Attitudes and Perspectives on BIM adoption in Estimating

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Abstract

Building Information Modeling (BIM) adoption in the construction industry in general, and for estimating in particular, appears to lag its early promise. Studies have indicated that efficiency and accuracy of quantity takeoff can be increased through the adoption of BIM, but the industry usage for quantity takeoff continues to be low to moderate. Understanding construction professional's views and attitudes toward the technology will help identify paths toward greater adoption and, in turn, greater efficiency in the industry. The following research questions need to be addressed:

1. How is BIM currently being used by estimators?
2. How useful do estimators feel BIM is in the early design phase for conceptual estimating?
3. What do estimators feel are the drawbacks to utilizing BIM for estimating?

In order to understand the answers to these questions a survey consisting of 56 questions was administered to 200 construction professionals. Results indicated that general attitudes toward technology and BIM were positive in the industry, but that models are generated too late in the design process, do not meet the needs of estimators for takeoff, and that a lot of ignorance still exists in the profession as to the capabilities and usage of BIM. A statistically significant correlation between company size and design-build experience was associated with a positive view of BIM. The implications are that useful models, tailored to the needs of the estimator, are need earlier in the design process in order to facilitate usage in estimating.

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Section 1: Introduction

Background

Building Information Modeling (BIM) has held great promise for revolutionizing the design, estimating, management and building operation phases of construction process since its arrival on the scene. It offers potential improvement in visualization, shop drawings, schedule, estimating, and coordination (Azhar 2011). Extraordinary promises as to the benefits of utilizing BIM in estimating have included 40% reduction in unbudgeted change, 3% accuracy of cost estimation, and 80% reduction in time to generate a cost estimate (Azhar 2011). Case study after case study demonstrates the estimated benefits to utilizing BIM technology, but the industry continues to adopt slowly. A recent survey conducted by Franco (2015) indicated that over three quarters of multifamily companies surveyed were not using BIM in any capacity. Potential barriers to entry related to time of generating a model, lack of motivation, a lack of understanding have been identified in previous studies (Franco 2015).

Problem Statement

Various reasons have been bandied about for the slow adoption of BIM in estimating in the general contractor and subcontractor world, but a targeted study of the opinions of estimators themselves and their attitudes toward BIM and its use in estimating remains. In order to better understand these opinions the following questions should be answered:

4. How is BIM currently being used by estimators?
5. How useful do estimators feel BIM is in the early design phase for conceptual estimating?
6. What do estimators feel are the drawbacks to utilizing BIM for estimating?

Literature Review

BIM Potential and Benefits

Building Information Modeling (BIM) is a multidisciplinary process centered on a digital three dimensional representation of a project known as a building information model (Azhar 2011). Models have the potential to provide visualization benefits, speed cost estimation, increase accuracy of materials takeoff, identify clashes in building systems, and understand schedule issues that may be hidden in a traditional approach. Azhar (2011) utilized case studies of hotel and university projects to demonstrate that BIM usage saved substantial sums through clash detection and integration of cost into model review meetings and design development.

Technical and work organization challenges for BIM adoption

While the technology continues to improve each year, it has until quite recently been reasonable to view BIM based estimating software as an immature technology (Forgues et al. 2012). The focus by each software developer on a specific phase or aspect of the Construction and design process have led to sometimes clunky interoperability issues (Gu and London 2010). Frequently the estimator is forced to resort to some combination of using BIM as a takeoff tool, and exporting quantities to a traditional spreadsheet or other estimating software. Organizational challenges brought about by the traditional work package emphasis of the construction and design process also lead to challenges where traditional specialists such as designers, estimators, and project managers find it difficult to accommodate a process like BIM that is inherently cross disciplinary (Forgues t al. 2012). Gu and London (2010) noted a consensus shared in focus

group interviews that BIM requires changes in existing work practice, which must then overcome the considerable inertia persistent in construction companies.

Applicability to concept estimating and preliminary work

In spite of the demonstrated benefits to using BIM for cost estimation, its use for feasibility stages has been rare (Park et al. 2014). Some of the challenges associated with early feasibility or concept work are reflected in the real world by the quality of the models and by the common practice of transferring the model in the preliminary design stage from one modeling software to another, such as Google Sketchup to Revit (Forgues et al. 2012). Park et al studied this usage in regards to a feasibility analysis on a national road project in 2014, drawing conclusions that the use of BIM in this analysis provided some consistency cross users, visualization advantages, and a flexibility that the traditional approach lacked.

Limited adoption by project estimators

Designers have been the first and firmest supporters of integrating BIM to the process, with contractors being the lightest users (Azhar 2011). Based on a survey conducted by Franco in 2015 the following responses were given by multifamily construction companies regarding use of BIM for Estimating.

Section 2: Methodology

A survey was created consisting of 56 questions, loosely grouped into three categories. The first category was general information used to verify distinct individual responses and understand the nature of the respondent's roles and backgrounds to assist in interpreting the responses. These questions were:

1. *Name*
2. *Company*
3. *Which category best describes your primary business?*
4. *Which category best describes your primary role at your company?*
5. *Which category best describes your primary construction type?*
6. *If a subcontractor - what is your trade?*
7. *Approximately what is the annual revenue of your company?*
8. *Approximately how many employees does your company have?*
9. *What percentage of your company's work is Design-Build?*
10. *Does your company work primarily in the United States?*
11. *What is your age?*

The second category consisted of questions developed to gauge respondent's current technology usage, again to better understand the nature of respondents and assist in data interpretation. The questions were:

12. *What software does your company use for Estimating and Takeoff (check all that apply)*
13. *To what extent is BIM used on your company's projects (on any level)*
14. *In what manner is BIM used on your company's projects? (check all that apply)*

15. *If you use BIM for Quantity Takeoff, which method best describes your usage?*
16. *At what point in the process is the first BIM model created?*
17. *At what point in the process is the first BIM model useful for quantity takeoff created?*

The final category were a series of statements that the respondents were asked to rate their agreement or disagreement with, intended to assess the respondents attitudes and perspectives regarding BIM use in construction and estimating. Statements were carefully selected to allow as much nuanced response as possible in a short survey, and response choices provided in order to provide respondents opportunity to provide a spectrum of agreement with each statement. The statements were:

18. *Do you consider yourself generally supportive of new technology in the workplace?*
19. *Do you consider yourself generally supportive of BIM in construction?*
20. *Do you consider yourself generally supportive of BIM usage in Estimating?*
21. *Do you feel that BIM adoption in the estimating process significantly lags that of other uses in the industry (design, conflict resolution, scheduling)*
22. *if yes, why do you think that BIM adoption in the Estimating process lags that of other uses in the industry?*
23. *Please rank the ways your company uses BIM in order from most used to least*
24. *BIM is a buzzword of the industry that has been generally overstated in value*
25. *BIM is a buzzword of the industry that's usage to an estimator has been overstated in value*
26. *BIM is a valuable technology that increases the efficiency of construction projects*
27. *BIM is a valuable technology for visualization, design, and conflict resolution but has limited value for estimating*

28. *BIM is a valuable technology for increasing the efficiency of the estimating process*
29. *BIM is a valuable technology for increasing the speed of the quantity takeoff*
30. *BIM is a valuable technology for increasing the accuracy of the estimating process*
31. *BIM is a valuable technology for quantity takeoff*
32. *BIM is a valuable technology for late stage estimating, but of limited use in the early conceptual stages*
33. *BIM is a valuable technology for all stages of the estimating process*
34. *BIM helps estimating due to its visualization aspects but isn't useful to me for quantity takeoff*
35. *There is room for improvement in the usage of BIM for estimating*
36. *I would like to see increased use of BIM in my company's estimating process*
37. *I can see increased value in BIM to the estimating process as the technology improves*
38. *BIM will become a larger part of the estimating process in the future*
39. *BIM is useful for estimating in some trades/construction types but not on the type of work I am focused on*
40. *The widespread integration of BIM into the estimating process is being held back by interoperability issues*
41. *The widespread integration of BIM into the estimating process is being held back by its limited utility in conceptual/early stage estimating*
42. *The widespread integration of BIM into the estimating process is being held back by the conservative nature of the construction industry*
43. *The widespread integration of BIM into the estimating process is being held back by lack of information on the technology*

44. *The widespread integration of BIM into the estimating process is being held back by difficulty of use*
45. *The widespread integration of BIM into the estimating process is being held back by poor quality BIM models (i.e. insufficiently accurate for takeoff)*
46. *The quantities I need for an estimate are not easily pulled from a BIM model in the early stages of the estimating process*
47. *The quantities I need for an estimate are not easily pulled from a BIM model in any stage of the estimating process*
48. *It is difficult to transition an estimate from traditional or Onscreen takeoff methods to BIM quantity generation as the project develops*
49. *It would be possible to increase usage of BIM in early/conceptual stages of the estimating process*
50. *It would improve the estimating process to increase BIM usage in the early/conceptual stages*
51. *A BIM model is best maintained by the contractor/builder*
52. *My company maintains a separate BIM model from the designer to use for estimating, conflict resolution, and scheduling*
53. *It is faster to takeoff 2 dimensional plans in early stages rather than dedicate effort and time to creation of a BIM model for early/conceptual estimating*
54. *It is not worth the time investment of creating a BIM model in the early process because the project isn't real enough*
55. *It is worth the time to create an early BIM model because it helps an estimator track changes as the building design evolves*

56. *Although time consuming up front, it is worth the creation of an early model as it pays off in later stages*

An invitation to complete the survey was distributed by individual emails from the author to a list of 3366 contacts. This list was compiled from personal industry contacts of the author, contractor databases available to the author, and General Contractor contacts made at the Texas A&M Construction Science career fair. No incentive was offered for participation. The email invited the respondent to complete the survey by following a link to a commercially available online survey tool called KwikSurvey. 200 distinct respondents participated, though response rates on individual questions ranged from 50 to 160. Ultimately there were 167 solid and generally complete responses.

Section 3: Results

For each section below questions and results have been selected as the key components. For a graphical breakdown of all results see Appendix A.

Which category best describes your primary business?

General Contractor	Developer-Builder	Subcontractor	Supplier	Designer	Other (Please Specify)
8	17	133	11	3	0

Which category best describes your primary construction type?

Civil/Infrastructure	Single Family residential	Multi-family Residential	Commercial/Retail	Medical	School	Industrial
14	13	106	87	33	34	26

If a subcontractor - what is your trade?

Not applicable	Please Specify
25	1

Approximately what is the annual revenue of your company?

Under 10 Million	10-25 Million	25-50 Million	50-100 Million	100-250 Million	250-500 Million	Over 500 Million
40	33	19	14	9	19	26

Approximately how many employees does your company have?

Under 50	50-100	100-250	250-500	500-1000	more than 1000
43	34	21	25	11	29

What percentage of your company's work is Design-Build?

None	1-25%	25-50%	50-75%	75%-100%	All of our work is Design-Build
30	86	21	5	11	10

Does your company work primarily in the United States?

yes	no
159	6

Which category best describes your primary role at your company?

Designer	Project Manager	Superintendent	Estimator	Executive	BIM Specialist	Other (Please Specify)
7	43	4	77	66	2	0

What software does your company use for Estimating and Takeoff (check all that apply)

MC^2/Ice	Excel	Navis Works	Deep Profiler	On Screen takeoff	Bid Point	Quick Bid	Revit	Other (Please Specify)
7	92	2	0	58	4	7	6	0

To what extent is BIM used on your company's projects (on any level)

None	Less than 25%	25%-50%	50%-75%	More than 75%
53	61	17	7	7

In what manner is BIM used on your company's projects? (check all that apply)

Design	Scheduling	Quantity Takeoff	Submittals	Presentations	Visualization	Conflict resolution	Marketing	Quality Control
46	14	21	27	19	33	50	12	21

If you use BIM for Quantity Takeoff, which method best describes your usage?

9	A spreadsheet report is generated by the designer from Revit or other BIM Software which is input into my estimating software
6	An estimator uses another software such as Deep Profiler to generate a quantity list in spreadsheet form to be input into my spreadsheet software
4	A dedicated BIM technician uses another software such as Deep Profiler to generate a quantity list in spreadsheet form to be input into my spreadsheet software
5	I use a software package that directly integrates the BIM model with my Estimating software without an intermediate spreadsheet generation

At what point in the process is the first BIM model created?

Schematic Design	Concept Design	Design Development	Construction Drawings
11	8	23	36

At what point in the process is the first BIM model useful for quantity takeoff created?

Schematic Design	Concept Design	Design Development	Construction Drawings	BIM is never useful for quantity takeoff
4	0	12	18	33

	Completely Disagree	Disagree	Somewhat Disagree	No Opinion	Somewhat Agree	Agree	Completely Agree		Disagree	No Opinion	Agree
BIM is a buzzword of the industry that has been generally overstated in value	5	17	15	32	24	12	7		33%	29%	38%
BIM is a buzzword of the industry that's usage to an estimator has been overstated in value	0	10	10	46	16	18	11		18%	41%	41%
BIM is a valuable technology that increases the efficiency of construction projects	0	4	5	20	30	38	15		8%	18%	74%
BIM is a valuable technology for visualization, design, and conflict resolution but has limited value for estimating	2	10	10	32	21	28	9		20%	29%	52%
BIM is a valuable technology for increasing the efficiency of the estimating process	6	7	5	50	20	22	2		16%	45%	39%
BIM is a valuable technology for increasing the speed of the quantity takeoff	7	7	6	53	18	16	6		18%	47%	35%
BIM is a valuable technology for increasing the accuracy of the estimating process	6	6	4	50	22	17	8		14%	44%	42%
BIM is a valuable technology for quantity takeoff	5	7	3	46	21	25	6		13%	41%	46%
BIM is a valuable technology for late stage estimating, but of limited use in the early conceptual stages	5	8	9	57	14	12	7		20%	51%	29%
BIM is a valuable technology for all stages of the estimating process	7	10	8	55	15	16	1		22%	49%	29%
BIM helps estimating due to its visualization aspects but isn't useful to me for quantity takeoff	2	15	12	43	20	16	3		26%	39%	35%
There is room for improvement in the usage of BIM for estimating	0	0	0	42	21	30	18		0%	38%	62%
I would like to see increased use of BIM in my company's estimating process	12	5	6	36	25	21	6		21%	32%	47%
I can see increased value in BIM to the estimating process as the technology improves	1	5	3	25	27	39	11		8%	23%	69%
BIM will become a larger part of the estimating process in the future	1	4	6	33	19	38	8		10%	30%	60%
BIM is useful for estimating in some trades/construction types but not on the type of work I am focused on	3	16	9	26	21	21	13		26%	24%	50%
The widespread integration of BIM into the estimating process is being held back by interoperability issues	0	1	2	63	25	12	7		3%	57%	40%
The widespread integration of BIM into the estimating process is being held back by its limited utility in conceptual/early stage estimating	2	3	1	64	23	12	4		6%	59%	36%
The widespread integration of BIM into the estimating process is being held back by the conservative nature of the construction industry	3	4	11	38	27	18	7		17%	35%	48%

	Completely Disagree	Disagree	Somewhat Disagree	No Opinion	Somewhat Agree	Agree	Completely Agree		Disagree	No Opinion	Agree
The widespread integration of BIM into the estimating process is being held back by lack of information on the technology	3	4	10	45	25	15	6		16%	42%	43%
The widespread integration of BIM into the estimating process is being held back by difficulty of use	1	1	8	47	30	20	3		9%	43%	48%
The widespread integration of BIM into the estimating process is being held back by poor quality BIM models (i.e. insufficiently accurate for takeoff)	0	4	4	55	20	13	13		7%	50%	42%
The quantities I need for an estimate are not easily pulled from a BIM model in the early stages of the estimating process	0	2	6	46	17	23	15		7%	42%	50%
The quantities I need for an estimate are not easily pulled from a BIM model in any stage of the estimating process	1	6	9	51	17	15	10		15%	47%	39%
It is difficult to transition an estimate from traditional or Onscreen takeoff methods to BIM quantity generation as the project develops	1	1	4	61	19	19	3		6%	56%	38%
It would be possible to increase usage of BIM in early/conceptual stages of the estimating process	3	1	11	50	21	18	3		14%	47%	39%
It would improve the estimating process to increase BIM usage in the early/conceptual stages	1	4	9	44	25	21	4		13%	41%	46%
A BIM model is best maintained by the contractor/builder	4	3	9	39	22	26	4		15%	36%	49%
My company maintains a separate BIM model from the designer to use for estimating, conflict resolution, and scheduling	11	21	8	49	4	12	3		37%	45%	18%
It is faster to takeoff 2 dimensional plans in early stages rather than dedicate effort and time to creation of a BIM model for early/conceptual estimating	0	1	4	30	25	30	19		5%	28%	68%
It is not worth the time investment of creating a BIM model in the early process because the project isn't real enough	1	4	8	36	24	20	16		12%	33%	55%
It is worth the time to create an early BIM model because it helps an estimator track changes as the building design evolves	4	8	11	54	18	12	1		21%	50%	29%
Although time consuming up front, it is worth the creation of an early model as it pays off in later stages	6	9	11	39	21	20	4		24%	35%	41%

Section 4: Analysis

Regarding the response rating associated with questions 25 through 56 a Likert scale of 1-7 was assigned to each response for analysis purposes, with 1 being “Completely Disagree” and 7 being “Completely Agree”. SPSS software was utilized for all correlation and regression analysis. A Spearman correlation was run since the use of ordinal data violated the assumptions necessary for a Pearson correlation.

General information

The data set collected represents a relatively broad spectrum of the industry with regard to annual revenues, trade, market segment, job title, and company size. However when it comes to role within the industry the respondents are overwhelmingly subcontractors rather than general contractors, Owners, or design professionals. Multifamily was also disproportionately represented in the data. Additionally respondents are almost exclusively performing work within the United States. As the author’s initial contact data base was largely created from the author’s own professional experience (multifamily estimator working nationally) these were unsurprising results.

Technology adoption

The data indicates a relatively low adoption of BIM technology by the respondents, with only 21% of respondent indicating that BIM was being utilized on more than 25% of their projects. A full third of respondents indicated that BIM was not being used on any project for their company. Additionally well over half indicated that the first BIM model was being created at Design Development stage or later, well after conceptual and schematic estimates have been performed. When further asked at what design stage a BIM model became useful for quantity take off, half of respondents indicated that a BIM model useful for quantity takeoff was *never* created.

Statistically significant associations were found at the 0.01 level using the Spearman correlation when relating company size either by revenue or employee count to BIM usage. Further, statistically significant association was found between companies doing more Design-Build work and BIM utilization. Results can be found in the table below.

Correlations

			Number of Employees	Annual Revenue	Percentage of Design-Build Work	To what extent is BIM used on your company's projects (on any level)
Spearman's rho	Number of Employees	Correlation Coefficient	1.000	.773**	.162*	.246**
		Sig. (2-tailed)	.	.000	.037	.001
		N	167	167	167	167
	Annual Revenue	Correlation Coefficient	.773**	1.000	.167*	.202**
		Sig. (2-tailed)	.000	.	.031	.009
		N	167	167	167	167
	Percentage of Design-Build Work	Correlation Coefficient	.162*	.167*	1.000	.306**
		Sig. (2-tailed)	.037	.031	.	.000
		N	167	167	167	167
	To what extent is BIM used on your company's projects (on any level)	Correlation Coefficient	.246**	.202**	.306**	1.000
		Sig. (2-tailed)	.001	.009	.000	.
		N	167	167	167	167

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Attitudes and perspectives

Regarding the questions in this category, it was striking how many of the respondents registered "no opinion". On the 33 questions in this section, between 18% and 59% chose "no opinion", with an average of 40%. Standout results include:

- *"BIM is a valuable technology that increases the efficiency of the construction projects"* - 74% agree on some level with only 8% disagreeing.
- *"I can see increased value in BIM to the estimating process as the technology improves"* - 69% agree on some level and 29% without opinion.

Contrasting these responses with the BIM adoption levels reported by the respondents indicates that there is a positive view of the technology that is not translating into actual adoption. When asked if respondents would like to see their company increase BIM usage for estimating a large plurality (47%) indicated that they would. Additional light is shed on this issue in later questions such as these:

- *"It is faster to takeoff 2 dimensional plans in early stages rather than dedicate effort and time to creation of a BIM model for early/conceptual estimating projects"* - 68% agree on some level with only 5% disagreeing.
- *"BIM is a valuable technology for visualization, design, and conflict resolution but has limited value for estimating"* - 52% agree on some level, with 20% disagreeing.
- *"BIM is useful for estimating in some trades/construction types but not on the type of work I am focused on"* - 50% agree on some level, with 24% without an opinion.

- *"The quantities I need for an estimate are not easily pulled from a BIM model in the early stages of the estimating process"* - 50% agree on some level, with 42% without an opinion.
- *"The quantities I need for an estimate are not easily pulled from a BIM model in any stage of the estimating process"* - 39% agree on some level, with 47% without an opinion.
- *"It is not worth the time investment of creating a BIM model in the early process because the project isn't real enough"* - 55% agree on some level, with 33% without an opinion.

Based on these responses, it seems that there is a prevailing opinion that models are either created too late in the design process to be useful, are unusable in common occurrence for quantity takeoff, or are useful for other industry applications but not for estimators.

To investigate whether there was any statistically significant correlation between responses and company size (by both revenue and employees), and Design-Build experience a correlation was computed for each. The Spearman rho statistic was computed due to the use of ordinal variables violating assumptions necessary for Pearson's correlation. No correlation was found between these factors and the responses to the two negatively phrased questions regarding BIM being a buzzword of industry (Questions 24 and 25), the question geared around visualization only (Question 34), the questions regarding BIM's ability to generate useful qto data (Questions 39 and 36) or the questions related to why BIM usage has been held back (Questions 40,40,42,43,44, and 45). However when asked regarding BIM's value for estimating, quantity takeoff, accuracy etc. a statistically significant correlation was uncovered.

Spearman's rho		Annual Revenue	Number of Employees	Percentage of Design-Build Work
Annual Revenue	Correlation Coefficient	1.000	.773	.167
	Sig. (2-tailed)	.	.000	.031
	N	167	167	167
Number of Employees	Correlation Coefficient	.773	1.000	.162
	Sig. (2-tailed)	.000	.	.037
	N	167	167	167
Percentage of Design-Build Work	Correlation Coefficient	.167	.162	1.000
	Sig. (2-tailed)	.031	.037	.
	N	167	167	167
BIM is a buzzword of the industry that has been generally overstated in value	Correlation Coefficient	.143	.116	.177
	Sig. (2-tailed)	.066	.135	.022
	N	167	167	167
BIM is a buzzword of the industry that's usage to an estimator has been overstated in value	Correlation Coefficient	.189	.171	.145
	Sig. (2-tailed)	.015	.027	.062
	N	167	167	167
BIM is a valuable technology that increases the efficiency of construction projects	Correlation Coefficient	.247	.276	.204
	Sig. (2-tailed)	.001	.000	.008
	N	167	167	167
BIM is a valuable technology for visualization, design, and conflict resolution but has limited value for estimating	Correlation Coefficient	.169	.146	.235
	Sig. (2-tailed)	.029	.060	.002
	N	167	167	167
BIM is a valuable technology for increasing the efficiency of the estimating process	Correlation Coefficient	.233	.233	.218
	Sig. (2-tailed)	.002	.002	.005
	N	167	167	167
BIM is a valuable technology for increasing the speed of the quantity takeoff	Correlation Coefficient	.203	.192	.204
	Sig. (2-tailed)	.008	.013	.008
	N	167	167	167
BIM is a valuable technology for increasing the accuracy of the estimating process	Correlation Coefficient	.233	.215	.209
	Sig. (2-tailed)	.002	.005	.007
	N	167	167	167
BIM is a valuable technology for quantity takeoff	Correlation Coefficient	.203	.210	.199
	Sig. (2-tailed)	.008	.006	.010
	N	167	167	167

Spearman's rho		Annual Revenue	Number of Employees	Percentage of Design-Build Work
Annual Revenue	Correlation Coefficient	1.000	.773	.167
	Sig. (2-tailed)	.	.000	.031
	N	167	167	167
Number of Employees	Correlation Coefficient	.773	1.000	.162
	Sig. (2-tailed)	.000	.	.037
	N	167	167	167
Percentage of Design-Build Work	Correlation Coefficient	.167	.162	1.000
	Sig. (2-tailed)	.031	.037	.
	N	167	167	167
BIM is a valuable technology for late stage estimating, but of limited use in the early conceptual stages	Correlation Coefficient	.228	.198	.243
	Sig. (2-tailed)	.003	.011	.002
	N	167	167	167
BIM is a valuable technology for all stages of the estimating process	Correlation Coefficient	.206	.183	.196
	Sig. (2-tailed)	.008	.018	.011
	N	167	167	167
BIM helps estimating due to its visualization aspects but isn't useful to me for quantity takeoff	Correlation Coefficient	.181	.175	.145
	Sig. (2-tailed)	.020	.024	.061
	N	167	167	167
There is room for improvement in the usage of BIM for estimating	Correlation Coefficient	.212	.223	.122
	Sig. (2-tailed)	.006	.004	.117
	N	167	167	167
I would like to see increased use of BIM in my company's estimating process	Correlation Coefficient	.207	.182	.193
	Sig. (2-tailed)	.007	.018	.012
	N	167	167	167
I can see increased value in BIM to the estimating process as the technology improves	Correlation Coefficient	.239	.249	.165
	Sig. (2-tailed)	.002	.001	.034
	N	167	167	167
BIM will become a larger part of the estimating process in the future	Correlation Coefficient	.179	.182	.187
	Sig. (2-tailed)	.021	.018	.015
	N	167	167	167
BIM is useful for estimating in some trades/construction types but not on the type of work I am focused on	Correlation Coefficient	.117	.111	.156
	Sig. (2-tailed)	.131	.155	.043
	N	167	167	167

Spearman's rho		Annual Revenue	Number of Employees	Percentage of Design-Build Work
Annual Revenue	Correlation Coefficient	1.000	.773	.167
	Sig. (2-tailed)	.	.000	.031
	N	167	167	167
Number of Employees	Correlation Coefficient	.773	1.000	.162
	Sig. (2-tailed)	.000	.	.037
	N	167	167	167
Percentage of Design-Build Work	Correlation Coefficient	.167	.162	1.000
	Sig. (2-tailed)	.031	.037	.
	N	167	167	167
The widespread integration of BIM into the estimating process is being held back by interoperability issues	Correlation Coefficient	.168	.161	.150
	Sig. (2-tailed)	.030	.038	.052
	N	167	167	167
The widespread integration of BIM into the estimating process is being held back by its limited utility in conceptual/early stage estimating	Correlation Coefficient	.151	.174	.218
	Sig. (2-tailed)	.052	.024	.005
	N	167	167	167
The widespread integration of BIM into the estimating process is being held back by the conservative nature of the construction industry	Correlation Coefficient	.179	.148	.186
	Sig. (2-tailed)	.020	.056	.016
	N	167	167	167
The widespread integration of BIM into the estimating process is being held back by lack of information on the technology	Correlation Coefficient	.136	.157	.195
	Sig. (2-tailed)	.081	.043	.011
	N	167	167	167
The widespread integration of BIM into the estimating process is being held back by difficulty of use	Correlation Coefficient	.112	.094	.227
	Sig. (2-tailed)	.150	.228	.003
	N	167	167	167
The widespread integration of BIM into the estimating process is being held back by poor quality BIM models (i.e. insufficiently accurate for takeoff)	Correlation Coefficient	.187	.186	.164
	Sig. (2-tailed)	.015	.016	.034
	N	167	167	167
The quantities I need for an estimate are not easily pulled from a BIM model in the early stages of the estimating process	Correlation Coefficient	.125	.136	.168
	Sig. (2-tailed)	.108	.080	.030
	N	167	167	167
The quantities I need for an estimate are not easily pulled from a BIM model in any stage of the estimating process	Correlation Coefficient	.105	.099	.207
	Sig. (2-tailed)	.178	.204	.007
	N	167	167	167

Spearman's rho		Annual Revenue	Number of Employees	Percentage of Design-Build Work
Annual Revenue	Correlation Coefficient	1.000	.773	.167
	Sig. (2-tailed)	.	.000	.031
	N	167	167	167
Number of Employees	Correlation Coefficient	.773	1.000	.162
	Sig. (2-tailed)	.000	.	.037
	N	167	167	167
Percentage of Design-Build Work	Correlation Coefficient	.167	.162	1.000
	Sig. (2-tailed)	.031	.037	.
	N	167	167	167
It is difficult to transition an estimate from traditional or Onscreen takeoff methods to BIM quantity generation as the project develops	Correlation Coefficient	.189	.180	.232
	Sig. (2-tailed)	.014	.020	.003
	N	167	167	167
It would be possible to increase usage of BIM in early/conceptual stages of the estimating process	Correlation Coefficient	.177	.221	.199
	Sig. (2-tailed)	.022	.004	.010
	N	167	167	167
It would improve the estimating process to increase BIM usage in the early/conceptual stages	Correlation Coefficient	.190	.189	.174
	Sig. (2-tailed)	.014	.015	.024
	N	167	167	167
A BIM model is best maintained by the contractor/builder	Correlation Coefficient	.094	.113	.159
	Sig. (2-tailed)	.228	.145	.040
	N	167	167	167
My company maintains a separate BIM model from the designer to use for estimating, conflict resolution, and scheduling	Correlation Coefficient	.184	.175	.181
	Sig. (2-tailed)	.017	.024	.019
	N	167	167	167
It is faster to takeoff 2 dimensional plans in early stages rather than dedicate effort and time to creation of a BIM model for early/conceptual estimating	Correlation Coefficient	.164	.165	.200
	Sig. (2-tailed)	.035	.033	.009
	N	167	167	167
It is not worth the time investment of creating a BIM model in the early process because the project isn't real enough	Correlation Coefficient	.122	.139	.236
	Sig. (2-tailed)	.116	.073	.002
	N	167	167	167
It is worth the time to create an early BIM model because it helps an estimator track changes as the building design evolves	Correlation Coefficient	.240	.235	.172
	Sig. (2-tailed)	.002	.002	.026
	N	167	167	167

Section 5: Conclusion

Although the construction industry is commonly characterized as being conservative when change and technology are involved, the results of this study generally show positive attitudes toward technology in general and BIM in particular. Of particular note was the large percentages of respondents registering “no opinion” when questioned about the specifics of BIM’s relation to the estimating process. This seems to indicate an ignorance as to the capabilities of the technology and its ability to increase accuracy and efficiency. Increased investment in training and software availability may serve to change this issue. Among respondents that did have an opinion of BIM usage for estimating there was identified a definite perception that the technology was immature, and therefore holds promise but is not as useful for estimating as estimators would like. A significant correlation was discovered regarding company size and design-build experience in relation to a positive view of BIM usage in estimating. In reviewing the data a number of avenues for future research become apparent. Given the significant representation of both the multifamily industry and subcontractors in the sample, it would be worth investigation as to whether similar responses would be achieved in other market sectors and among general contractors. Furthermore, while a definite trend was identified regarding a lack of confidence in a BIM models ability to generate useful quantity takeoff, it is not apparent as to whether this is a justified conclusion of estimators or a perception issue. A study comparing takeoff generated from a model in each design phase of the project and comparing to traditional methods would explore this issue.

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Appendix A

Codebook

Notes

Output Created		06-Mar-2017 17:48:05
Comments		
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Syntax		CODEBOOK Revenue [o] PrimaryBusiness [n] Role [n] ConstructionType [n] SubTrade [n] Employees [o] DesignBuild [o] USWork [n] Age [s] Software [n] BIMUsage [o] BIMUsageType [n] BIMEstUsage [n] ModelCreation [o] UsefulModelCreation [o] TechSupport [n] BimSupport [n] BimEstSupport [n] BimLag [n] LagWhy [n] UsageRank [n] BimBuzz [s] Attitudes25 [s] Attitudes26 [s] Attidudes27 [s] Attitudes28 [s] Attitudes29 [s] Attitudes30 [s] Attitudes31 [s] Attidutes32 [s] Attitudes33 [s] Attitudes34 [s] Attitudes35 [s] Attitudes36 [s] Attitudes37 [s] Attitudes38 [s] Attitudes39 [s] Atiitudes40 [s] Attitudes41 [s] Attitudes42 [s] Attitudes43 [s] Attitudes44 [s] Attitudes45 [s] Attitudes46 [s] Attitudes47 [s] Attitudes48 [s] Attitudes49 [s] Attitudes50 [s] Attitudes51 [s] Attitudes52 [s] Attitudes53 [s] Attitudes54 [s] Attitudes55 [s] Attitudes56 [n] /VARINFO POSITION LABEL TYPE FORMAT MEASURE VALUELABELS MISSING ATTRIBUTES /OPTIONS VARORDER=VARLIST SORT=ASCENDING MAXCATS=200 /STATISTICS COUNT PERCENT MEAN STDDEV QUARTILES.
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[DataSet0] \\filer.arch.tamu.edu\faculty\mjordan\My Documents\Thesis\MJ Thesis SPSS.sav

Revenue

		Value	Count	Percent
Standard Attributes	Position	7		
	Label	Annual Revenue		
	Type	Numeric		
	Format	F40		
	Measurement	Ordinal		
Valid Values	0		8	4.8%
	1	under 10 Million	40	24.0%
	2	10-25 Million	33	19.8%
	3	25-50 Million	19	11.4%
	4	50-100 Million	14	8.4%
	5	100-250 Million	9	5.4%
	6	250-500 Million	19	11.4%
	7	Over 500 Million	25	15.0%

PrimaryBusiness

		Value	Count	Percent
Standard Attributes	Position	3		
	Label	Primary Business		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		1	.6%
	1	General Contractor	8	4.8%
	2	Developer	17	10.2%
	3	Subcontrcator	132	79.0%
	4	Supplier	8	4.8%
	5	Designer	1	.6%
	6	Other	0	.0%

Role

		Value	Count	Percent
Standard Attributes	Position	4		
	Label	Primary Role at Company		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		1	.6%
	1	Designer	7	4.2%
	2	PM	40	24.0%
	3	Superintendent	2	1.2%
	4	Estimator	53	31.7%
	5	Executive	62	37.1%
	6	BIM Specialist	2	1.2%
	7	Other	0	.0%

ConstructionType

		Value	Count	Percent
Standard Attributes	Position	5		
	Label	Industry Segment		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		167	100.0%

SubTrade

		Value	Count	Percent
Standard Attributes	Position	6		
	Label	Sub Trade		
	Type	String		
	Format	A244		
	Measurement	Nominal		
Valid Values	0		10	6.0%
	1		24	14.4%
	230593 230800		1	.6%
	999999		1	.6%
	access flooring		1	.6%
	Boring and Tunneling		1	.6%
	Cabinetry		1	.6%
	Cabinets and Countertops		1	.6%
	Ceramic and Stone Tile		1	.6%
	Commercial Roofing & Waterproofing		1	.6%
	concrete		2	1.2%
	Concrete		5	3.0%
	Concrete Turnkey, Concrete Formwork, Concrete Placement		1	.6%
	Demolition / Excavation		1	.6%
	Division 5		1	.6%

	Division 9	1	.6%
	Divison 5	1	.6%
	Drilled Pier Foundations	1	.6%
	Drilled Shafts	1	.6%
	Drilling, shoring, ground improvement	1	.6%
	Drywall	1	.6%
	Drywall Contractor (metal stud framing, gypsum board, insulation, firestopping, acoustical ceilings)	1	.6%
	Drywall, Metal framing and siding	1	.6%
	Drywall, Metal stud framing, ACT	1	.6%
	Earth Retention Systems and Specialty Foundations	1	.6%
	Electrical	5	3.0%
	Electrical & Low Voltage	1	.6%
	elevators	1	.6%
	Elevators	3	1.8%
	Elevators/Escalators	1	.6%
	Excavation Support, Underpinning, Shotcrete, Drilled Piers & Micropiles	1	.6%
	Excavation/Underground	1	.6%
	Exterior Glass and Glazing and Specialty Products	1	.6%
	Exterior Metal Wall panel systems	1	.6%
	Fence & welding contractor	1	.6%
	Final Cleaning	1	.6%
	Finish Carpentry	1	.6%
	Fire Protection	1	.6%
	Fire Sprinkler	1	.6%
	Fire Sprinklers	2	1.2%
	Fire Sprinklers/Pump Rooms	1	.6%

	Flagpoles - Division 10750	1	.6%
	floorcovering	1	.6%
	flooring	1	.6%
	Foundations, Piling, Support of Excavation	1	.6%
	Framing	1	.6%
	Framing, Drywall, Poured Floors	1	.6%
	Geotechnical Construction	1	.6%
	Glass & Glazing	2	1.2%
	Glass and Glazing	1	.6%
	Glazing Contractor	1	.6%
	Grading/Paving/Underground Utilities	1	.6%
	HVAC	2	1.2%
	insulation	2	1.2%
	Insulation	3	1.8%
	Insulation Installer	1	.6%
	Landscape, Hardscape	1	.6%
	Landscape/Hardscape	1	.6%
	Landscape/Irrigation	1	.6%
	Life Safety Systems - Fire Alarm and Fire Protection	1	.6%
	Low slope /steep slope roofing and architectural sheet metal	1	.6%
	masonry	1	.6%
	Masonry	3	1.8%
	MASONRY	1	.6%
	Masonry: Stone veneer	1	.6%
	MECHANICAL	1	.6%
	Mechanical Contractor	1	.6%
	Metal stud framing/drywall	1	.6%
	metals, aluminum rail manufacture	1	.6%
	Miscellaneous Steel	1	.6%

	Painting	1	.6%
	plaster	1	.6%
	Plumbing	2	1.2%
	Precast	1	.6%
	Precast concrete manufacturer	1	.6%
	RAILING FABRCATOR	1	.6%
	Roofing and sheet metal	1	.6%
	Rough Carpentry	1	.6%
	rough carpentry / framing	1	.6%
	Rough Carpentry/ Framing	1	.6%
	ROUGH FRAMING	1	.6%
	Rough Wood Framing	1	.6%
	Roughy Carpentry	1	.6%
	Shoring; Drilling; Cassions; Deep Foundation	1	.6%
	Signage Manufacturer	1	.6%
	Site utilities and excavation	1	.6%
	sitework	1	.6%
	Sitework	1	.6%
	Specialty - Civil Construction	1	.6%
	sports floors	1	.6%
	Steel Fab and erection	1	.6%
	Stone veneer, stucco, eifs	1	.6%
	Structural Concrete	5	3.0%
	Structural Concrete & Reinforcing	1	.6%
	submetering	1	.6%
	Swimming Pools	2	1.2%
	swimming pools/fountains	1	.6%
	Tile installation	1	.6%
	Turnkey structural elevated concrete	1	.6%
	Underground Wet Site Utilities	1	.6%

	Utility Contractor - Water, Sewer, Storm, SWM		1	.6%
	Utility Plumber Mechanical		1	.6%
	Vertical Transportation		1	.6%
	Waterproofing		1	.6%
	waterproofing, cauling, AVB, Deck Coating Systems, Expansion Joints		1	.6%
	window blinds shades motorization		1	.6%
	Window Treatments		1	.6%
	Window Treatments / Drywall / Ceilings		1	.6%
	Wood framing		1	.6%
	wood framing subcontractor		1	.6%

Employees

		Value	Count	Percent
Standard Attributes	Position	8		
	Label	Number of Employees		
	Type	Numeric		
	Format	F40		
	Measurement	Ordinal		
Valid Values	0		4	2.4%
	1	Under 50	43	25.7%
	2	50-100	34	20.4%
	3	100-250	21	12.6%
	4	250-500	25	15.0%
	5	500-1000	11	6.6%
	6	more than 1000	29	17.4%

DesignBuild

		Value	Count	Percent
Standard Attributes	Position	9		
	Label	Percentage of Design-Build Work		
	Type	Numeric		
	Format	F40		
	Measurement	Ordinal		
Valid Values	0		4	2.4%
	1	none	30	18.0%
	2	1-25%	86	51.5%
	3	25-50%	21	12.6%
	4	50-75%	5	3.0%
	5	75-100%	11	6.6%
	6	All	10	6.0%

USWork

		Value	Count	Percent
Standard Attributes	Position	10		
	Label	Do they work primarily in the US		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		2	1.2%
	1	Yes	159	95.2%
	2	No	6	3.6%

Age

		Value
Standard Attributes	Position	11
	Label	Age of Respondent
	Type	Numeric
	Format	F40
	Measurement	Scale
N	Valid	167
	Missing	0
Central Tendency and Dispersion	Mean	44.53
	Standard Deviation	14.890
	Percentile 25	37.00
	Percentile 50	47.00
	Percentile 75	55.00

Software

		Value	Count	Percent
Standard Attributes	Position	12		
	Label	What Software is used for Estimating		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		167	100.0%
	1	MC^2/ICE	0	.0%
	2	Excel	0	.0%
	3	Navis	0	.0%
	4	Deep Profiler	0	.0%
	5	OST	0	.0%
	6	BidPoint	0	.0%
	7	QuickBid	0	.0%
	8	Revit	0	.0%

Software

		Value	Count	Percent
Standard Attributes	Position	12		
	Label	What Software is used for Estimating		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		167	100.0%
	1	MC^2/ICE	0	.0%
	2	Excel	0	.0%
	3	Navis	0	.0%
	4	Deep Profiler	0	.0%
	5	OST	0	.0%
	6	BidPoint	0	.0%
	7	QuickBid	0	.0%
	8	Revit	0	.0%
	9	Other	0	.0%

BIMUsage

		Value	Count	Percent
Standard Attributes	Position	13		
	Label	To what extent is BIM used on your company's projects (on any level)		
	Type	Numeric		
	Format	F40		
	Measurement	Ordinal		
Valid Values	0		22	13.2%
	1	None	53	31.7%
	2	Less than 25%	61	36.5%
	3	25-50%	17	10.2%
	4	50-75%	7	4.2%
	5	More than 75%	7	4.2%

BIMUsageType

		Value	Count	Percent
Standard Attributes	Position	14		
	Label	In what manner is BIM used on your company's projects? (check all that apply)		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		167	100.0%
	1	Design	0	.0%
	2	Scheduling	0	.0%
	3	Quantity Takeoff	0	.0%
	4	Submittals	0	.0%
	5	Presentations	0	.0%

BIMEstUsage

		Value	Count	Percent
Standard Attributes	Position	15		
	Label	<none>		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		167	100.0%

ModelCreation

		Value	Count	Percent
Standard Attributes	Position	16		
	Label	At what point in the process is the first BIM model created?		
	Type	Numeric		
	Format	F40		
	Measurement	Ordinal		
Valid Values	0		89	53.3%
	1	Schematic Design	11	6.6%
	2	Concept Design	8	4.8%
	3	Design Development	23	13.8%
	4	Construciton Drawings	36	21.6%

UsefulModelCreation

		Value	Count	Percent
Standard Attributes	Position	17		
	Label	At what point in the process is the first BIM model useful for quantity takeoff created?		
	Type	Numeric		
	Format	F40		
	Measurement	Ordinal		
Valid Values	0		100	59.9%
	1	Schematic Design	4	2.4%
	2	Concept Design	0	.0%
	3	Design Development	12	7.2%
	4	Construciton Drawings	18	10.8%
	5	Never	33	19.8%

TechSupport

		Value	Count	Percent
Standard Attributes	Position	18		
	Label	Do you consider yourself generally supportive of new technology in the workplace?		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		48	28.7%
	1	Yes	115	68.9%
	2	No	4	2.4%

BimSupport

		Value	Count	Percent
Standard Attributes	Position	19		
	Label	Do you consider yourself generally supportive of BIM in construction?		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		57	34.1%
	1	Yes	95	56.9%
	2	No	15	9.0%

BimEstSupport

		Value	Count	Percent
Standard Attributes	Position	20		
	Label	Do you consider yourself generally supportive of BIM usage in Estimating?		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		64	38.3%
	1	Yes	59	35.3%
	2	No	44	26.3%

BimLag

		Value	Count	Percent
Standard Attributes	Position	21		
	Label	Do you feel that BIM adoption in the estimating process significantly lags that of other uses in the industry (design, conflict resolution, scheduling)		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		68	40.7%
	1	Yes	66	39.5%

BimLag

		Value	Count	Percent
Standard Attributes	Position	21		
	Label	Do you feel that BIM adoption in the estimating process significantly lags that of other uses in the industry (design, conflict resolution, scheduling)		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		68	40.7%
	1	Yes	66	39.5%
	2	No	33	19.8%

LagWhy

		Value	Count	Percent
Standard Attributes	Position	22		
	Label	Why does BIM Usage Lag in Estimating		
	Type	String		
	Format	A244		
	Measurement	Nominal		
Valid Values	0		109	65.3%
	Ability to consistently receive BIM drawings in Estimating process gives us no incentive to change our estimating procedures		1	.6%

	Alot of the other trades do not use any sort of BIM or much advance planning	1	.6%
	As a subcontractor we are subject to obtain the BIM models from the architect. Our understanding is the architects generally design in BIM, but do not share those designs unless the owners pay for the work.	1	.6%
	BIM allows us more accuracy in estimating than other methods.	1	.6%
	BIM does not fit well with our requirements.	1	.6%
	BIM is not being used in the envelope construction yet but there is a need in order to see how windows, flashings, transitions and difficult tie-ins are going to be detailed. BIM will help provide some of these answers to details that are lack	1	.6%
	BIM is not practical for a rough carpentry sub to rely upon. There are way too many variables for the BIM design to be correctly drawn the first time around and ultimately, we have aborted the few BIM designs on contracts we had and redid them	1	.6%
	BIM is not the fastest way to do a take-off.	1	.6%

	Bim is useful for conflicts, beam locations, blockouts, etc. but not in estimating the installation.		1	.6%
	BIM usage generally stops at MEP trades and doesn't incorporate metal framing and finishes to the level of detail needed for estimating.		1	.6%
	Construction companies tend to lag on the tenhnologic side. Adoption is slow, but gaining.		1	.6%
	Everyone works off of prints. If you can not estimate a project from prints (because there is no BIM model), you need not be estimating, selling or working on a project.		1	.6%
	For our line of work it is rather complicated. And needs a lot of computer firepower. Which is not a real problem but does have an effect. The other thing is there is a large volume of take off software out there that is competing. Now this is		1	.6%
	Generation gap. Not included in construction management courses.		1	.6%
	Great at conflict resolution		1	.6%

	I believe BIM was created for scheduling and prediction/resolution of trade conflicts and sequencing. I have not heard of BIM used in estimating practices.		1	.6%
	I do not have the exposure to seeing BIM used in estimated as often as conflict resolution, coordination, and scheduling		1	.6%
	I do not use it and have no need to use it at this time		1	.6%
	I don't see BIM as being readily available or affordable to companies like mine		1	.6%
	I dont know of anyone that is currently using BIM for estimating, mostly conflict resolution.		1	.6%
	I feel like the use of BIM for estimating is just getting started where conflict resolution has been used for years and continues to evolve. From conflict resolution, I feel like design and scheduling became the next priority and quickly caught		1	.6%
	I feel that keeping up with the latest technology is the key to success.		1	.6%

	I know it is being used by some GC's, but when it comes to figuring window blinds or roller shades, I have not found a software that can coordinate between the plans issued and sizes I need		1	.6%
	I've been aware of BIM for some time but not in the context of estimating		1	.6%
	In general, Architect's development of their BIM drawings are behind in the amount of detail necessary for accurate quants. for good estimates. Also, Architects knowing this have a hard time release partial completed documents.		1	.6%
	In our field we generally use BIM for submittal review and coordination.		1	.6%
	In our position the BIM process can result in a much more efficient project but in most cases we are released to late in the game to get started.		1	.6%
	It has not been adopted widely enough to make it useful in estimating and take off. Also the designers don't detail projects fully in BIM so their models have blank spots that are not complete.		1	.6%

	It is difficult to extract data from the BIM model in a clean, easily manipulated format. Many estimating software platforms are currently working to solve this but we have yet to see anybody with a viable solution.		1	.6%
	It is not readily available to estimating		1	.6%
	Lack of familiarity with the technology and a lack of willingness by companies to purchase new software		1	.6%
	Methodical process are hard to change especially in something as important as estimating.		1	.6%
	My personal experience is that estimators usually don't have a well enough developed model to make material takeoffs useful in the bidding stage of a project. And after contracts are awarded and models develop, very accurate material takeoffs		1	.6%
	Newer technology. Not fully adopted other than at cutting edge GCs		1	.6%
	Not aware of it's estimating use.		1	.6%

	Often a cumbersome experience; typically standards for quantity takeoff are being created by BIM personnel, and the knowledge gap between BIM personnel and estimators is substantial.		1	.6%
	Our models are fully available on our pre-engineered line of elevators online. I believe that they are used by less than 5% of the architectural community in building design. We also offer services to create custom BIMs for engineered elevato		1	.6%
	overkill cut it out just build the gosh darn things and quit always looking for shortcuts and cheat codes		1	.6%
	Personally have not had the time to learn anything about BIM. BIM seems like a good tool, but not sure about the cost - benefit as it relates to time to generate a bid. Most estimators stick with what they know how to do in order to bid in a		1	.6%
	Projects are almost always awarded prior to any 3d modeling cordination needed to create a BIM model for estimation.		1	.6%
	Seems estimating tends to lean towards an "old school" mentality.		1	.6%

	Since the budgeting we do requires us to price off of concept sketches or conceptual drawings; in my experience, we rarely have drawings that are far enough along to generate a BIM model. I think this mostly comes down to the money - we don't w		1	.6%
	Slows the starting process down		1	.6%
	Subcontractoring community diverse in size and capability for most its difficult to handle the cost of BIM		1	.6%
	Takes too long for fully designed system		1	.6%
	Takes too long to perform quantity take-off		1	.6%
	The challenge is we are producing estimates ahead of complete designs, and therefore ahead of a complete model.		1	.6%
	the design development process causes drawings to be inaccurate - thus rendering the BIM process for estimating in-accurate		1	.6%
	The information provided for the components of the model is inadequate to price accurately.		1	.6%

	The model is almost never provided by the design team until after project is bid/awarded. Also, the quality of the models are poor for mechanical take off.	1	.6%
	The quantity take off at the estimating stage may not be an exact representation of the project and based on timing historicals may be more readily used then and entire quantity take off.	1	.6%
	there is no choice if you want the job. don't feel it saves much time	1	.6%
	THIS IS THE FIRST THING I HERE. "LET ME TELL YOU WHAT I WONT"	1	.6%
	Training to old school people, and not much awareness of use full ness of the product	1	.6%
	We are have made bim a requirement on projects with lead architects, but there has been very few sub consultants on the team that embrace. Requiring it from all consultants limits the pool of talent you can draw on.	1	.6%
	We do not design our system prior to estimating a project. The design process happens upon award of contract.	1	.6%
	we don't use it	1	.6%

	we don't use it and it has been around for at least a decade.	1	.6%

UsageRank

		Value	Count	Percent
Standard Attributes	Position	23		
	Label	<none>		
	Type	Numeric		
	Format	F40		
	Measurement	Nominal		
Valid Values	0		167	100.0%

BimBuzz

		Value	Count	Percent
Standard Attributes	Position	24		
	Label	BIM is a buzzword of the industry that has been generally overstated in value		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.71		
Dispersion	Standard Deviation	2.284		
	Percentile 25	.00		
	Percentile 50	3.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	5	3.0%
	2	Disagree	17	10.2%
	3	Somewhat Disagree	15	9.0%
	4	No Opinion	32	19.2%

	5	Somewhat Agree	24	14.4%
	6	Agree	12	7.2%
	7	Completely Agree	7	4.2%

Attitudes25

		Value	Count	Percent
Standard Attributes	Position	25		
	Label	BIM is a buzzword of the industry that's usage to an estimator has been overstated in value		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.99		
Dispersion	Standard Deviation	2.407		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	0	.0%
	2	Disagree	10	6.0%
	3	Somewhat Disagree	10	6.0%
	4	No Opinion	46	27.5%
	5	Somewhat Agree	16	9.6%
	6	Agree	18	10.8%
	7	Completely Agree	11	6.6%

Attitudes26

		Value	Count	Percent
Standard Attributes	Position	26		
	Label	BIM is a valuable technology that increases the efficiency of construction projects		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.51		
Dispersion	Standard Deviation	2.664		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	6.00		
Labeled Values	1	Completely Disagree	0	.0%
	2	Disagree	4	2.4%
	3	Somewhat Disagree	5	3.0%
	4	No Opinion	20	12.0%
	5	Somewhat Agree	30	18.0%
	6	Agree	38	22.8%
	7	Completely Agree	15	9.0%

Attidudes27

		Value	Count	Percent
Standard Attributes	Position	27		
	Label	BIM is a valuable technology for visualization, design, and conflict resolution but has limited value for estimating		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.09		
Dispersion	Standard Deviation	2.483		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	2	1.2%
	2	Disagree	10	6.0%
	3	Somewhat Disagree	10	6.0%
	4	No Opinion	32	19.2%
	5	Somewhat Agree	21	12.6%
	6	Agree	28	16.8%
	7	Completely Agree	9	5.4%

Attitudes28

		Value	Count	Percent
Standard Attributes	Position	28		
	Label	BIM is a valuable technology for increasing the efficiency of the estimating process		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and Dispersion	Mean	2.88		
	Standard Deviation	2.307		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	6	3.6%
	2	Disagree	7	4.2%
	3	Somewhat Disagree	5	3.0%
	4	No Opinion	50	29.9%
	5	Somewhat Agree	20	12.0%
	6	Agree	22	13.2%
	7	Completely Agree	2	1.2%

Attitudes29

		Value	Count	Percent
Standard Attributes	Position	29		
	Label	BIM is a valuable technology for increasing the speed of the quantity takeoff		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.87		
Dispersion	Standard Deviation	2.306		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	4.00		
Labeled Values	1	Completely Disagree	7	4.2%
	2	Disagree	7	4.2%
	3	Somewhat Disagree	6	3.6%
	4	No Opinion	53	31.7%
	5	Somewhat Agree	18	10.8%
	6	Agree	16	9.6%
	7	Completely Agree	6	3.6%

Attitudes30

		Value	Count	Percent
Standard Attributes	Position	30		
	Label	BIM is a valuable technology for increasing the accuracy of the estimating process		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.98		
Dispersion	Standard Deviation	2.373		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	6	3.6%
	2	Disagree	6	3.6%
	3	Somewhat Disagree	4	2.4%
	4	No Opinion	50	29.9%
	5	Somewhat Agree	22	13.2%
	6	Agree	17	10.2%
	7	Completely Agree	8	4.8%

Attitudes31

		Value	Count	Percent
Standard Attributes	Position	31		
	Label	BIM is a valuable technology for quantity takeoff		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.05		
Dispersion	Standard Deviation	2.409		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	5	3.0%
	2	Disagree	7	4.2%
	3	Somewhat Disagree	3	1.8%
	4	No Opinion	46	27.5%
	5	Somewhat Agree	21	12.6%
	6	Agree	25	15.0%
	7	Completely Agree	6	3.6%

Attidutes32

		Value	Count	Percent
Standard Attributes	Position	32		
	Label	BIM is a valuable technology for late stage estimating, but of limited use in the early conceptual stages		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.80		
Dispersion	Standard Deviation	2.262		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	4.00		
Labeled Values	1	Completely Disagree	5	3.0%
	2	Disagree	8	4.8%
	3	Somewhat Disagree	9	5.4%
	4	No Opinion	57	34.1%
	5	Somewhat Agree	14	8.4%
	6	Agree	12	7.2%
	7	Completely Agree	7	4.2%

Attitudes33

		Value	Count	Percent
Standard Attributes	Position	33		
	Label	BIM is a valuable technology for all stages of the estimating process		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and Dispersion	Mean	2.69		
	Standard Deviation	2.184		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	4.00		
Labeled Values	1	Completely Disagree	7	4.2%
	2	Disagree	10	6.0%
	3	Somewhat Disagree	8	4.8%
	4	No Opinion	55	32.9%
	5	Somewhat Agree	15	9.0%
	6	Agree	16	9.6%
	7	Completely Agree	1	.6%

Attitudes34

		Value	Count	Percent
Standard Attributes	Position	34		
	Label	BIM helps estimating due to its visualization aspects but isn't useful to me for quantity takeoff		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.74		
Dispersion	Standard Deviation	2.237		
	Percentile 25	.00		
	Percentile 50	3.00		
	Percentile 75	4.00		
Labeled Values	1	Completely Disagree	2	1.2%
	2	Disagree	15	9.0%
	3	Somewhat Disagree	12	7.2%
	4	No Opinion	43	25.7%
	5	Somewhat Agree	20	12.0%
	6	Agree	16	9.6%
	7	Completely Agree	3	1.8%

Attitudes35

		Value	Count	Percent
Standard Attributes	Position	35		
	Label	There is room for improvement in the usage of BIM for estimating		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.47		
Dispersion	Standard Deviation	2.634		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	6.00		
Labeled Values	1	Completely Disagree	0	.0%
	2	Disagree	0	.0%
	3	Somewhat Disagree	0	.0%
	4	No Opinion	42	25.1%
	5	Somewhat Agree	21	12.6%
	6	Agree	30	18.0%
	7	Completely Agree	18	10.8%

Attitudes36

		Value	Count	Percent
Standard Attributes	Position	36		
	Label	I would like to see increased use of BIM in my company's estimating process		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.86		
Dispersion	Standard Deviation	2.423		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	12	7.2%
	2	Disagree	5	3.0%
	3	Somewhat Disagree	6	3.6%
	4	No Opinion	36	21.6%
	5	Somewhat Agree	25	15.0%
	6	Agree	21	12.6%
	7	Completely Agree	6	3.6%

Attitudes37

		Value	Count	Percent
Standard Attributes	Position	37		
	Label	I can see increased value in BIM to the estimating process as the technology improves		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.39		
Dispersion	Standard Deviation	2.629		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	6.00		
Labeled Values	1	Completely Disagree	1	.6%
	2	Disagree	5	3.0%
	3	Somewhat Disagree	3	1.8%
	4	No Opinion	25	15.0%
	5	Somewhat Agree	27	16.2%
	6	Agree	39	23.4%
	7	Completely Agree	11	6.6%

Attitudes38

		Value	Count	Percent
Standard Attributes	Position	38		
	Label	BIM will become a larger part of the estimating process in the future		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.22		
Dispersion	Standard Deviation	2.575		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	6.00		
Labeled Values	1	Completely Disagree	1	.6%
	2	Disagree	4	2.4%
	3	Somewhat Disagree	6	3.6%
	4	No Opinion	33	19.8%
	5	Somewhat Agree	19	11.4%
	6	Agree	38	22.8%
	7	Completely Agree	8	4.8%

Attitudes39

		Value	Count	Percent
Standard Attributes	Position	39		
	Label	BIM is useful for estimating in some trades/construction types but not on the type of work I am focused on		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.92		
Dispersion	Standard Deviation	2.522		
	Percentile 25	.00		
	Percentile 50	3.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	3	1.8%
	2	Disagree	16	9.6%
	3	Somewhat Disagree	9	5.4%
	4	No Opinion	26	15.6%
	5	Somewhat Agree	21	12.6%
	6	Agree	21	12.6%
	7	Completely Agree	13	7.8%

Atiitudes40

		Value	Count	Percent
Standard Attributes	Position	40		
	Label	The widespread integration of BIM into the estimating process is being held back by interoperability issues		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.03		
Dispersion	Standard Deviation	2.324		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	0	.0%
	2	Disagree	1	.6%
	3	Somewhat Disagree	2	1.2%
	4	No Opinion	63	37.7%
	5	Somewhat Agree	25	15.0%
	6	Agree	12	7.2%
	7	Completely Agree	7	4.2%

Attitudes41

		Value	Count	Percent
Standard Attributes	Position	41		
	Label	The widespread integration of BIM into the estimating process is being held back by its limited utility in conceptual/early stage estimating		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and Dispersion	Mean	2.89		
	Standard Deviation	2.275		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	4.00		
Labeled Values	1	Completely Disagree	2	1.2%
	2	Disagree	3	1.8%
	3	Somewhat Disagree	1	.6%
	4	No Opinion	64	38.3%
	5	Somewhat Agree	23	13.8%
	6	Agree	12	7.2%
	7	Completely Agree	4	2.4%

Attitudes42

		Value	Count	Percent
Standard Attributes	Position	42		
	Label	The widespread integration of BIM into the estimating process is being held back by the conservative nature of the construction industry		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and Dispersion	Mean	2.92		
	Standard Deviation	2.412		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	3	1.8%
	2	Disagree	4	2.4%
	3	Somewhat Disagree	11	6.6%
	4	No Opinion	38	22.8%
	5	Somewhat Agree	27	16.2%
	6	Agree	18	10.8%
	7	Completely Agree	7	4.2%

Attitudes43

		Value	Count	Percent
Standard Attributes	Position	43		
	Label	The widespread integration of BIM into the estimating process is being held back by lack of information on the technology		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.86		
Dispersion	Standard Deviation	2.354		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	3	1.8%
	2	Disagree	4	2.4%
	3	Somewhat Disagree	10	6.0%
	4	No Opinion	45	26.9%
	5	Somewhat Agree	25	15.0%
	6	Agree	15	9.0%
	7	Completely Agree	6	3.6%

Attitudes44

		Value	Count	Percent
Standard Attributes	Position	44		
	Label	The widespread integration of BIM into the estimating process is being held back by difficulty of use		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.03		
Dispersion	Standard Deviation	2.345		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	1	.6%
	2	Disagree	1	.6%
	3	Somewhat Disagree	8	4.8%
	4	No Opinion	47	28.1%
	5	Somewhat Agree	30	18.0%
	6	Agree	20	12.0%
	7	Completely Agree	3	1.8%

Attitudes45

		Value	Count	Percent
Standard Attributes	Position	45		
	Label	The widespread integration of BIM into the estimating process is being held back by poor quality BIM models (i.e. insufficiently accurate for takeoff)		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.05		
Dispersion	Standard Deviation	2.437		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	0	.0%
	2	Disagree	4	2.4%
	3	Somewhat Disagree	4	2.4%
	4	No Opinion	55	32.9%
	5	Somewhat Agree	20	12.0%
	6	Agree	13	7.8%
	7	Completely Agree	13	7.8%

Attitudes46

		Value	Count	Percent
Standard Attributes	Position	46		
	Label	The quantities I need for an estimate are not easily pulled from a BIM model in the early stages of the estimating process		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.20		
Dispersion	Standard Deviation	2.549		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	0	.0%
	2	Disagree	2	1.2%
	3	Somewhat Disagree	6	3.6%
	4	No Opinion	46	27.5%
	5	Somewhat Agree	17	10.2%
	6	Agree	23	13.8%
	7	Completely Agree	15	9.0%

Attitudes47

		Value	Count	Percent
Standard Attributes	Position	47		
	Label	The quantities I need for an estimate are not easily pulled from a BIM model in any stage of the estimating process		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.93		
Dispersion	Standard Deviation	2.386		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	1	.6%
	2	Disagree	6	3.6%
	3	Somewhat Disagree	9	5.4%
	4	No Opinion	51	30.5%
	5	Somewhat Agree	17	10.2%
	6	Agree	15	9.0%
	7	Completely Agree	10	6.0%

Attitudes48

		Value	Count	Percent
Standard Attributes	Position	48		
	Label	It is difficult to transition an estimate from traditional or Onscreen takeoff methods to BIM quantity generation as the project develops		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and Dispersion	Mean	2.93		
	Standard Deviation	2.317		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	4.00		
Labeled Values	1	Completely Disagree	1	.6%
	2	Disagree	1	.6%
	3	Somewhat Disagree	4	2.4%
	4	No Opinion	61	36.5%
	5	Somewhat Agree	19	11.4%
	6	Agree	19	11.4%
	7	Completely Agree	3	1.8%

Attitudes49

		Value	Count	Percent
Standard Attributes	Position	49		
	Label	It would be possible to increase usage of BIM in early/conceptual stages of the estimating process		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.83		
Dispersion	Standard Deviation	2.318		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	3	1.8%
	2	Disagree	1	.6%
	3	Somewhat Disagree	11	6.6%
	4	No Opinion	50	29.9%
	5	Somewhat Agree	21	12.6%
	6	Agree	18	10.8%
	7	Completely Agree	3	1.8%

Attitudes50

		Value	Count	Percent
Standard Attributes	Position	50		
	Label	It would improve the estimating process to increase BIM usage in the early/conceptual stages		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and Dispersion	Mean	2.94		
	Standard Deviation	2.374		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	1	.6%
	2	Disagree	4	2.4%
	3	Somewhat Disagree	9	5.4%
	4	No Opinion	44	26.3%
	5	Somewhat Agree	25	15.0%
	6	Agree	21	12.6%
	7	Completely Agree	4	2.4%

Attitudes51

		Value	Count	Percent
Standard Attributes	Position	51		
	Label	A BIM model is best maintained by the contractor/builder		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.92		
Dispersion	Standard Deviation	2.433		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	4	2.4%
	2	Disagree	3	1.8%
	3	Somewhat Disagree	9	5.4%
	4	No Opinion	39	23.4%
	5	Somewhat Agree	22	13.2%
	6	Agree	26	15.6%
	7	Completely Agree	4	2.4%

Attitudes52

		Value	Count	Percent
Standard Attributes	Position	52		
	Label	My company maintains a separate BIM model from the designer to use for estimating, conflict resolution, and scheduling		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.31		
Dispersion	Standard Deviation	2.108		
	Percentile 25	.00		
	Percentile 50	2.00		
	Percentile 75	4.00		
Labeled Values	1	Completely Disagree	11	6.6%
	2	Disagree	21	12.6%
	3	Somewhat Disagree	8	4.8%
	4	No Opinion	49	29.3%
	5	Somewhat Agree	4	2.4%
	6	Agree	12	7.2%
	7	Completely Agree	3	1.8%

Attitudes53

		Value	Count	Percent
Standard Attributes	Position	53		
	Label	It is faster to takeoff 2 dimensional plans in early stages rather than dedicate effort and time to creation of a BIM model for early/conceptual estimating		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.43		
Dispersion	Standard Deviation	2.685		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	6.00		
Labeled Values	1	Completely Disagree	0	.0%
	2	Disagree	1	.6%
	3	Somewhat Disagree	4	2.4%
	4	No Opinion	30	18.0%
	5	Somewhat Agree	25	15.0%
	6	Agree	30	18.0%
	7	Completely Agree	19	11.4%

Attitudes54

		Value	Count	Percent
Standard Attributes	Position	54		
	Label	It is not worth the time investment of creating a BIM model in the early process because the project isn't real enough		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	3.17		
Dispersion	Standard Deviation	2.566		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	5.00		
Labeled Values	1	Completely Disagree	1	.6%
	2	Disagree	4	2.4%
	3	Somewhat Disagree	8	4.8%
	4	No Opinion	36	21.6%
	5	Somewhat Agree	24	14.4%
	6	Agree	20	12.0%
	7	Completely Agree	16	9.6%

Attitudes55

		Value	Count	Percent
Standard Attributes	Position	55		
	Label	It is worth the time to create an early BIM model because it helps an estimator track changes as the building design evolves		
	Type	Numeric		
	Format	F4		
	Measurement	Scale		
N	Valid	167		
	Missing	0		
Central Tendency and	Mean	2.62		
Dispersion	Standard Deviation	2.169		
	Percentile 25	.00		
	Percentile 50	4.00		
	Percentile 75	4.00		
Labeled Values	1	Completely Disagree	4	2.4%
	2	Disagree	8	4.8%
	3	Somewhat Disagree	11	6.6%
	4	No Opinion	54	32.3%
	5	Somewhat Agree	18	10.8%
	6	Agree	12	7.2%
	7	Completely Agree	1	.6%

Attitudes56

		Value	Count	Percent
Standard Attributes	Position	56		
	Label	Although time consuming up front, it is worth the creation of an early model as it pays off in later stages		
	Type	Numeric		
	Format	F4		
	Measurement	Nominal		
Valid Values	0		57	34.1%
	1	Completely Disagree	6	3.6%
	2	Disagree	9	5.4%
	3	Somewhat Disagree	11	6.6%
	4	No Opinion	39	23.4%
	5	Somewhat Agree	21	12.6%
	6	Agree	20	12.0%
	7	Completely Agree	4	2.4%