AIPM -08

ESTIMATING PROJECT COST CONTINGENCY
BEYOND GUESSWORK & TOWARDS REGRESSION

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Aim of Presentation

- Review literature - project cost contingency
  - concept
  - traditional % approach for estimating
- Case study research
  - accuracy of project cost contingency using %
- Review literature - regression analysis
  - more accurate approach for estimating project cost contingency?

CONTINGENCY – DEFINITION

- "most misunderstood, misinterpreted and misapplied word in project execution"

- "*Amount of money added to estimate to allow for changes experience shows will likely be required*"

- *"amount of funds needed above the estimate to reduce the risk of overruns of a level acceptable to the organization*" (PMI, 2004).

CONTINGENCY –ATTRIBUTES

1. Reserve of money
2. Part of Project Management

   Risk - caters for risk in projects

   RM that supports cost management
3. Base Estimate + C = total commitment.
4. Major impact on project outcomes.eg
   - Too high = sloppy management
   - Too high = lose tender
   - Too low = unrealistic financial environment

Contingency - Coverage

- Known unknowns (specifically identified)
  - Eg scope development, contractual liabilities

- Unknown unknown(surprises, unforeseeable)
  - residual uncertainty in project - difficult to estimate

- Excludes:
  - scope changes
  - Escalation/inflation
  - Unforeseeable major events

PROJECT BUDGET & CONTINGENCY

- Budget Estimate = Baseline + Contingency
- Cost growth: Actual – Budget Estimate
- Merrow & Schroeder 1991:
  - cost growth = inadequate contingency within estimate

Project Cost Contingency

Estimating Methods

CONTINGENCY ESTIMATING METHODS

Traditional percentage

Method of Moments

Monte Carlo Simulation

Factor Rating

Individual risks – expected value

Range Estimating

Regression Analysis

Artificial Neural Networks

Fuzzy Sets

Influence Diagrams

Theory of Constraints

Analytical Hierarchy Process

2 types contingency in construction projects (HM Treasury, 1993):

- *Design Contingency*
  - changes during design process
- *Construction Contingency:*
  - changes during construction process.

% problems

- Arbitrary
- "inadequate , cause delay, litigation, bankruptcy“
- Difficult to defend / justify
- Double-counting
- Hidden in each cost element (‘padding’) + % to total
- Implied certainty
- Single-figure - “Implies degree of certainty that is simply not justified”
- Constrained Creativity
- Routine & mundane, oversights

Research – Case Study 1

- Australian government road authority. 860 full time staff.
- *Construction Contingency:* traditional % approach
- Construction contingency caters for contract variations
- estimating accuracy: contingency v variations.
- contract variation due to scope changes were excluded
- Sample:
  - 48 projects
  - 1997 to 2002
  - All projects reached practical completion
  - All open competitive tendering, AS 2124 – 1992
  - all regions of state.
  - dollar value: A$0.05m to over A$35m

Contingency (%)	Projects
0/10%	87.5%
10/20%	8.3%
20/30%	4.2%
5.24%	Mean
0.04	Std Devn.

Cost Growth (%)	Projects
>-20%	2.1%
-10/-20%	2.1%
0/-10%	10.4%
0/10 %	58.3%
10/20%	16.6%
>20%	10.4%
9.92%	Mean
0.21	Std Devn.

Case study 1

Accuracy of Contingency

9.92% - 5.24% = 4.68%

Shortfall in contingency of 4.68%.

Case study 1

- construction contingency: av. 5.24% of contract value
- average contract variations, 9.92% of contract value

- 87.5% of projects, contingency < 10%.
- low % - most of design known

- low variability, bunch in 0-10% range: anchoring?

- Variability:
  - greater for cost growth than contingency
  - contingency tied to initial anchor value? (10%)

Research – Case Study 2

- Australian water authority. Directly employs 2,200 people
- 2005-06: $1.4 bn revenue; capital expenditure $648 million.
- design & construction of water assets (e.g. dams, pipes)
- Uses traditional % approach to calculate contingency.
- 228 construction engineering projects
  - sample 2001 to 2005. All reached practical completion.
  - open competitive tendering, AS 2124
  - all regions of state. A$0.18m to A$32m
  - budget estimate early in design phase ("Definition Estimate") for all costs:
    - construction + consultants + contingency.

Contingency (%)	Projects
0/10%	74.6%
10/20%	25.0%
20/30%	0.4%
7.53%	Mean
0.05	Std Devn.

Cost Growth (%)	Projects
-40/-50%	0.4%
-30/-40%	4.9%
-20/-30%	6.1%
-10/-20%	14.0%
0/-10%	21.9%
0/10%	22.4%
10/20%	11.0%
20/30%	8.3%
30/-40%	3.1%
40/50%	4.4%
>50%	3.5%
5.12%	Mean
0.26	Std Devn.

Research – Case Study 2 - Contingency

- Contingency averaged 7.53% in Definition Estimate
- 75% of projects: contingency <10%.
- concentration around low % value - anchoring?
- low degree of variability - bunch in 0-10% range
- Average difference between Definition Estimate & Final Actual Costs: 5.12%.
- i.e cost growth of 5.12% above DE (which has average 7.53% contingency)
- So, on average, contingency of 12.65% (7.53+5.12) needed in DE to represent final financial commitment
- Variability - cost growth greater than contingency

Case Studies - Summary

- on average, contingency insufficient for predicting final actual costs
- highlights inaccuracy of traditional %
- A better way: Regression?

REGRESSION ANALYSIS TO FORECAST COST OF CONSTRUCTION/ENGINEERING PROJECTS

PAST RESEARCH

REGRESSION

- Used since 1970s for estimating cost

- Review of some use of regression analysis for predicting final cost of project

Merrow, Phillips and Myers 1981

- 44 process plants, 34 private firms in North America.

- analysed cost growth (i.e. ratio of forecast cost to actual cost)
-
- Regression analysis used to 'yield more realistic expectations of ultimate costs'

- Dependent variable : cost growth

- 47% estimates predicted +/-5% of the actual cost growth.

Oberlander & Trost (2001)

- Regression - predict amount of cost contingency required based the quality/accuracy of project cost estimate.
- variables to measure quality of estimates:
  - who involved
  - how estimate prepared
  - what is known
  - other factors
- Results - significant correlation between regression estimate and final cost

Burroughs and Juntima 2004

- Regression forecast Contingency Performance Indicator [CPI]
- CPI = contingency estimated - contingency used.
- EG: 50% estimated, 20% used, CPI = 50-20 = 30%
- Regression model produced a median CPI of 7%.

FINDINGS & CONCLUSIONS

- Paucity of research into cost contingency.
- Traditional % contingency flawed
- 2 case studies: traditional % contingency inadequate
- Need more accurate method: Regression?
- Merrow & Schroeder (1991):
- "The accuracy of regression models suggests that cost growth problems ... are more a matter of appropriate estimating than significant deviations from an appropriate project cost.
- In other words, despite cost growth .., most projects are probably not costing more than they should".

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QUESTIONS