Software Cost Estimation
Why is it different?

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Tampa, May 2019
Harold van Heeringen

Introducing myself

Drs. Harold van Heeringen,

- >20 years experience in IT, >15 years in software measurement and metrics
- **ISBSG** – President
- **METRI** – Senior Consultant ADM Benchmarking
- **NESMA** – board member International cooperation and partnerships
- **COSMIC** - Dutch representative in the International Advisory Council (IAC)
- **ICEAA** trainer of CEBoK chapter 12: Software Cost Estimation
- **sCEBoK** initiator and module developer
- Dutch Association for Cost Engineers (**DACE**) – working group parametric analysis
- Speaker at many conferences on software measurement, estimation and benchmarking

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ISBSG: **www.isbsg.org**
Nesma: **www.nesma.org**
METRI: **www.metrigroup.com**

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Topics addressed

- Industry Maturity

- Software Estimation – the current practice

- Performance measurement

- Standard Performance Metrics

- Software Size

- Estimation Maturity Model

- Introducing the Software Cost Estimation Body of Knowledge

- Available Industry Data

- Conclusions

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Software Projects often fail!

Project Success Rate

Chart axis: 60%, 50%, 40%, 30%, 20%, 10%, 0% — years 2011, 2012, 2013, 2014, 2015

Legend: Succesful — Challenged — Failed
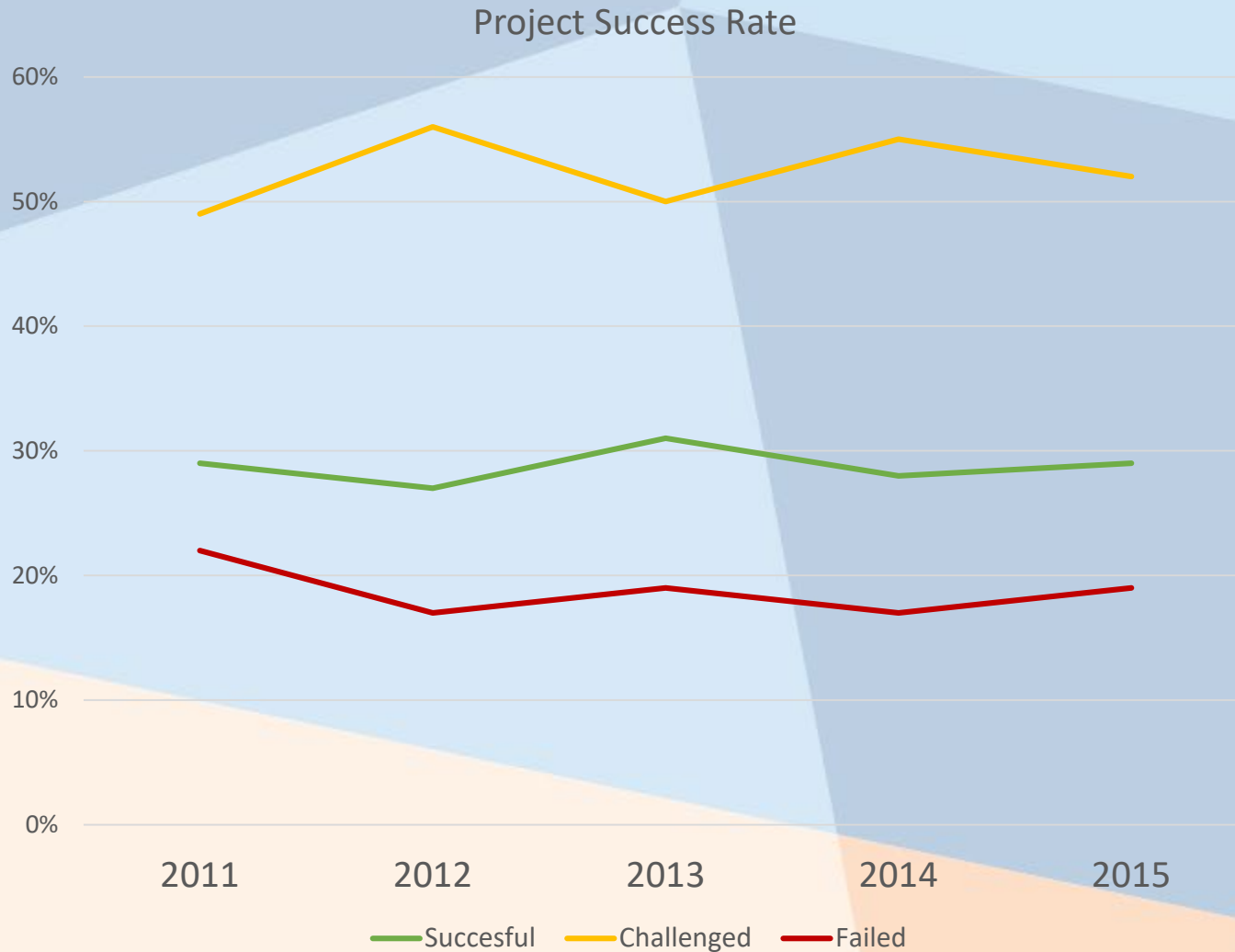
'Falende ICT kost overheid miljarden'

25-04-2014 11:42 | Door Pim van der Beek | Er zijn 41 reacties op dit artikel | Permalink

'De Nederlandse overheid raakt elk jaar vier tot vijf miljard euro kwijt aan ict-projecten die mislukken. Vooral met de grote technologieprojecten gaat het mis. Van die projecten - vanaf een budget van 7,5 miljoen euro - slaagt maar 7 procent. Van alle projecten bij elkaar is 30 procent succesvol.' Dat zei hoogleraar beleidsinformatica en directeur van Venture Informatisering Adviesgroep nv (VIAgroep) Hans Mulder tijdens de eerste bijeenkomst van de tijdelijke ICT-Comissie van de Tweede Kamer die onderzoek doet naar ict-projecten binnen de overheid.

Failing IT projects cost the Dutch government 7 billion USD per year

Projects > 10 million USD only 7% succeeds.

In total, only 30% of IT projects are successful.

These are tax dollars and one of the reasons the whole country was in recession for years.

commissie voor. Mulder pleit onder andere voor kleinere projecten. Die zijn ook makkelijker te stoppen als het misloopt. Bij grote projecten moet de overheid vaak doormodderen', zei hij volgens persbureau ANP.

bekijk reacties (41)   print   stuur door

Dé cloud bestaat niet.   Advertorial
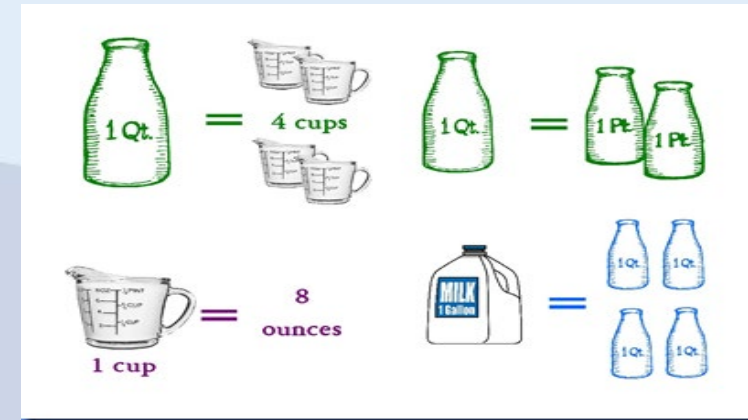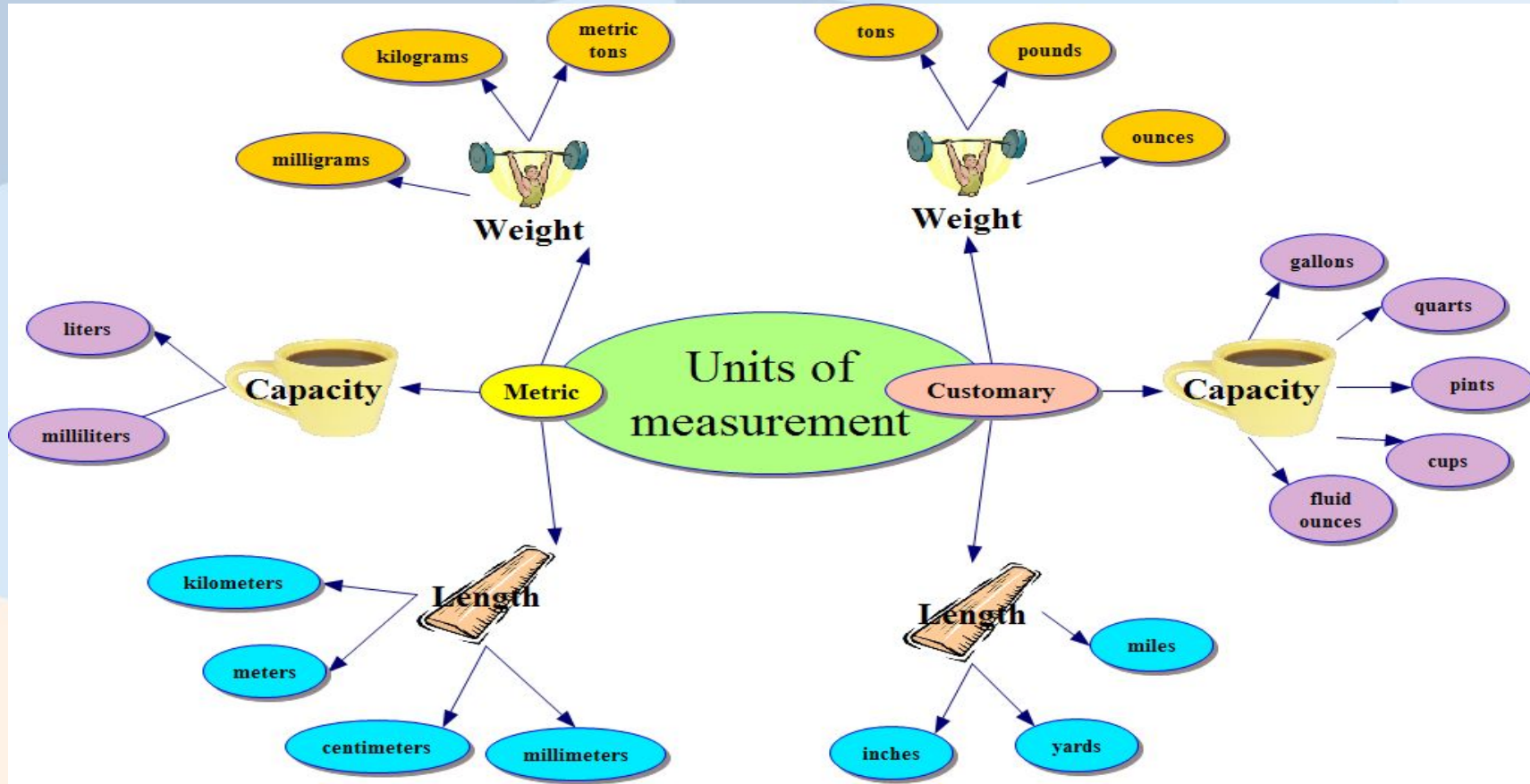Sogeti geniet het vertrouwen van top 500 organisaties, waaronder PostNL. Sogeti helpt ook u graag met concrete cloudoplossingen. Van een stapsgewijze aanpak tot de meest vergaande cloud-only strategie. Ontdek dat dé cloud niet bestaat. Bezoek de Sogeti Cloud Cases.

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Performance Measurement
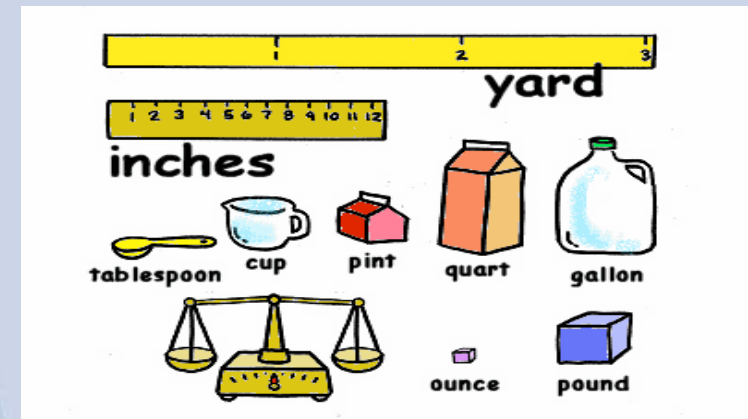
Size

Software Size

LOC, SLOC, ESLOC
Nesma / IFPUG Function Points
COSMIC Function Points
Usecase Points
IBRA points
Fast Function Points
SNAP Points
Configuration Points
Object Points
Complexity Points

.....

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Key Performance Metrics

- **Productivity**

$$\frac{\text{Effort hours spent}}{\textbf{Size} \text{ of the delivered Software Product}}$$

- **Cost Efficiency**

$$\frac{\text{Team cost}}{\textbf{Size} \text{ of the delivered Software Product}}$$

- **Velocity**

$$\frac{\text{Duration (months)}}{\textbf{Size} \text{ of the delivered Software Product}}$$

- **Product Quality**

$$\frac{\text{Defects Delivered}}{\textbf{Size} \text{ of the delivered Software Product}}$$

- **Code Quality Metrics**

  Maintainability
  Reliability
  Performance
  Security
  Technical Debt
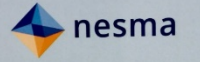
SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Estimating maturity model*

- Expert opinions, not based on data.
- Human bias: Likely to be inaccurate and low
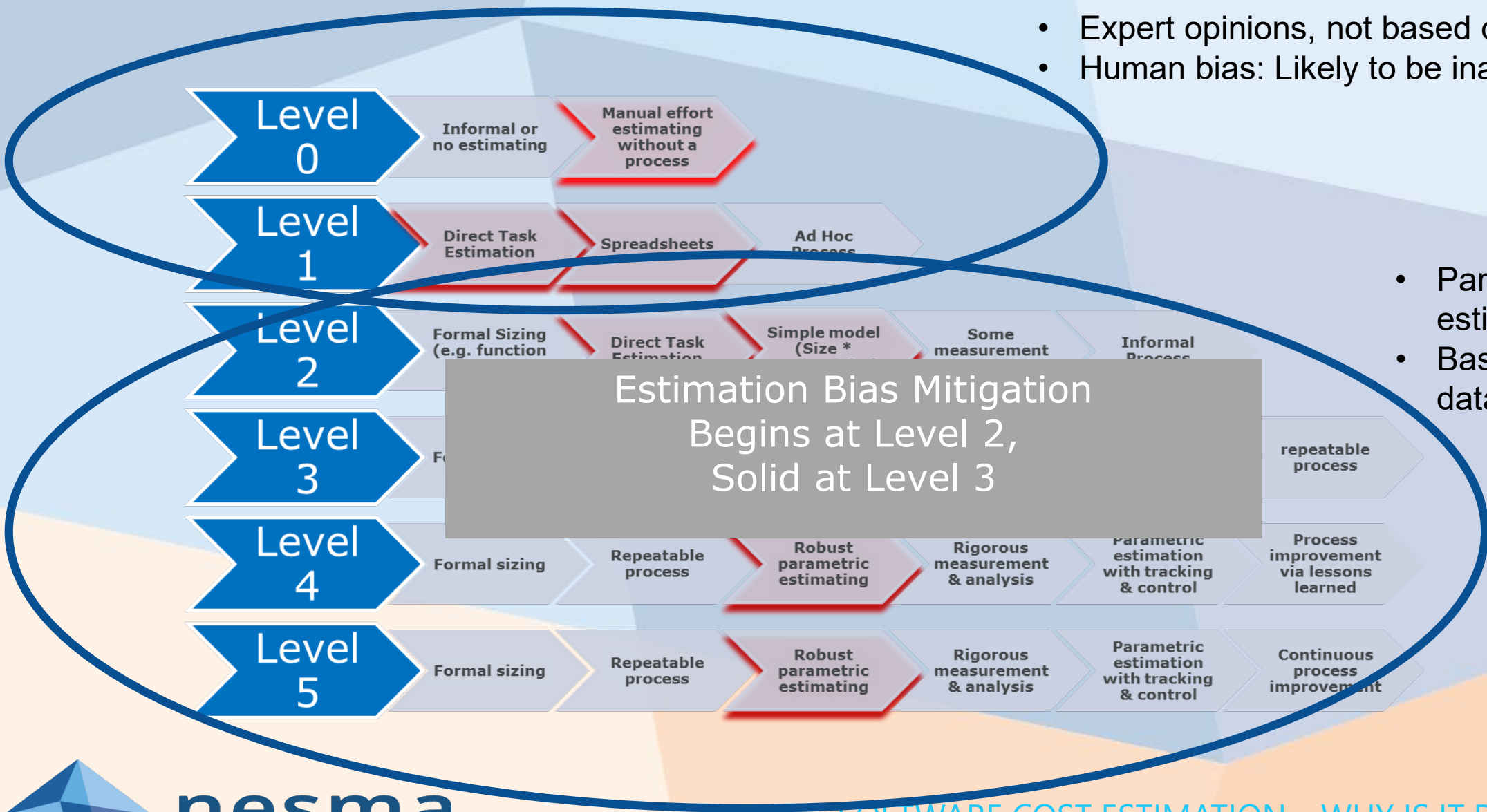
- Parametric estimates
- Based on size, data and models

Level 0	Informal or no estimating	Manual effort estimating without a process			
Level 1	Direct Task Estimation	Spreadsheets	Ad Hoc Process		
Level 2	Formal Sizing (e.g. function	Direct Task Estimation	Simple model (Size *	Some measurement	Informal Process
Level 3	Fo				repeatable process
Level 4	Formal sizing	Repeatable process	Robust parametric estimating	Rigorous measurement & analysis	Parametric estimation with tracking & control	Process improvement via lessons learned
Level 5	Formal sizing	Repeatable process	Robust parametric estimating	Rigorous measurement & analysis	Parametric estimation with tracking & control	Continuous process improvement

Estimation Bias Mitigation
Begins at Level 2,
Solid at Level 3

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

* Developed by Dan Galorath, www.galorath.com

Cost Estimator

Overview

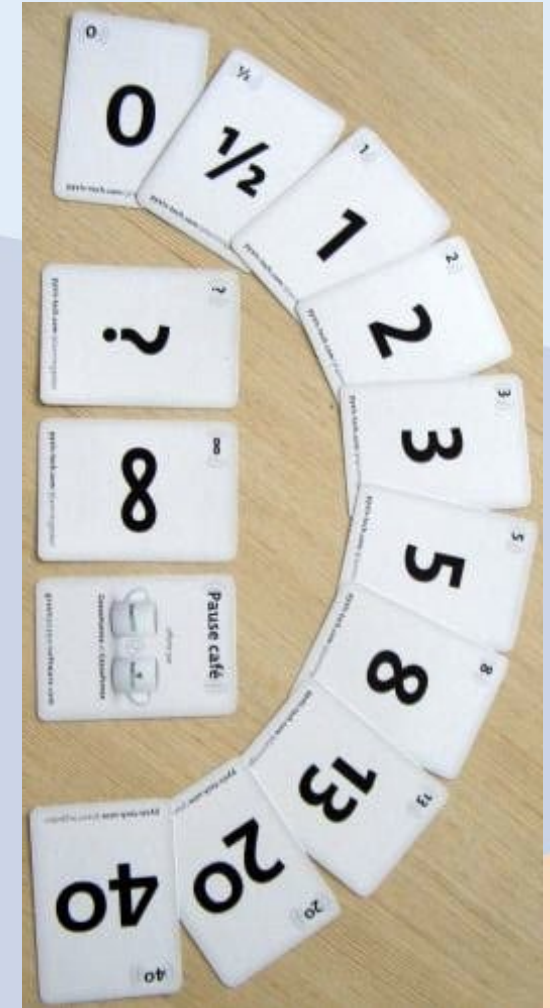Cost estimators use standard estimating techniques to calculate the cost of a construction or manufacturing project. They help contractors, owners, and project planners determine how much a project or product will cost to decide if it is economically viable. There are approximately 216,270 cost estimators employed in the United States.

Quick Facts

Alternate Title(s)	None
Duties	Plan and troubleshoot projects with owners, architects, engineers, and contractors; identify all cost items (e.g., site preparation; labor, materials); gather information and measurements; prepare estimates using job notes, blueprints, and supporting documentation; calculate estimates using software programs
Salary Range	$25,000 to $100,000+
Work Environment	Indoors/Outdoors
Best Geographical Location(s)	Nationwide, with particular focus on government and large commercial areas
Minimum Education Level	• Bachelor's Degree
School Subjects	• Business • Economics • Mathematics
Experience	Internship or co-op
Personality Traits	• Organized • Realistic • Technical

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Software Cost Estimator

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

'Expert' Estimation

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Realistic estimation is a Key Success Factor

A realistic estimate is one of the most important conditions for a successful project.

The estimate is the basis for:

- Business case
- Planning
- Proposal (outsourcing: fixed price / date)
- Financial result of the project... and the organization
- Claiming and releasing of resources
- Alignment between IT and business / customer
- Progress reports / dashboards
- The feeling of the team and the stakeholders

Without a realistic estimate, **the project is likely to fail!**

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Effects

Non-linear extra costs

Planning errors

Team enlargement →more expensive, not faster

Extra management attention / overhead

Stress: More defects, lower maintainability !!

100%

Optimistism

Pessimism

Additional Costs

Linear extra costs

Extra hours will be used

0%

Low Estimates

Realistic Estimates

High Estimates

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Estimation maturity and extra cost

100%

Additional Costs

Optimistism

Expert Estimates Level 0-1

Parametric Estimates Level 2-5

Pessimism

0%

Low Estimates   Realistic Estimates   High Estimates

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?
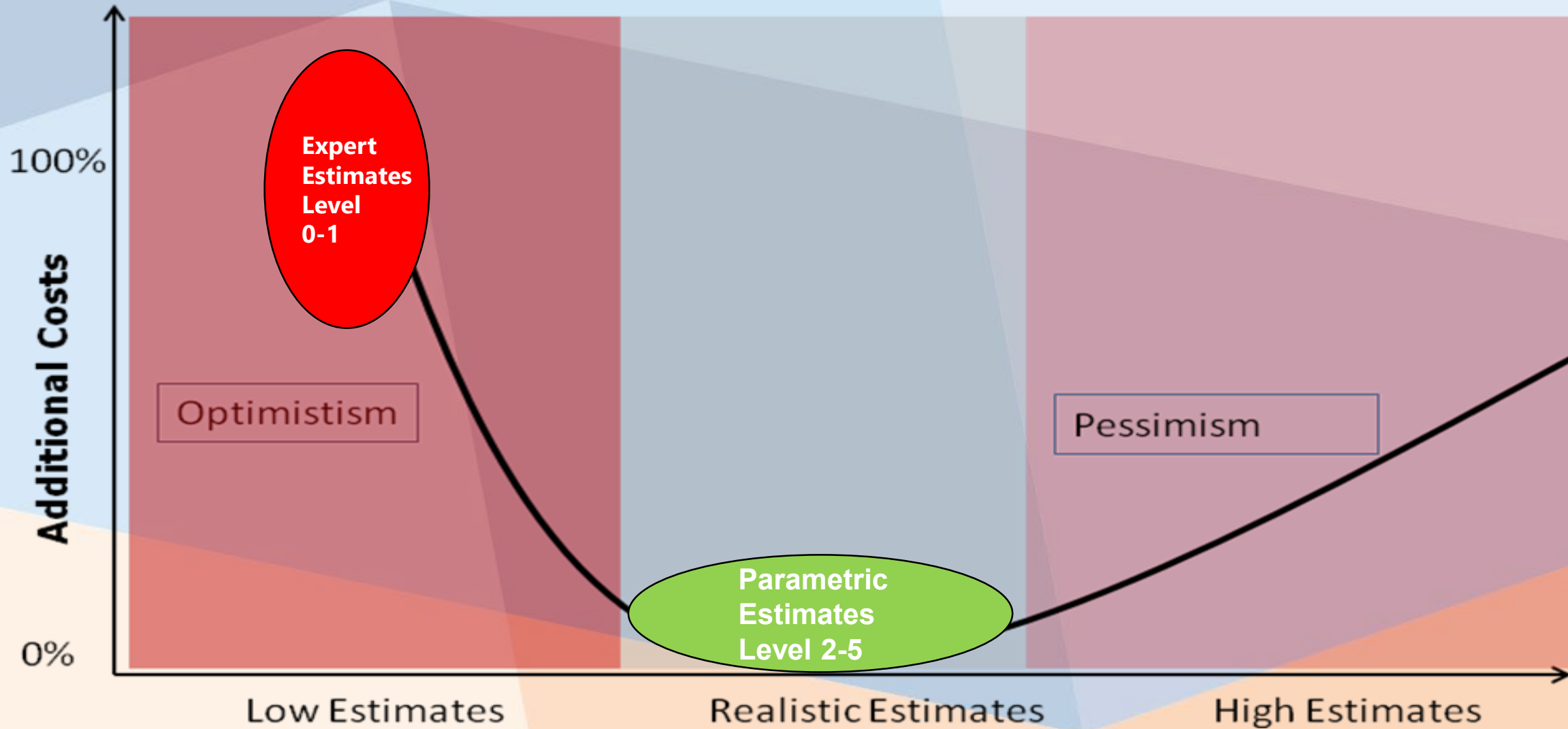
Software Cost Estimator as a Profession

Overview

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Software

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Software

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

ICEAA

International Cost Estimating and Analysis Association

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MEMBERSHIP

ICEAA PORTAL

ABOUT ICEAA

THE CERTIFICATION PROGRAM

ICEAA WORKSHOPS

ICEAA ASSOCIATION AWARDS

PUBLICATIONS

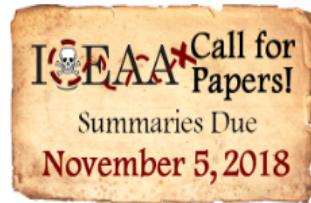CHAPTERS

ECONOMIC DATA SOURCES

CAREERS

CONTACT ICEAA

Welcome to ICEAA

The International Cost Estimating and Analysis Association is a nonprofit organization that strives to promote and to enhance the profession of cost estimating and analysis with the primary goal of fostering the professional growth of our members in cost estimating, cost analysis, and allied fields. ICEAA is represented locally by more than 20 chapters nationwide and international affiliates in Australia, Canada, Japan and the United Kingdom.

Member Benefits

Membership is open to all interested individuals from all levels of expertise from the government, private sector and academia. ICEAA members enjoy a valuable suite of member benefits, including:

- Discounted registration to the annual Professional Development & Training Workshop, an annual training event that brings together industry experts for a dynamic four-day informational environment
- Local and regional seminars designed to address specific topics of special interest and networking events to expand your circle of colleagues
- Subscription to *ICEAA World*, a magazine filled with important association news, book reviews, feature articles and chapter updates
- Subscription to the *Journal of Cost Estimating & Analysis*, ICEAA's scholarly journal dedicated to providing the most current and innovative research and analysis in the cost community
- Eligibility to submit articles and papers for publication in both *ICEAA World* and the *Journal of Cost Estimating & Analysis*

CCEA® Finishing School
Register by September 30

Software and IT Cost Analysis Solutions Team Meeting
21-23 August 2018

ICEAA 2018 All-Member Virtual Meeting September 20

ICEAA Call for Papers!
Summaries Due November 5, 2018

ICEAA 2018
June 12-15 ❖ Phoenix, Arizona

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Nesma: Metrics and more

In a world that is becoming more and more agile, metrics are an indispensable base for managing the essentials of your software project: quality, cost and time. Nesma provides you with valuable information about software metrics and measurements, and the way metrics support your road to successful and cost-effective software projects.

LEARN MORE

Your starting point for successful software projects

Sizing and more

Nesma has its origin in measuring the size of software. Today, size and other metrics form the base for many activities that play a role in successful and cost-effective software projects.

ⓘ Learn more

SW Cost Estimating

Estimating cost and managing budgets is very important in software projects. Together with ICEAA and with support of international organizations, Nesma is involved in establishing a Software Cost Estimating Body of Knowledge (sCEBoK).

ⓘ Learn more

Publications

Nesma offers a combination of both free and paid publications that are helpful for you as a metrics professional. Take a look at these publications and raise your level of knowledge!

ⓘ Learn more

In the spotlight

Software Cost Estimation Body of Knowledge (sCEBoK)

- **Software** Cost Estimation Body of Knowledge (sCEBoK).
- This body of knowledge will contain relevant knowledge to fulfil the role of **Software Cost Estimator** and will be the basis for training and certification. Except knowledge, experience is an important criterion to pass this exam.
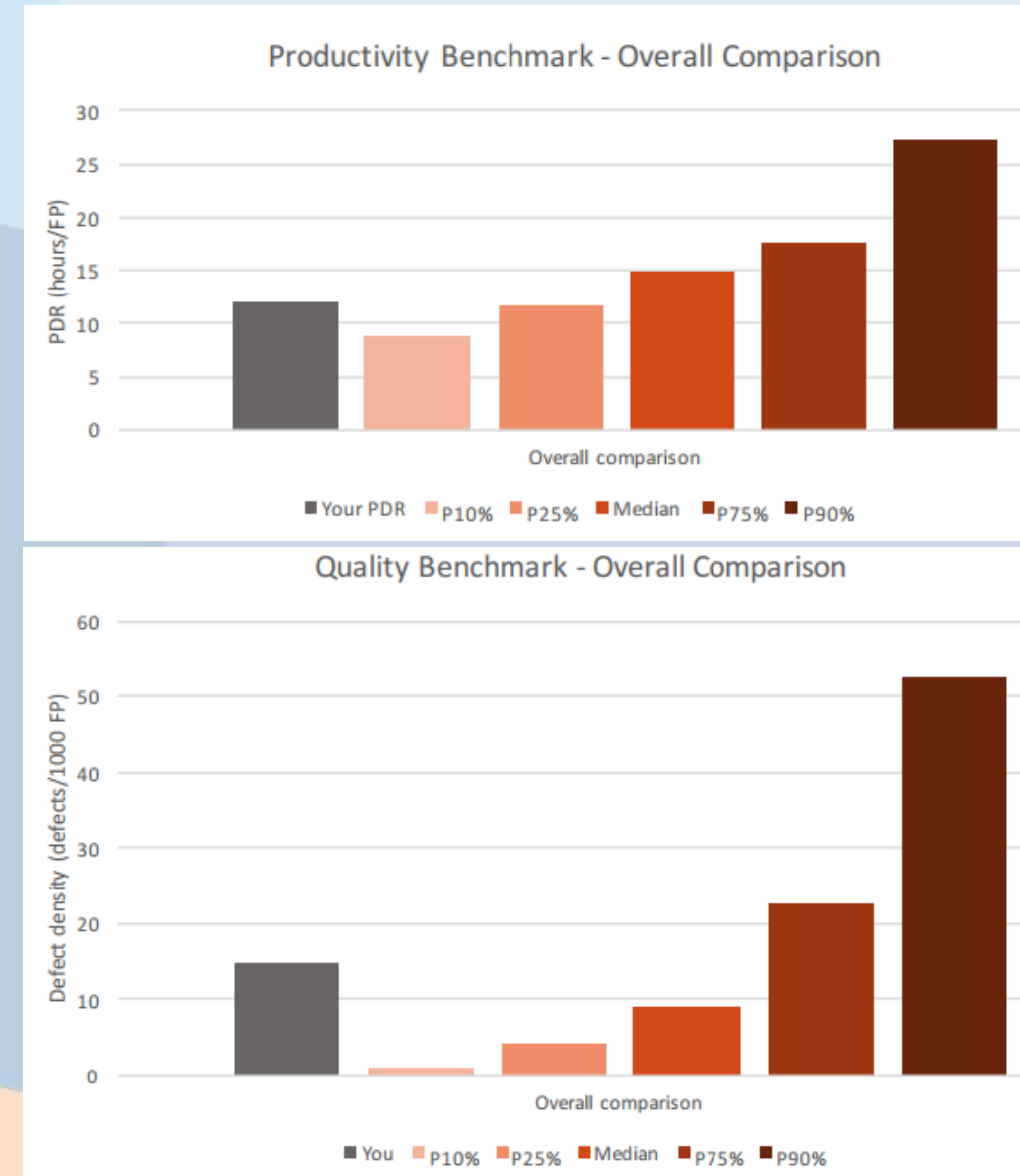
sCEBoK 2018 content

Currently the sCEBoK consist of the following modules, as presented during the ICEAA Conference in Phoenix in June 2018:

- Estimation principles
- Solution based estimation
- Basis of Estimate (BOE)
- Basis of Measurement (BOM)
- Budget process
- Data collection and basic data analysis
- Statistics to support basic metric analysis

- Estimation in the software lifecycle
- Estimation methods – Formal
- Estimation models – Size based methods
- Estimation maturity
- Cost drivers
- Benchmarking
- Application Maintenance

For the final sCEBoK, additional modules will be developed and current modules will be further improved with support of professionals of international software organizations. The new modules will focus on knowledge with respect to software cost estimation as well as on a further refinement of estimation models for modern lifecycles like Agile and DevOps. The sCEBoK will consist of training material including detailed notes. As a next step a wiki will be developed to share the knowledge.

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Available Industry Data

- International Software Benchmarking Standards Group (ISBSG)
- Independent and not-for-profit organization based in Australia
- Full Members are non-profit organizations, like AMMS, Nesma, IFPUG, FiSMA, China SPI, GUFPI-ISMA, JFPUG, Kosma and commercial organizations Galorath, Kexin Science and Leda-MC
- Bronze member: COSMIC

- Grows and exploits two repositories of software data:
  - New development projects and enhancements **(> 9000 projects, releases and sprints)**
  - Maintenance and support **(> 1100 applications)**

- Everybody can submit project data
  - Questionnaires on the site, online or Excel data files
  - Anonymous
  - Free benchmark report in return

Productivity Benchmark - Overall Comparison

Quality Benchmark - Overall Comparison

SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Mission

- Mission: "**To improve the management of IT resources** by both business and government, through the provision and exploitation **of public repositories of software engineering knowledge** that are <u>standardized, verified, recent</u> and <u>representative of current technologies</u>"

- All ISBSG data is
  - validated and rated in accordance with its quality guidelines
  - current
  - representative of the industry
  - independent and trusted
  - captured from a range of organization sizes and industries

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

ISBSG data

- >9100 rows in Excel, Easy to analyze.
- 250 data fields (columns) per project

#Projects

ISBSG Project ID	Rating Data Quality Rating	Rating UFP rating	Software Age Year of Project	Major Grouping Industry Sector	Major Grouping Organisation Type	Ma...					Sizing Size	Relative Size
10007	B	B	2016	Communication	Telecom	Bus...					51	S
10293	B	B	2016	Utilities	General;	Bus...					32	S
10392	B	B	2016	Communication	Telecom	Bus...					132	M1
10421	B	B	2016	Communication	Telecommunicatio	Bus...					74	S
10546	B	B	2016	Communication	Telecom	Bus...					86	S
10834	A	B	2016	Government	General;	Bus...					167	M1
11014	B	B	2016	Communication	Telecommunicatio	Bus...					66	S
11294	C	C	2016	Banking							280	M1
11530	B	B	2016	Communication	Telecom	Bus...					118	M1
12117	B	B	2016	Communication	Telecommunicatio	Bus...					174	M1
12255	B	B	2016								362	M2
12744	B	B	2016	Communication	Telecommunicatio	Bus...					91	S
12798	B	B	2016	Communication	Telecommunicatio	Bus...					110	M1
12808	C	C	2016	Banking			New Development		COBOL	Gartner FFP	51	S
12989	B	B	2016	Communication	Telecommunicatio	Business Applicati	Customer Relation	Enhancement	3GL	Java	IFPUG 4+	98	S
13003	B	B	2016					Enhancement	4GL	.Net	IFPUG	118	M1
13461	B	B	2016	Communication	Telecommunicatio	Business Applicati	Other	Enhancement	3GL	Java	IFPUG 4+	189	M1
13472	B	B	2016	Communication	Telecom	Business Applicati	Customer Relation	Enhancement		Java	IFPUG 4+	58	S
13492	B	B	2016	Communication	Telecommunicatio	Business Applicati	Customer Relation	Enhancement	3GL	Java	IFPUG 4+	133	M1
13888	B	B	2016					New Development		Java	IFPUG	453	M2
13915	B	B	2016	Communication	Telecommunicatio	Business Applicati	Customer relations	Enhancement	3GL	Java	IFPUG 4+	123	M1
14423	B	B	2016	Communication	Telecom	Business Applicati	Customer Relation	Enhancement		Java	IFPUG 4+	80	S
14550	A	B	2016	Government	Government;	Onshore		New development	3GL	C#	NESMA	192	M1
14892	B	B	2016	Communication	Telecom	Business Applicati	Customer Relation	Enhancement		Java	IFPUG 4+	195	M1
14938	B	B	2016	Communication	Telecom	Business Applicati	Customer Relation	Enhancement		Java	IFPUG 4+	78	S
15103	B	B	2016					New Development		.Net	IFPUG	139	M1
15436	B	B	2016					New Development		.Net	IFPUG	95	S
15528	B	B	2016	Communication	Telecommunicatio	Business Applicati	Customer Relation	Enhancement	3GL	Java	IFPUG 4+	192	M1

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Example: Estimate Landing zone

	PDR (hours/FP)
Number of projects	166
Minimum	4,2
Percentile 10%	5,3
Percentile 25%	6,8
Median	7,8
Percentile 75%	9,4
Percentile 90%	10,2
Maximum	15,3
Average	7,9

- Selection:
  - Data Quality: A or B
  - Year of Project > 2012
  - Project Type: Enhancement
  - Primary Programming language: Java
  - Count approach: Nesma or IFPUG
- The landing zone may be in this case:
  - Low: 6.8 h/FP
  - Likely: 7.8 h/FP
  - Max: 9.4 h/FP
- Further refinement may be possible,
  - Size category
  - Development methodology
  - Industry
  - Application type
  - …

SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?

Future

Project Success Rate

Overview

Software

Cost estimators use standard estimating techniques to calculate the cost of a construction or manufacturing project. They help contractors, owners, and project planners determine how much a project or product will cost to decide if it is economically viable. There are approximately 216,270 cost estimators employed in the United States.

Legend: ——Succesful ——Challenged ——Failed

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SOFTWARE COST ESTIMATION – WHY IS IT DIFFERENT?
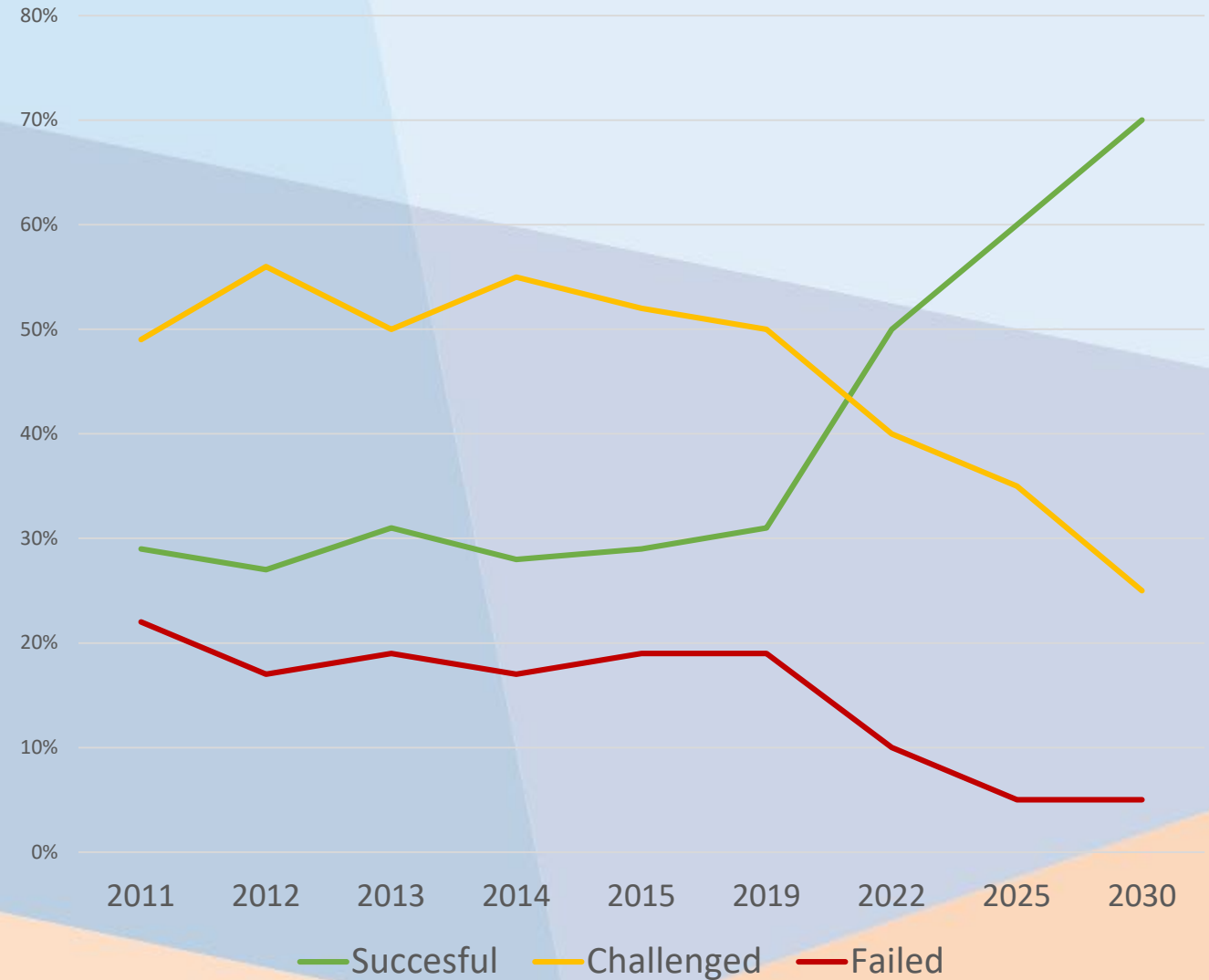
Thank you!

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