Do different Functionality Types Affect the Relationship between Software Functional Size and Effort?

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Atos Origin

Agenda

- The Problem
- Common Approaches to Effort Estimation
- Our Approach to Effort Estimation
- Data Preparation and Analysis
- Discussion of the Results
- Conclusions

The Problem

- The planning, monitoring and control of software development projects require that effort and costs be adequately estimated.
- Effort estimation still remains a challenge for practitioners and researchers alike.
- Various cost drivers, including software size as the primary input, which might have an impact on effort estimation have been explored.
- No model is considered to perform well enough to fully meet market needs and expectations.

Common Approach

- The functional size of a software system is expressed as a single value obtained by a specific FSM method.
- This single value is derived from a measurement function in all FSM methods
  - Add together the functional sizes of different Base Functional Component (BFC) Types to obtain a total functional size.
- The effort estimation models take this single functional size figure as the primary input.

- Our hypothesis:
  - The effort required to develop the unit size of each of the BFC Types, which provide different user functionalities, is different.
- We explored whether effort estimation models based on the functional size of BFC Types, rather than the total functional size, improve estimation reliability.

Our Approach

Data Preparation

- Projects data from ISBSG 2007 Repository, CD Release 10.
- ISBSG Repository includes high-quality data about 4,106 projects.
- Among those, 117 projects were sized using COSMIC-FFP.
- The projects cover a wide range of applications, development techniques and tools, implementation languages, and platforms.
- We built a series of homogeneous subsets considering the factors which were found to significantly affect the size-effort relationship.

Step	Attribute	Filter	Projects Excluded	Remaining Projects
1	Count Approach*	= COSMIC-FFP	3,989	117
2	Data Quality Rating (DQR)	= {A | B | C}	4	113
3	Rating for Unadjusted Function Points (UFP)	={A | B}	21	92
4	Application Type	= {Management Information System}	49	14
		= {Financial Transaction Processing/ Accounting}		21
		= {Customization to a Product Data Management System}		14
5	Business Type	Missing for most of the projects	-	
6	Maximum Team Size	Missing for most of the projects	-	

* No further filter has been considered with respect to the COSMIC-FFP versions

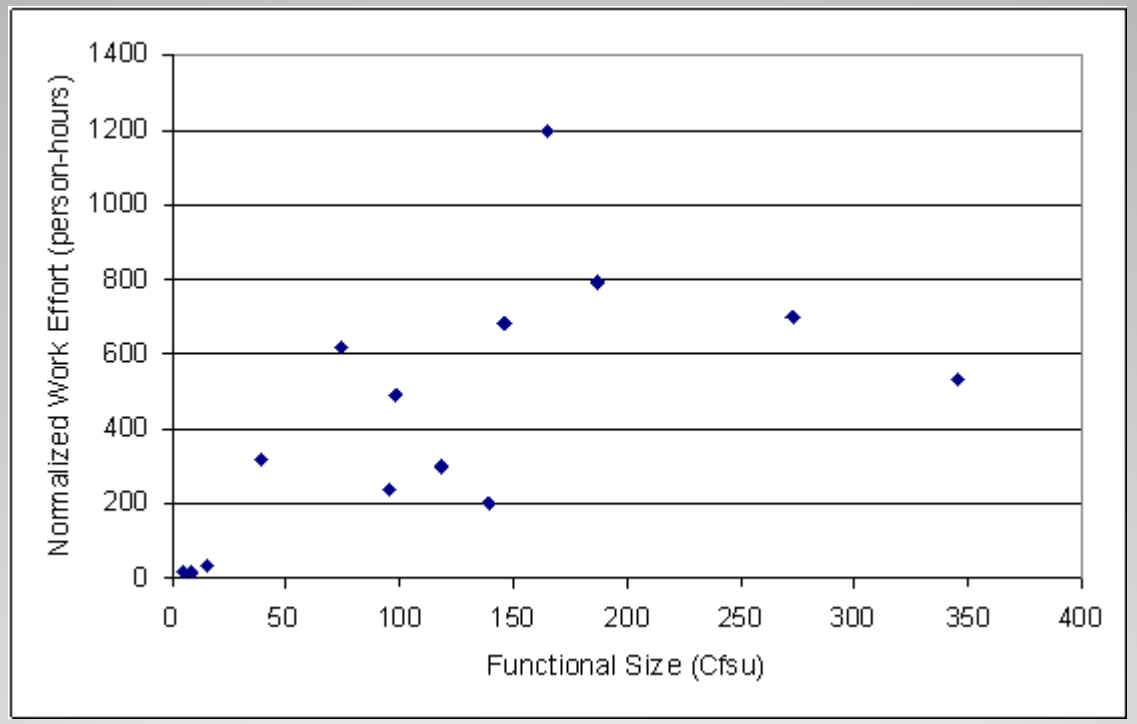
Filtration of ISBSG 2007 Dataset Release10

- First, sub-datasets are analyzed to determine the strength of the relationship between the total functional size and the development effort
  - Linear Regression Analysis method
- Next, the strength of the relationship between the functional sizes of the COSMIC-FFP BFC Types and development effort is analyzed
  - Multiple Regression Analysis method
- Then, the findings are compared.

Statistical Data Analysis & Results

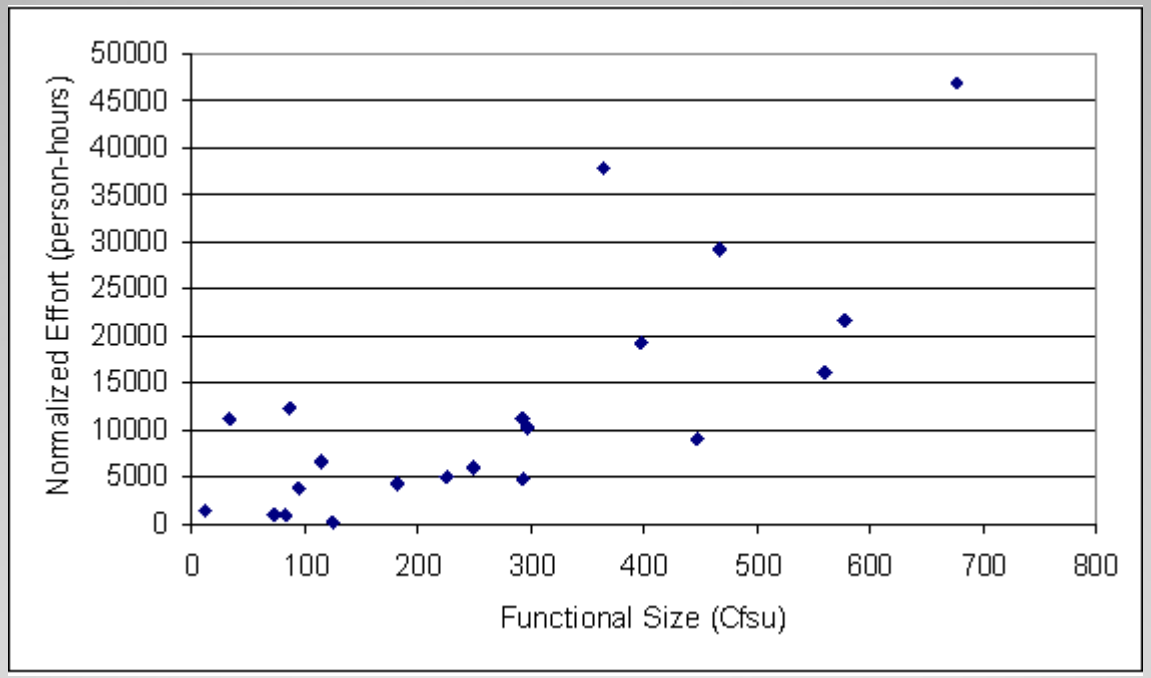
- All the statistical data analyses were performed with the GiveWin 2.10 commercial tool and its sub modules.
- Linear Regression Analysis performed
  - Independent variable:Functional Size
  - Dependent variable:Normalized Work Effort
- A significance test is carried out in building a linear regression model.
  - This is based on a 5% level of significance.
- An F-test is performed for the overall model.
  - A (Pr > F) value of less than 0.05 indicates that the overall model is useful.
  - That is, there is sufficient evidence that at least one of the coefficients is non-zero at a 5% level of significance.
- A t-test is conducted on each βj ($0 \leq j \leq k$).
  - If all the values of (Pr > |t|) are less than 0.05, then there is sufficient evidence of a linear relationship between y and each xj ($1 \leq j \leq k$) at the 5% level of significance.

Total Functional Size - Effort Relationship



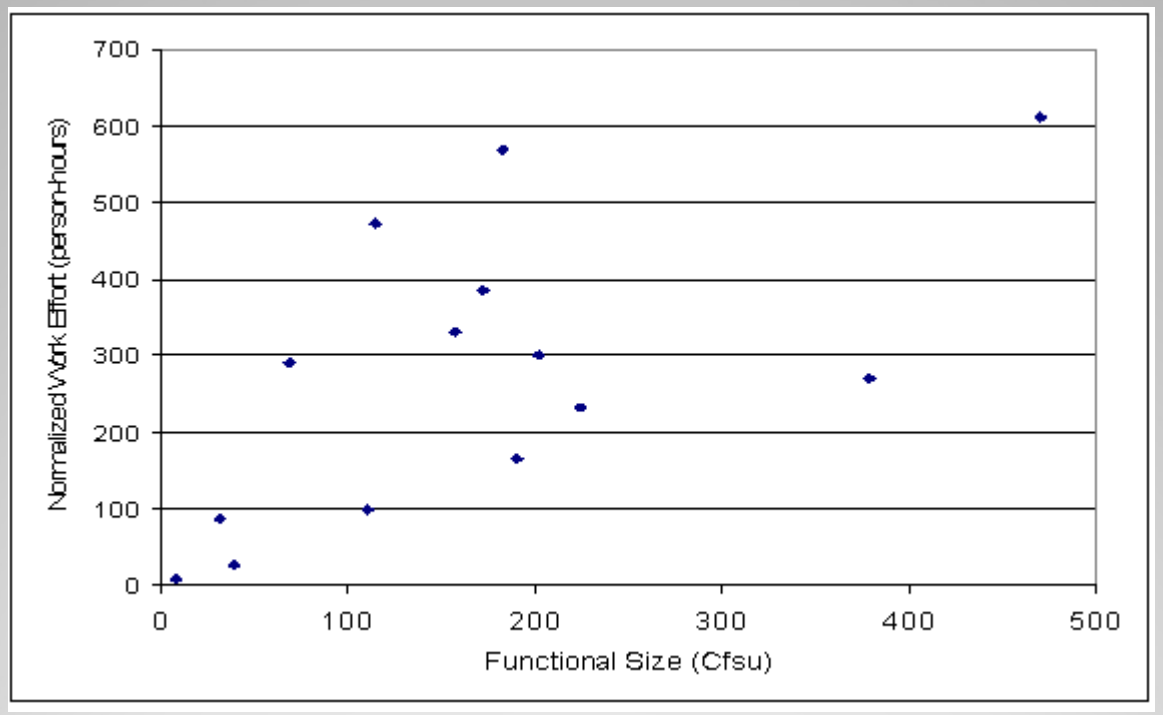
$R^2 = 0.23$

Sub-dataset 1: Customization to a Product Data Management System



R^2=0.56

Sub-dataset 2: Financial Transaction Process/Accounting



R^2=0.39

Sub-dataset 3: Management Information System

Subset 1: Customization to a Product Data Management System

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Functional Size	3.01454	0.51622	5.840	0.0001	0.0001	0.0000	1.00000

R^2 = 0.23

	value	prob
normality test	3.8843	0.1434

Subset 2: Financial Transaction Process/Accounting

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Functional Size	46.61200	5.48730	8.495	0.0000	0.0000	0.0000	1.0000

R^2 = 0.56

	value	prob
normality test	5.2770	0.0715

Subset 3: Management Information System

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	120.95059	69.13106	1.750	0.1057	0.0879	0.0745	0.6000
Functional Size	0.91522	0.33057	2.769	0.0170	0.0012	0.0080	1.0000

R^2 = 0.39

	value	prob
normality test	1.9550	0.3763

Regression Analysis Results (Normalized Work Effort – Total Functional Size)

Functional Sizes of BFC Types –Effort Relationship

- The functional size in COSMIC FFP is determined by summing up the Entry (E), Exit (X), Read (R) and Write (W) data movement types.
- We used the following multiple linear regression model:

$$NW\_Effort = B_0 + B_1(E) + B_2(X) + B_3(R) + B_k(W)$$

- where *NW_Effort* (Normalized Work Effort) is the dependent variable and *E, X, R* and *W* are the independent variables.

Subset 1: Customization to a Product Data Management System

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Read	6.69258	0.96538	6.933	0.0000	0.0000	0.0000	1.0000

$R^2 = 0.41$

	value	prob
normality test	2.0558	0.3578

Subset 2: Financial Transaction Process/Accounting

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Entry	220.99324	24.61603	8.978	0.0000	0.0000	0.0000	1.0000

$R^2 = 0.60$

	value	prob
normality test	6.6034	0.0368

Subset 3: Management Information System

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Write	18.56507	2.08722	8.895	0.0000	0.0000	0.0000	1.0000

$R^2 = 0.54$

	value	prob
normality test	2.7829	0.2487

Multiple Regression Analysis Results (Normalized Work Effort – Funct. Sizes of BFC Types)

Discussion of the Results

- The R^2 statistics derived for the two approaches are compared:
- When the functional sizes of each of the BFC Types are taken into account for effort estimation purposes, instead of the Total Functional Size; R2 values increase from
  - 0.23 to 0.41 for Subset 1;
  - 0.56 to 0.60 for Subset 2
  - 0.39 to 0.54 for Subset 3
- The results showed a significant improvement in the modeling of the size-effort relationship in the estimation models for at least two of the subsets.
- An interesting observation is that the functional size of a single BFC Type can model both Normalized Work Effort and Total Functional Size such as:
  - Reads in subset 1
  - Entries in subset 2
  - Writes in subset 3

Conclusion

- The effort required to develop software for different functional domains might be better explained by taking into account the functional sizes of different BFC Types.
- More research is needed to analyze the effect of different BFC Types on effort estimation.
- Further work should also include comparisons with related work performed with the FPA method.

Thank you very much!

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