ADDRESSING THE SHORT-TERM INSURANCE PROTECTION GAP FOR RESIDENTIAL BUILDINGS IN SOUTH AFRICA: A SIMPLE YET EFFECTIVE COST MODEL

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ABSTRACT

PURPOSE OF PAPER

This paper illustrates how a simple yet effective cost model based on manipulated and refined quantity surveying techniques can assist South African homeowners to improve the accuracy of replacement cost estimates and thus sufficiently insure their residential properties.

DESIGN/METHODOLOGY/APPROACH

Raw data for 21 residential units was generated through a quantitative process by applying recognised quantity surveying measuring and estimating methods. The data was further processed to derive multipliers for use in the cost model. A two-pronged approach was applied to the analysis of the data, firstly regression and correlation statistical analysis were conducted to illustrate the integrity of the data and secondly the proposed cost model was applied to demonstrate the ease of its use. The data of 15 residential units was used in the comparative analysis while the data of the other 6 units was used as test cases for the cost model.

RESEARCH LIMITATIONS/IMPLICATIONS

This paper is based on a pilot study limited to a select sample of residential designs varying in size from $56m^2$ to $660m^2$. The results and can thus not be viewed as conclusive.

FINDINGS

The findings suggest that the proposed cost model is fit for purpose and can produce accurate estimated replacement costs based on the input of the seven identified variables. However, the statistical analysis indicates instability due to large variances within the sample. This could be corrected by improved data.

VALUE OF PAPER

Improved replacement cost estimation of residential buildings based on an understandable, reliable and affordable cost model would place residential property owners and insurance industry role-players in a much-improved situation in the event of an insurance claim and lessen the potential financial damage to be suffered.

PRACTICAL IMPLICATIONS

Insureds are reliant on building cost information to comply with their responsibility to determine the insured values of their properties. Without readily available, reliable, relevant, understandable and cost effective information in the public domain, insureds are dependent on third parties to supply such information. Developing a cost database through the implementation of the proposed cost model is envisaged in the longer term.

Keywords: Cost modelling; replacement cost for residential buildings; insurance protection gap.

1. INTRODUCTION

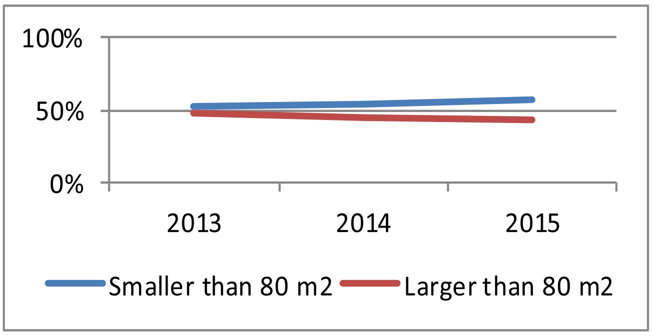
According to Longcore [1] insurance makes the world go around in the modern and sophisticated economic environment we live in, because very few people would be able to afford houses, motor cars or any other assets of substantial value without the assurance that the assets and thus their financial interests are protected.

To be or to become a homeowner is a major step towards creating personal wealth. According to McCarthy et al. [2] housing is a good financial investment that delivers a decent return that falls in between a higher returns of riskier stock market investments and lower returns of less risky bond investments.

South Africa, as the rest of the world, is experiencing unprecedented levels of growth in urbanisation that is currently at 65% and is expected to grow to 70% by 2030 [3]. With this trend comes an increased demand and supply of residential units. South Africans, on average, spend 32.55% of their annual household consumption on housing, water, electricity, gas and other fuels. In Gauteng and the Western Cape that are the preferred provinces the housing expenditure is respectively 36.71% and 34.25% [4] whereas to urbanisation is respectively 97% and 92% [3].

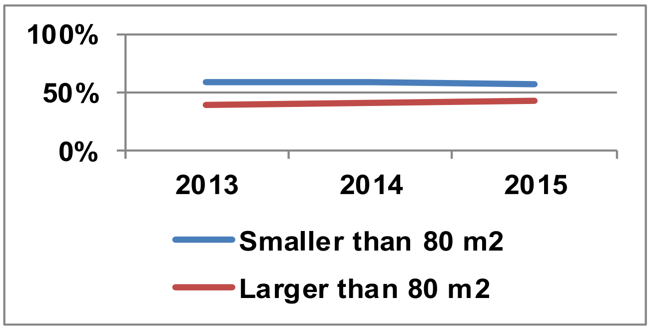
Statistics for residential building plans passed and residential units completed during the past three years show that the majority of new residential units are smaller than 80 m^2. The trend for building plans passed shows an upward trajectory which is an indication that this trend is to continue in future.

Graph 1: Residential building plans passed



Source[5]

Graph 2: Residential units completed



Source[6]

Inadequate short-term building insurance, referred to as underinsurance or a protection gap, is a global phenomenon [7]. It is likely that owners of residential units smaller than 80 m^2 are new entrants to the property market. The risk of not being able to respond to and/or recover from the consequences of a non-routine event in a resilient manner should be motivation to ensure adequate insurance cover.

The protection of wealth at the lower end of the insurance market is therefore more vital than the protection of wealth at the higher end of the insurance market.

2. THE FINANCIAL PROTECTION

2.1 INTERPRETING RISK

The H W Heinrich's triangle that was devised in 1931, was based on the occurrence of insurance claims for workplace accidents. Thoyts [8] maintains that the principles equally apply to many applications, also to property insurance. The tendency shows that the frequency of risks is inversely proportionate to its severity. This principle is illustrated in figure 1 below. The premise is thus that many more trivial events will take place before a catastrophic event does.

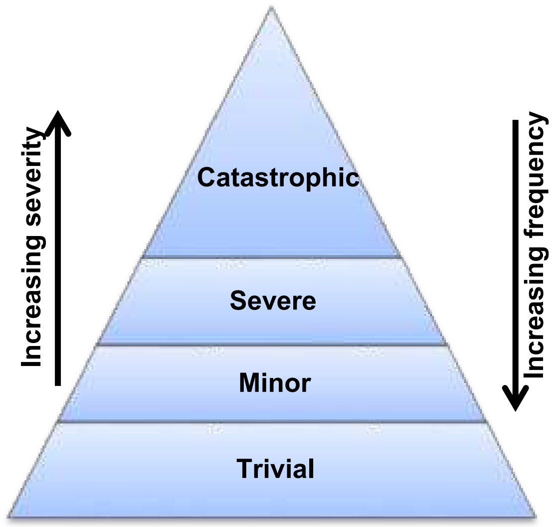


Figure 1: The Heinrich triangle [8]

Due to the considerable value of residential properties most damage thereto could be regarded as severe when weighing the homeowner's financial cash flow situation against the repair cost of the damage. Severe damage however rarely occurs.

2.2 TRANSFERRING THE FINANCIAL RISK

The primary function of purchasing insurance is for insureds to transfer the financial risk associated with owning high value properties to the insurers. According to Thoyts [8] an element of uncertainty, the measurement of the uncertainty (probability), the potential of a loss occurring and the financial quantification of the potential loss are essential ingredients for an insurance policy to come into effect. By measuring the uncertainty, thus determining the probability of a non-routine event happening, it is converted to a risk.

Information about the probabilities of and the severities of possible losses for different perils needed to assess risks are not readily available. Instead, insurance companies aggressively market their products with an overemphasis on premium price. Reliable information to determine the correct amount of insurance for residential buildings is also not readily available and obtaining it from a reliable source is costly.

The positive theory of demand assumes a world where decisions to purchase insurance are made based on the premise that the risk is accurately perceived, the collection and processing of relevant information is costless and that the amount of insurance purchased would maximise the purchaser's expected utility [9]. However, many homeowners are indifferent to or totally oblivious of the risks (the probability and severity of the consequence) that face them until a non-routine event occurs that turns their complacency into chaos [10].

Due to the absence of reliable building cost information in the South African public domain to assist homeowners in obtaining appropriate insurance values of their properties, individuals turn to sources that are available such as neighbours, friends, colleagues, estate agents, etc. [7].

The result hereof is that the entire risk intended to be transferred to the insurer is not transferred and an insurance protection gap develops.

2.3 THE SHORT-TERM INSURANCE PROTECTION GAP

Inadequate short-term insurance is often interchangeably referred to as under-insurance or a protection gap. There is however a distinct difference in that under-insurance refers to the balance between the economically viable value of the property and the actual value of insurance purchased, thus indicative of an intentional choice, whereas the protection gap refers to the difference between the economic loss and the insured loss [7]. Uninformed or ill-informed homeowners do not intentionally choose an insurance value lower than an economically viable value.

The cost model proposed in this paper is specifically designed to address a protection gap.

3. METHODS FOR DETERMINING THE COST OF THE RISK AT STAKE

3.1 COST MODELS COMMONLY APPLIED IN THE BUILT ENVIRONMENT

The development of cost models currently applied in the built environment date back to the 1950's and has largely been driven by the Building Cost Information Service (BCIS) of the Royal Institution of Charted Surveyors (RICS). The use and influence of the BCIS systems are however not available in South Africa hence the databases to support cost models that do exist are developed, maintained and used exclusively within private practices.

Cost models are either deductive, such as the cost per square metre model, or inductive, such as elemental estimates and bills of quantities. Results of deductive models produced via the application statistical techniques are inaccurate. Results of inductive cost models are produced based on exact algebraic equations and are therefore much more accurate [11][12].

Different cost models for application at the different design development stages of projects have been developed. The accuracy of early stage estimating has been indicated as between ±20 and 40% and to ±10% for 50% of the projects in two different studies [13] [14]. Several other researchers have reached similar results and indicated an approximate variance of 15% in the accuracy between early stage and later stage estimating [15]. The application of the appropriate cost model at the appropriate stage of design development is thus very important. The easier it is to apply a cost model, the less reliable the results are [12].

The deductive models based on the size of buildings incorporate only horizontal measures. Their results are therefore greatly influenced by design variables such as size, shape, height (storey and total), fullness on plan and circulation spaces [11][16][17].

The R/m^2 deductive cost model designed for early stage design development use is however commonly used to determine insurance values for residential properties due to the ease of its use as well as the lack of more detailed information in the public domain. This practice therefore contributes to the insurance protection gap.

4. BRINGING THE INSURANCE AND BUILT ENVIRONMENT COST MODEL TOGETHER

Insurance companies have no interest in developing any mechanisms to assist policy holders in obtaining the appropriate values for residential property insurance because the contractual responsibility for determining the correct value vests with the insured. It is evident that cost models designed specifically for application in early stage design development deliver course results and are thus not suited for the calculation of insurance replacement costs.

The research undertaken for this paper aims to investigate the possibility of developing of a cost model that could produce results more accurately than deductive cost models and yet be simple enough to be understood by individual homeowners with limited or no knowledge of calculating building costs.

The BCIS developed a tool called BCIS Rebuild Online in conjunction with the Association of British Insurers that calculates house rebuilding costs. The tool is used by quantity surveyors, valuers, property managers, loss adjusters, insurers and risk management firms (BCIS, 2016). A similar tool is needed for South African circumstances.

5. DESIGN AND METHODOLOGY

5.1 BACKGROUND

The literature reviewed highlighted the necessity of accessible, relevant and reliable building cost information to assist homeowners in determining accurate replacement cost estimates for insurance purposes. Of the approximately 6.845 million formal dwellings in South Africa [19] 83% or 5.681 million are single freehold dwellings, 12% are sectional title units and 5% are estate properties[20].

This research is based on a sample of 21 residential units ranging from 56 m^2 to 660 m^2 in size with varying levels of finishes and designs. The data for sampling was purposively sourced from a private practice's database that specialises in insurance claims based on the completeness of the information per case. The sample does not purport to be representative of the population. The data of 15 of the 21 residential units was used in the application of the proposed cost model. The analysed data of the further 6 residential units was used to test the model.

The distribution of the size of the residential units included in the sample is illustrated in Table 1 below.

Table 1: Distribution of residential unit size included in the sample

Size of dwellings	Number included in sample	Number included in test cases
50 to 100 m^2	6	1
101 to 200 m^2	2	2
201 to 300 m^2	3	1
301 to 400 m^2	1	2
401 to 500 m^2	2	0
501 to 600 m^2	0	0
601 to 700 m^2	1	0
	15	6

5.2 METHOD

The Standard System for Measuring Building Work (7th edition, 2015) was followed to generate the quantitative data. The measured items were then consistently re-arranged for each residential unit into seven elements, namely ground floor construction; external envelope; roof; internal divisions; furniture, fixtures and equipment; plumbing services and electrical services to form the basis for input into the cost model. The unit rates utilised in all the estimated replacement costs that serve as the benchmarks for evaluating the model output represent current rates in the Gauteng area to eliminate the necessity of time and location adjustments. External works was eliminated from the analysis as the components thereof are rather a function of the site than the residential unit itself.

5.3 DATA ANALYSIS

A dual approach to data analysis was followed. Firstly, the IBM SPSS Statistics software was utilised to conduct a statistical analysis in the form of a linear regression to establish the significance of the data. Although this process is necessary to test the integrity of the data, the statistical output would not serve the purpose of assisting the general public in understanding the estimating model. Secondly, a mathematical cost model was developed based on mean cost ratios and case specific multipliers.

The proportionate mean cost of the elements to the complete replacement cost is illustrated in figure 1 below

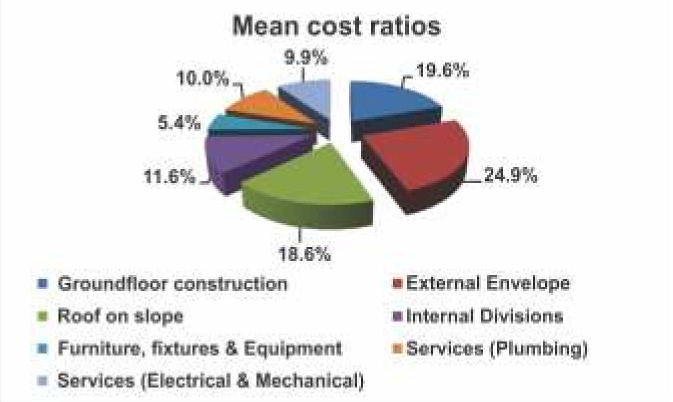


Figure 2: Proportionate mean costs per element

Forty-eight percent (48%) of the mean cost ratios represent horizontal elements while 52% represents vertical elements.

5.3.1 STATISTICAL ANALYSIS

Independent variables (predictors) were chosen to explain the dependent variable (replacement cost). The chosen variables are the construction area, the roof area on slope, the area of the external envelope, the area of doors and windows, the length of internal divisions and length of furniture and fixtures.

The ß coefficients derived from the linear regression are used to estimate replacement costs for the 6 test cases.

Table 2 : Descriptive statistics for independent variables

	Mean	Std. Deviation	N
Replacement Cost	1 144 226	847 773	15
Construction area	227	183	15
Roof area	302	254	15
External envelope	218	137	15
Windows and doors	39	27	15
Internal divisions	70	58	15
Furniture, fixtures and equipment	22	20	15

The results produced by the linear regression to explain the relationships between the independent variable are illustrated in table 3 and 4 below.

Table 3: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.996[a]	0.993	0.987	95 749.18	0.993	181.589	6	8	0.000

The high value for R2, the adjusted R2 and relatively small standard error are an indication that the cost model is fit for the purpose.

The high F-value indicates a large variability in the between-group and with-in group ratios of the predictors.

Table 4: Coefficients [a]

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for ß		Collinearity Statistics	
	ß	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	-51930.338	64 249.44		-0.808	0.442	-200089.8	96229.132		
Construction area	3174.295	2 099.93	0.685	1.512	0.169	-1668.152	8016.742	0.004	225.133
Roof area	-567.724	1 537.85	-0.17	-0.369	0.722	-4114.013	2978.565	0.004	232.516
External envelope	1832.285	492.32	0.297	3.722	0.006	696.991	2967.58	0.143	6.972
Windows and doors	1729.452	2 396.99	0.056	0.722	0.491	-3798.021	7256.925	0.154	6.501
Internal divisions	2740.081	1 522.24	0.186	1.800	0.110	-770.208	6250.371	0.085	11.72
Furniture, fixtures and equipment	-509.039	3 900.91	-0.012	-0.130	0.899	-9504.541	8486.463	0.112	8.908

[a] Dependable variable: Replacement cost

The high t-values imply that the predictors differ in varying degrees from the mean. The wide confidence intervals suggest less accurate estimates. Apart from the predictor for external envelope, all the confidence intervals contain zero which is an indication that there is not sufficient evidence to conclude that the predictors would deliver an accurate estimated replacement cost. The estimated replacement costs are calculated by multiplying the ß coefficient by the predictors of test cases.

The collinearity statistics clearly indicate that the predictors are highly correlated. This was not unexpected as it is quite obvious that the roof area for instance would increase as the construction area increases. However, the area of the external envelope would not necessarily increase when the shape of the building changes, but will increase when the construction area increases. Each of the coefficients estimates the change in the mean in reaction to one unit of change in one of the predictors. The high values of the variance inflation factors (VIF) also indicate that the predictors vary considerably from the linear correlation and could be unstable.

The outcomes of the t-values, f-value and VIF all indicate that the variances within the sample are large. This was expected due to the large range in size combined with the small sample size. The results could and should be improved if the sample size is increased.

The estimated replacement costs obtained by multiplying the ß values by the predictor quantities for each test case are shown in table 5 below

Table 5: Estimated replacement costs based on statistical model

Predictors	ß	Test cases											
		1	R c	2	R c	3	R c	4	R c	5	R c	6	R c
Construction area	3174.295	360	1 142 746	56	177 761	140	444 401	152	482 493	340	1 079 260	283	898 325
Roof area	1832.285	290	531 363	74	135 589	179	327 979	166	304 159	386	707 262	236	432 419
External envelope	-567.724	409	- 232 199	68	- 38 605	186	-105 597	217	-123 196	452	- 256 611	462	- 262 288
Doors and Windows	2740.081	87	238 387	19	52 062	43	117 823	42	115 083	162	443 893	71	194 546
Internal divisions	-509.039	68	- 34 615	2	- 916	17	- 8 654	15	- 7 636	48	- 24 434	37	- 18 834
Furniture, fixtures and equipment	1729.452	27	46 695	10	17 295	27	46 695	21	36 318	71	122 791	36	62 260
Constant	-51930.338		- 51 930		- 51 930		- 51 930		- 51 930		- 51 930		- 51 930
Replacement costs			1 640 447		291 254		770 718		755 292		2 020 231		1 254 497

5.3.2 THE MATHEMATICAL MODEL

The working of the cost model is demonstrated by extrapolating the mean replacement cost as well as the mean R/m^2. The estimated replacement costs based on the extrapolation of the mean R/m^2 is obtained by multiplying the mean R/m^2 by the mean cost ratios and the predictor quantities.

The estimated replacement costs based on the extrapolation of the mean replacement cost is obtained by multiplying the mean replacement cost by the mean cost ratios and the case multipliers.

The mean cost ratios are determined by weighting the monetary values for each element in the sample against their replacement costs and then calculating the mean for each element ratio. The case multipliers are calculated by dividing the case predictors by the mean predictors.

The values derived for the six test cases are shown in table 6.

Table 6 : Mean cost ratios and case multipliers

Elements	Unit	Mean cost ratios	Case Multipliers					
			1	2	3	4	5	6
Ground floor construction	m^2	0.196	1.58358	0.24633	0.61584	0.66862	1.49560	1.24487
External envelope	m^2	0.249	1.33028	0.33945	0.82110	0.76147	1.77064	1.08257
Roof area (on slope)	m^2	0.186	1.35251	0.22487	0.61508	0.71759	1.49471	1.52778
Internal division	m	0.116	1.24642	0.27221	0.61605	0.60172	2.32092	1.01719
Furniture, fixture & equipment	m	0.054	3.11165	0.04671	0.44118	0.38927	1.24567	0.96021
Services (plumbing)	no	0.100	1.55172	0.40107	0.80214	0.40107	1.44385	0.80214
Services (electrical and mechanical)	m^2	0.099	1.58590	0.24670	0.61674	0.66960	1.49780	1.24670
		1.000						

The mean replacement cost and the mean R/m^2 for the sample are calculated as R1 144 226.13 and R5 138.41 respectively.

The estimated replacement costs resulting from extrapolating the mean replacement cost as well as the means R/m^2 are contained in table 7 below.

Due to limited space the results are summarised to reflect only the totals for the replacement cost.

The idea is however that homeowners be supplied with the values for each element.

Table 7: Results obtained by applying the mean cost ratios and case multipliers to the mean replacement cost and the mean R/m^2

Test cases	m^2	Estimated replacement cost utilising the mean replacement cost	Estimated replacement cost utilising the mean R/m^2
1	360	1 737 358	1 849 828
2	56	312 507	287 751
3	140	773 425	719 377
4	152	781 038	745 293
5	340	1 877 895	1 747 059
6	283	1 340 325	1 454 170
		Average	Average

6. FINDINGS

6.1 THE STATISTICAL MODEL

The estimated replacement costs obtained by multiplying the ß coefficients by the predictor quantities as shown in table 5 above compared to the benchmark estimates show accuracies varying from 78.06% to 96.48% with an average accuracy of 86.88%. Although the level of accuracy in four of the test cases seems high, there is still a variance of 18.42% from the lowest to the highest level of accuracy. This supports the interpretation that the coefficients (in this case the ß coefficient) are unstable due to the small sample size.

Table 8: Comparison of statistical model results to the benchmark

Test case	m^2	Benchmark estimate	Estimated replacement cost	Accuracy
		R c	R c	%
1	360	1 990 000	1 640 447	78.69
2	56	281 000	291 254	96.48
3	140	940 000	770 718	78.06
4	152	715 200	755 292	94.69
5	340	1 772 500	2 020 231	87.74
6	283	1 435 000	1 254 498	85.61
			Average	86.88

The importance of the outcome however lies in the fact that a model that requires the input of only eight predictors (construction area, area of the external envelope, area of external windows and doors, roof area on slope, length of internal divisions, length of furniture, fixtures and equipment and the number of sanitary fittings) delivers a replacement cost that is approximately 87% accurate on average.

To explain the process of obtaining these estimated replacement costs could be confusing to individual homeowners as the ß coefficient does not relate directly to the units of the predictors. Home-owners would still be in the undesirable position of being presented with a single cost without any supporting detailed information showing exactly how the estimated value was derived.

6.2 THE MATHEMATICAL MODEL

The level of accuracy emanating from the mathematical model again seems to be high. The accuracy of the results obtained from the extrapolated mean replacement cost varies between 78.46% and 108.43% with an average accuracy of 91.60% and that of the extrapolated mean R/m^2 between 69.33% and 104.04% with an average accuracy of 94.67%.

These represent variances of 29.97% based on the mean replacement cost and 34.71% based on the mean R/m^2. This again highlights the instability of the predictions that require improved data.

Table 9: Comparison between replacement cost estimates extrapolated from mean replacement costs and mean R/m^2 and the benchmark estimates

Test cases	m^2	Benchmark Estimate	Estimated replacement cost utilising the mean replacement cost	%	Estimated replacement cost utilising the mean R/m^2	%
1	360	1 990 000	1 737 358	85.46	1 849 828	92.42
2	56	281 000	312 507	89.92	287 751	102.35
3	140	940 000	773 425	78.46	719 377	69.33
4	152	715 200	781 038	108.43	745 293	104.04
5	340	1 772 500	1 877 895	94.39	1 747 059	98.54
6	283	1 435 000	1 340 325	92.94	1 454 170	101.32
			Average	91.60	Average	94.67

On average the statistical model produced the least accurate results (86.88%) with the smallest variance (18.42%) whereas the mean R/m^2 extrapolation seemingly produced the most accurate (94.67%) results with the highest variance in results (34.71%).

The mean replacement cost extrapolation rather resembles the results of the extrapolated R/m^2 with an average accuracy of 91.60% with a 29.97% variance.

The high level of accuracy achieved by the mathematical model is deceiving when judged by the high variances in results.

7. CONCLUSION

The purpose of this paper was to demonstrate the working of the proposed cost model to address the insurance protection gap. The literature highlighted the existence of an insurance protection gap and the overview of cost models emphasised the importance of applying a suitable cost model to the appropriate level of available design information. The literature further stressed the importance of the availability of reliable cost information.

The key findings show that the proposed cost model could potentially be implemented to assist homeowners with accurate replacement cost estimates based on simple and limited input that could easily be generated by various role-players in the insurance industry that do not necessarily have intimate knowledge of calculating building costs.

The confirmation of the fitness for purpose derived from the statistical analysis is promising. Indications are that the results can be significantly improved by an increased sample size. It is therefore recommended that the data be enhanced and that interim tests be conducted until the accuracy of the cost model is confirmed at a statistically significant level of 95%.

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