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Short paper

Analysis of Practical Software Project Estimation

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Introduction

The ISBSG collects IT industry data, where output is measured using ISO/IEC standardized and objective, repeatable, auditable methods. These include: Nesma, IFPUG and COSMIC function-point counting methods. Typical key metrics based on function points are:

- Project Delivery Rate (PDR)[1] Hours spent per function point
- Cost efficiency: Cost (or Price) per function point
- Quality: Defects per function point (in test and/or 1st month of production)
- Delivery Speed: Function points delivered per calendar month.

The ISBSG 'New Developments & Enhancements' repository contains thousands of completed projects for which these metrics are calculated, enabling organizations to use this industry data for fact-based understanding and decision making.

In this short paper, we analyze the Project Delivery Rate as estimated from software size and team size. The data for this analysis is found in the book, Practical Software Project Estimation, published by the ISBSG in 2010 and for sale on amazon.com: https://www.amazon.nl/-/en/Peter-Hill/dp/0071717919.

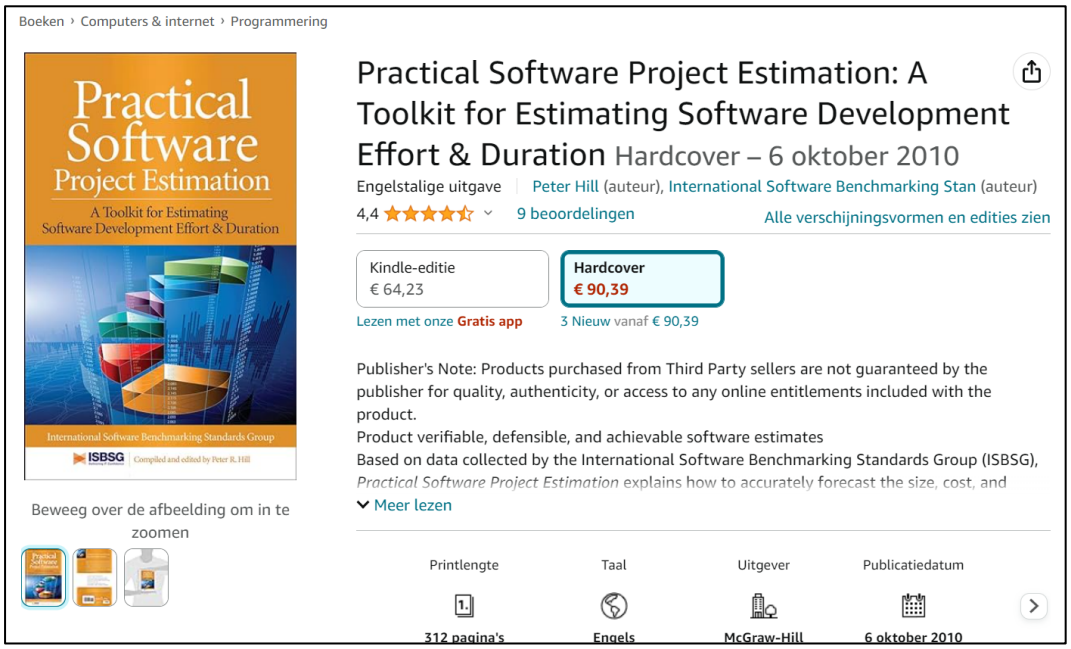

Figure 1: Screenshot of the book from the Amazon website

[1] The PDR is the inverse of the universal concept of Productivity (output/input) as it is easier to process for human minds, which usually struggles with metrics with many decimals.

Main Discussion

There is much information in the well-reviewed book, Practical Software Project Estimation.

In this short report we analyze the data table, **Table C-1.0 Project delivery rate, estimated from software size and maximum team size,** from the "Estimation Equations" section of the book. This table contains values from the 2010 ISBSG data, which can be used for software project estimation. A copy of the table is shown here:

Class	C	E1	E2	N	R2(adj)	Median MRE
All	57.39	-0.558	0.71	584	0.33	0.37
Enhancement	79.12	-0.616	0.692	381	0.33	0.37
New Development	37.48	-0.496	0.759	203	0.32	0.37
Midrange (MR)	60.76	-0.664	0.96	61	0.65	0.23
Multi	34.49	-0.51	0.875	125	0.46	0.3
3GL	51.74	-0.526	0.693	367	0.27	0.38
4GL	32.9	-0.468	0.692	141	0.42	0.3
New & MR	35.09	-0.597	1.08	16	0.57	0.24
New & Multi	37.41	-0.463	0.736	47	0.36	0.3
Enh & MR	115.9	-0.759	0.872	45	0.73	0.19
Enh & Multi	38.97	-0.566	0.951	78	0.5	0.31
New & 3GL	39.4	-0.489	0.762	127	0.33	0.38
Enh & 4GL	64.1	-0.605	0.728	98	0.6	0.27
MR & 3GL	42.94	-0.605	0.994	27	0.61	0.28
MR & 4GL	56.86	-0.664	0.967	30	0.66	0.18
Multi & 3GL	36.44	-0.491	0.832	91	0.43	0.3
Multi & 4GL	9.35	-0.282	0.801	32	0.39	0.23
Enh & MR & 3GL	81.76	-0.647	0.785	19	0.68	0.24
Enh & MR & 4GL	162.7	-0.865	0.963	25	0.76	0.19
New & Multi & 3GL	72.34	-0.53	0.666	30	0.38	0.43
New & Multi & 4GL	6.72	-0.228	0.839	16	0.33	0.16
Enh & Multi & 3GL	25.63	-0.462	0.909	61	0.46	0.3
Enh& Multi & 4GL	13.98	-0.372	0.829	16	0.42	0.21

Table 1: Project delivery rate estimated from software size & team size (Table C-1.0 from book)

To calculate your project delivery rate, the following are required: the project's functional size in IFPUG or Nesma function points (FP) and the project's maximum team size. The following formula is then given, using values from the table above:

$$\mathbf{PDR = C \times Size^{E1} \times MaxTeam^{E2}}$$

Where:

PDR – Project Delivery Rate (hours/fp)
C – constant value from table 1
Size – software size in function points
MaxTeam – maximum team size
E1 – constant value from table 1
E2 – constant value from table 1

Example

Consider the following example to illustrate the use of the PDR formula given above. Imagine the functional size of a new application, yet to be developed, is 200 function points. The primary programming language is Java (i.e. 3GL language) and we have a team of 7 people. Refer to Table 1 (above) and locate the row with a "Class" (column 1) value of "New and 3GL". Use the corresponding values of C, E1 and E2 in the "New & 3GL" row. These values from Table 1 are displayed in Table 2 below:

Functional size	200	FP
Maximum team size	7	people
C from table	39.4	
E1 from table	-0.489	
E2 from table	0.762	
PDR =	$C \times Size^{E1} \times MaxTeam^{E2}$	
PDR =	**13.01**	hours/FP

Table 2: Values used to calculate Project delivery rate

For this estimate, a PDR of 13 hours/FP is expected. Since 200 function points are to be developed, the total number of required hours is 13.0 x 200 = 2600 effort hours. Given the 7 people in the team (who spend 280 effort hours per week), a total duration of 9.3 weeks is calculated. Of course, as a project manager you need to add additional time for risk and uncertainty.

Now let's look at the current ISBSG Developments & Enhancements repository and see if the data supports this.

For the analysis, we created a subset of the 2023 ISBSG D&E repository, making the following filtering options:

- Data Quality is A or B
- Count approach is IFPUG 4+ or Nesma
- Primary Programming Language = Java
- Development type = new development
- Relative size is M1 (100-300 FP)

This results in the following table with descriptive statistics:

Metric	Metric Description	Metrics for Project Delivery Rate (hrs/FP)
N	Sample size	72
Min	Minimum value	2.6
P10	10th percentile	4.9
P20	20th percentile	5.7
P25	25th percentile	6.2
P30	30th percentile	6.8
P40	40th percentile	7.7
Median	Median	9.4
P60	P60	11.3
P70	P70	13.7
P75	P75	14.7
P80	P80	16.3
P90	P90	22.7
Max	Maximum	86.5
Avg	Average (mean)	13.2

Table 3: PDR Metrics from the ISBSG Repository

The PDR of 13.0 hours per FP, as calculated from the book published in 2010, results in a pessimistic estimate. This is because the median PDR value from the ISBSG Repository, shown in Table 3, is 9.4 hours per FP. However, the PDR of 13.0 hours is less than the 70th percentile PDR value, as shown in Table 3, which seems reasonable.

The comparison of PDR values indicates that software development has become more productive over time. The reason for this could be explained by better development tools and methods. It is important to note that a pessimistic estimate is not necessarily a bad thing.

See Figure 2, extracted from the great book by Steve McConnell – Software Estimation, Demystifying the black art (https://www.amazon.com/Software-Estimation-Demystifying-Developer-Practices/dp/0735605351). Optimistic estimates are very likely to result in failures: non-linear extra costs, while pessimistic estimates are likely to succeed, as the laws of Parkinson takes effect. This means that while the project could have been delivered earlier and cheaper, it is still delivered within the estimation boundaries. Figure 2shows this effect.

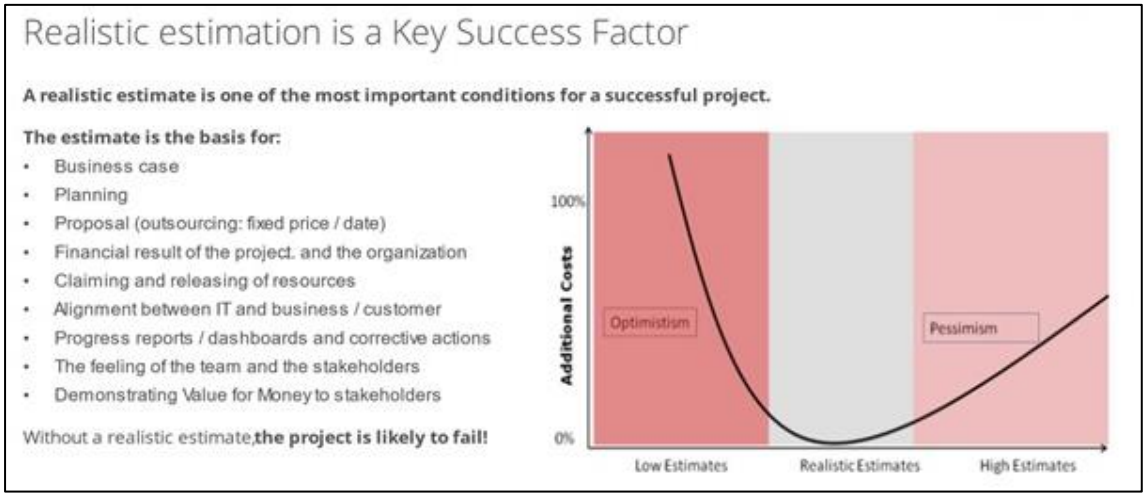

Figure 2: The importance of a realistic estimate

Conclusions

This analysis just shows a high-level analysis of the data in the repository without considering other important factors. In this case we analyzed a formula published in a book in 2010 against actual data in 2023. It seems that the formula is still useful for software project estimation!

If you wish to do your own analysis, or if you are interested to use the ISBSG data for cost estimation, benchmarking, performance measurement, procurement, etc., please subscribe to the data here: https://www.isbsg.org/project-data/

The International Software Benchmarking Standards Group (ISBSG)

The ISBSG is a not-for-profit organization founded in 1997 by a group of national software metrics associations. Their aim was to promote the use of IT industry data to improve software processes and products.

ISBSG is an independent international organization that collects and provides industry data of software development projects and maintenance & support activities in order to help all organizations (commercial and government, suppliers and customers) in the software industry to understand and to improve their performance and decision making. ISBSG sets the standards of software data collection, software data analysis and software project benchmarking processes and is considered to be the international thought leader in these practices.

The ISBSG mission is to support commercial and public organizations to improve the estimation, planning, control and management of IT software projects and/or maintenance and support contracts.

To achieve this:

ISBSG maintains and grows 2 repositories of IT software development/maintenance & support data. This data originates from trusted, international IT organizations and can be obtained for a modest fee from the website www.isbsg.org/project-data/

Help us to collect data

ISBSG is always looking for new data. In return for your data submission, we issue a free benchmark report that shows the performance in your project or contract against relevant industry peers.

Please submit your data through one of the forms listed on http://isbsg.org/submit-data/

A specific Agile/Scrum data collections questionnaire can be downloaded here: https://cutt.ly/4vnuXVT

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