Quality 'C' Class - "Standard or Normal Construction"												
3		COST MODEL ASSUMPTIONS												
4	ITEM													Unit
5	Base Floor Size	1000	1200	1300	1400	1500	1600	1800	2400	3200	4000	5000		Cost
39	Single Window Equiv (SWE) of One Story Homes	9	10	10	10	10	10	12	15	21	26	34		
40	1st Floor SWE of Two Story Homes	6	7	9	9	9	9	9	9	12	16	21		
41	SWE Adjustment for Two Story Homes	(3)	(3)	(1)	(1)	(1)	(1)	(3)	(6)	(9)	(10)	(13)		
42	Full Upper Floor Single Window Equivalents	6	6	7	8	8	8	8	8	10	12	14		
43	Half Story/Attic Single Window Equivalents	2	2	2	2	2	2	2	2	2	2	2		
44														
45	UNIFORMAT II Computational Detail													
46	A. SUBSTRUCTURE													
47	A10 Foundations													
48	A1010 Standard Foundations													
49	One Story Structure	6355	7237	7654	7886	8257	8629	9464	10855	14056	16700	19716		46.39
50	1.5 or Two Story Structure	8893	10126	10710	11035	11554	12073	13242	15189	19668	23368	27587		64.91

the five different cost calculations for the 28 model homes listed in table 9. Note that the best median sales ratio and second-best COD occur with the locally adjusted cost tables using the *2011 National Construction Estimator* as the source of the cost data. Note also that the median ratios for *unadjusted* calculations of all three sources of national cost data, including Craftsman, produce combined median ratios that are 21 to 36 percent too high for one-story and two-story homes. This interesting result is discussed later.

The new cost tables and a locally derived age adjustment schedule (indicated depreciation) were used to calculate RCNLD and perform a sales ratio study based upon RCNLD with 2,200 Allen County (Fort Wayne), Indiana, validated sales that occurred from January 4, 2010, through March 1, 2011. The result was a median sale ratio of 1.00 and a COD of 9.02 without market adjustments.

Table 10. Results for residential new construction cost estimation from five different cost models

Summary of Findings	Median Sales Ratio (Median)			Coefficient of Dispersion (COD)		
28 New Construction 2011 Homes from Four Builders	1-story	2-story	Combined	1-story	2-story	Combined
RS Means Residential Cost Data 2011	1.21	1.31	1.32	3.88	3.35	4.73
Final model estimates from 2011 National Construction Estimator (Craftsman)	1.02	1.09	1.06	3.84	4.08	4.75
Initial model estimates from 2011 National Construction Estimator (Craftsman)	1.30	1.40	1.36	4.25	4.20	4.99
2011 Residential Cost Handbook (Marshall & Swift)	1.18	1.31	1.21	4.44	4.68	6.78
Estimates from 2011 National Building Cost Manual (Craftsman)	1.23	1.40	1.26	4.30	5.11	7.30

Economies of Scale in the Residential and Commercial Cost Tables

One major tenet of economic theory is a concept known as *economies of scale*,

Table 9. New cost model etimated values of 28 local builder homes

Model Ref	Total Size	Floor1SF	Floor2SF	Access Date	Model Price	Land Value	Grade C RCN	RCN + Land	A/S_ratio
M-Fulton	1,152	1,152	–	3/16/2011	104,990	21,000	96,400	117,400	1.12
W-Concord	1,267	1,267	–	3/16/2011	110,000	21,900	99,900	121,800	1.11
M-Angelica	1,345	1,345	–	3/16/2011	127,990	25,100	101,500	126,600	0.99
R-Newport	1,426	1,426	–	3/16/2011	129,995	25,400	104,700	130,100	1.00
M-Sanibel	1,368	1,368	–	3/16/2011	130,990	25,600	102,300	127,900	0.98
W-Jackson II	1,433	1,433	–	3/16/2011	135,900	26,500	106,100	132,600	0.98
R-Hudson	1,450	1,450	–	3/16/2011	129,995	25,400	105,600	131,000	1.01
W-Ascott	1,607	1,607	–	3/16/2011	140,900	27,400	111,200	138,600	0.98
M-Argosy	1,804	1,804	–	3/16/2011	137,990	26,800	121,700	148,500	1.08
M-Kentmore	1,958	1,958	–	3/16/2011	153,990	29,600	127,800	157,400	1.02
B-Camden	1,888	1,888	–	3/16/2011	150,900	29,100	126,100	155,200	1.03
M-Cheswicke	2,245	2,245	–	3/16/2011	159,990	30,700	137,600	168,300	1.05
B-Dogwood	2,201	2,201	–	3/16/2011	159,900	30,600	139,200	169,800	1.06
R-Jackson	1,917	837	1,080	3/16/2011	137,995	23,500	120,500	144,000	1.04
M-Farrel	1,536	768	768	3/16/2011	119,990	20,700	110,000	130,700	1.09
M-Braiden	1,720	886	834	3/16/2011	125,990	21,600	118,700	140,300	1.11
M-Columbia	2,159	844	1,315	3/16/2011	151,990	29,600	124,300	153,900	1.01
W-Bedford	1,800	724	1,076	3/16/2011	119,900	23,900	114,000	137,900	1.15
R-Franklin	2,460	1,084	1,376	3/16/2011	148,995	29,100	139,800	168,900	1.13
M-Wakefield	2,090	1,054	1,036	3/16/2011	129,990	25,700	131,100	156,800	1.21
W-Bristol II	2,459	1,051	1,408	3/16/2011	159,900	31,000	141,000	172,000	1.08
B-Harrison	2,133	976	1,157	3/16/2011	149,900	29,200	130,700	159,900	1.07
B-Hartford	2,442	1,074	1,368	3/16/2011	164,900	31,900	136,300	168,200	1.02
W-Compton	3,010	1,214	1,796	3/16/2011	177,900	34,100	163,000	197,100	1.11
B-Indepent	2,347	1,091	1,256	3/16/2011	159,900	31,000	137,400	168,400	1.05
R-Jamestown	3,007	1,393	1,614	3/16/2011	164,995	31,900	161,900	193,800	1.17
M-Torrey	2,760	1,530	1,230	3/16/2011	171,990	33,100	162,600	195,700	1.14
M-Agusta	3,287	1,577	1,710	3/16/2011	194,990	37,100	174,600	211,700	1.09
				Median Price	**144,948**			**Median ratio**	**1.06**
								COD	**4.75**

that is, when more units are produced, it costs less to produce each unit. Economic efficiencies result from carrying out a process such as building construction on a larger and larger scale. "Scale economies can be present in nearly every function of a business, including manufacturing, purchasing . . .," wrote Porter (1980, 7) in *Competitive Strategy*. This occurs because nearly all production processes involve fixed costs and variable costs, and the fixed costs are spread over the larger number of units as volume increases.

In addition to specialization and the division of labor within the various construction trades, there are various inputs that a building contractor controls in a larger construction project that contribute to economies of scale, as follows:

- *Lower material costs.* When a builder buys materials in bulk for larger jobs, for example, concrete, plywood, or steel, the builder can take advantage of volume discounts.
- *Specialized equipment.* As the scale of a construction project increases, a builder can employ specialized labor and equipment, resulting in greater efficiency. For example, beyond a certain size, spreading and grading a 6-inch crushed rock base for a slab is more economical when done with a D-4 tractor than by hand or with smaller equipment, which is more labor-intensive.
- *Learning curve effect.* Each new commercial building construction project has a unique set of plans and requirements. The learning curve effect refers to the capability of workers to improve their productivity by regularly repeating an action; the productivity is increased through practice, self-perfection, and minor innovations, resulting in a reduction in the number of work-hours necessary to achieve a specified amount of output, such as placing 1,000 square feet of concrete or hanging 1,000 square feet of drywall. Studies have shown that the learning curve effect can result in a reduction of 18 to 20 percent in the work-hours necessary to achieve a specified amount of output each time the amount of output or size of the job is doubled (McGuigan, Moyer, and Harris 2002).

This important concept must be acknowledged when published sources of cost data are used to estimate building construction costs. The published rate will be most accurate for the approximate building size assumed by the publisher and will be increasingly inaccurate as building size differs from the assumed size. For example, buildings having the same relationship of perimeter length to floor size might range from 6,000 square feet to 36,000 square feet. These buildings would have a different per-square-foot cost to build, because fixed costs for the larger building would be spread over a greater number of square feet and because of the three key factors detailed above. So while some national cost estimates are driven only by the perimeter length to floor area relationship, economies of scale must also be accounted for in the cost per square foot for the construction of these buildings.

Published sources instruct cost estimators to make an adjustment to the costs to account for economies of scale. "Every estimator knows that as quantity built increases, the unit cost decreases . . . when comparison projects are either much larger or much smaller than the proposed project, adjustments need to be made for the economy of scale," wrote Bledsoe (1992, 14), author of *Successful Estimating Methods . . . from Concept to Bid.* Sources of national cost data vary in the application of such adjustments in their tables. Size adjustments are applied only when the publication provides tables that show the cost per square foot for a particular building type within an expected size range.

The *2011 National Construction Cost Estimator*, which was used to develop the new cost tables, does not contain such tables; therefore, economies-of-scale adjustments were included in the new cost calculation models. The *2011 National Building Cost Manual* (Ogershok 2010), *RSMeans Residential Cost Data 2011* (Mewis, Babbitt, and Baker 2010), and the *Residential Cost Handbook 2011* (Marshall & Swift 2010) do contain tables that present square foot costs across a range of sizes. Analysis of the tables in each publication indicated that the only publisher using a size adjustment to account for economies of scale is RSMeans. The cost per square foot change relative to size reflected in the *2011 National Building Cost Manual* and the *Residential Cost Handbook 2011* results solely from the relationship between perimeter and floor area. Interestingly, use of the RSMeans tables to calculate RCN for the homes listed in table 9 produced the best COD, as presented in table 10. The economies-of-scale size adjustment incorporated in the new cost tables based upon Bledsoe (1992) and those found in the Means (2010) tables are nearly identical.

The new model relied upon the size adjustment method explained by Bledsoe (1992, 13–22) to account for economies of scale. Identical methodology and factoring were utilized for residential, commercial, and industrial tables. Bledsoe used the term *size factor* to refer to the difference in size between two buildings in his size adjustment method. For example, a building with a size of 5,000 square feet and one with a size of 40,000 square feet would have a *size factor* computed as (40000 ÷ 5000) = 8. According to Bledsoe, when the size factor is in the range of

0.9 to 1.1 (building sizes are within 10 percent of one another), there is little difference for which a size factor cost multiplier is needed; however, when sizes differ significantly (more than 10 percent), a cost adjustment multiplier is required for accurate estimates.

Bledsoe's research has determined that an exponential relationship exists between size factor and the total cost multiplier (TCM): that is, an exponent of 0.9 is required for buildings and simple projects. The economies-of-scale calculation in the new cost tables uses the exponent of 0.9 because the calculation applies to buildings. In other words, the exponential formula causes the economies-of-scale factor to rise at a lower rate than the increase in size. For example, a building that is 3.2 times larger than another building experiences a cost reduction based on economies of scale of only 11 percent per square foot.

Economic Conditions, Subjective Quality Opinions, and Locally Verified Economic Modifiers

During the past ten years there has been more turbulence in real property values than at any time since the Great Depression of the 1930s. The Case-Shiller Home Price Index published by Standard & Poor's is the leading measure for the U.S. residential housing market, tracking changes in the value of residential real estate both nationally and in 20 metropolitan regions. In April 2002, the index for Chicago was 119.64; in May 2007, it reached its highest level, 170.14 (an increase of 42 percent in 5 years). This peak was followed by the collapse of the real estate bubble and the ensuing financial crisis. In April 2011 the index for Chicago was 113.45, a decrease of 33 percent from the peak and 5 percent below its level in 2002.

In January 2012, the U.S. Census Bureau reported new home sales in 2011 were 302,000, a new record low following record low new home sales in 2009 and 2010 (U.S. Census Bureau News 2012). Thus, 2011 became the worst year for new home sales since 1963 when tracking began. According to Associated Builders & Contractors, construction industry unemployment in January 2012 was 17.7 percent, more than double the national unemployment rate of 8.5 percent (ThomasNet News 2012). To survive in these difficult times, many healthy construction companies are substantially reducing their overhead expenses and undertaking projects with little or no profit; less healthy companies are failing. Because of the turbulent real estate prices and a depressed construction industry with high unemployment, it has become very difficult for national publishers to estimate local construction costs.

As is the case with appraisers and assessors, building quality opinions among cost publishers are subjective and relative. In addition to the *2011 National Building Cost Manual* and the *2011 National Construction Estimator* published by the Craftsman Book Company, which were used for developing the new cost schedules, 2011 cost data from two other major national publishers (R.S. Means and Marshall & Swift) were used for comparison with the new cost schedules. When costs per square foot were calculated according to publisher instructions for construction classified as *average* in their publications (see tables 6,10, and 11), two of the three publishers had similar costs and the third was noticeably higher. However, these calculated costs were all 21 to 36 percent higher than the actual new construction base home prices offered by major homebuilders in the Midwest where they were compared (see table 10).

The homes used for comparison were being constructed from stock plans of large national homebuilders such as Ryland. Such builders maximize economies of scale and construction efficiency. An important consideration, nevertheless, is the fact that few new homes are sold for their advertised base price; buyers are offered various desirable upgrades for the base model that can add 10 to 20 percent to the base price. Hence, the actual final recorded contract prices of these new homes are normally higher than the

Table 11. Comparison of quality grade cost per square foot differences between publishers

Quality Nomenclature				One story stucco exterior cover on wood stud frame														
	RS		Indiana	1,600 SF					2,400 SF					3,200 SF				
Craftsman NBC	Means	M&S RCH	2012[1]	NBC	Means	RCH	2012[1]	New[2]	NBC	Means	RCH	2012[1]	New[2]	NBC	Means	RCH	2012[1]	New[2]
n/a	n/a	Low	E	–	–	56.51	22.96	50.87	–	–	51.37	20.77	46.13	–	–	47.99	20.26	45.00
6 - Min Std	Economy	Fair	D	62.55	80.50	64.05	45.91	62.25	58.73	70.85	59.45	41.54	56.46	56.84	64.50	56.21	40.52	55.07
5 - Average Std	Average	Average	C	80.17	98.05	74.27	57.39	75.92	75.08	86.80	69.44	51.92	68.85	72.50	79.60	66.11	50.65	67.16
4 - Good Std	Custom	Good	B	98.81	121.60	95.39	68.87	94.14	92.48	104.80	90.49	62.30	85.37	89.36	94.40	86.84	60.78	83.28
3 - Best Std	Luxury	Very Good	A	122.24	156.60	110.86	91.82	118.44	118.89	136.70	106.10	83.07	107.41	116.37	124.60	102.20	81.04	104.77
2 - Semi-Luxury	n/a	Excellent	AA	180.05	–	160.06	137.74	174.62	178.46	–	155.60	124.61	158.36	176.47	–	139.19	121.56	154.47
1 - Luxury	n/a	n/a	AAA	308.14	–	–	206.60	273.31	301.54	–	--	186.91	247.86	295.97	–	–	182.34	241.78
			Builder Markup	25%	17%	- ?? -	–5% *	25%	25%	17%	- ?? -	–5% *	25%	25%	17%	- ?? -	–5% *	25%

[1] *Includes VEM adjustment*

[2] *New Model based on Table 5 Specifications without VEM*

advertised base price. The basic quality grade of the construction does not change when the upgrades are made; however, the extra doors and windows and the flooring upgrades increase the final price. Therefore, it is necessary to determine which features are included in the typical base model and devise a method to adjust the cost when more than the typical features exist, such as using plus or minus designators on the quality classification.

Appraisers may disagree about whether the quality of base homes built by firms such as Ryland should be classified as *average* or *economy*. As table 11 shows, the publishers of cost data do not agree even though their specifications for *average quality* are very similar. Assessors in the jurisdiction and throughout the state where this research was conducted classify these homes as average, which would cause RCN to be excessive if the raw published data were used without further adjustment. Quality classification of the homes as either *economy* or *average* is not a major issue if the classification is applied consistently by assessors and the VEM adjustment is locally derived. A VEM analysis should always be conducted to correlate any national cost data from published sources with local economic conditions and quality assumptions.

Conclusion

The cost tables developed in this project differ from previous tables in a number of ways. First, the underlying property models (representing a typical property for each type) were updated to reflect current building practices by revising the model assumptions. Second, economies-of-scale factors were included in the methodology for converting single-size national unit costs into a schedule of square foot costs by size. Third, the published national cost data were brought into line with those of local real estate market and the local construction industry by applying a locally derived VEM. Sales ratio testing has verified that the resulting cost tables produce more accurate RCN estimates, allowing appraisers and assessors to produce initial value estimates that require fewer market and property factor adjustments.

This research has shown that the cost model itself and its underlying assumptions may be more important than the actual source of cost data used. It has also demonstrated that construction industry costs from published sources can be used to create cost tables for use by appraisers and assessors, which may help relieve budgetary pressures.

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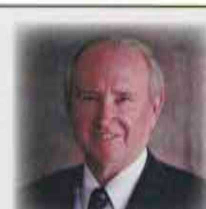

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