The most common Functional Size Measurement (FSM) Methods compared

#	Characteristic	IFPUG FPA r4.3	NESMA FPA v2.2	Mark II FPA r1.3.1	COSMIC FSM r3.0.1
1	Origin	Created by Allan Albrecht at IBM in 1978 Latest release (January 2010) of the original method	Created by NESMA (aka NEFPUG) in mid-1980s Latest versions (2004): 2.1 (English) 2.2 (Dutch translation) Derived from IFPUG but alternative method for Sizing Enhancements	Created by Charles Symons at Nolan Norton in 1984 (put into public domain 1991) Updated method for use with DBMS, structured methods, CASE tools, etc	Created by international consortium of industry subject matter experts and academics from 19 countries in 1997 Updated method for use with OOA/D, layered architectures, Web2.0, lean/agile, etc
2	Complies with international standard for Functional Size Measurement Methods – ISO14143 and other official recognition	ISO/IEC 20926:2003 ISO Standard applies only to unadjusted FP	ISO/IEC 24570:2005 ISO Standard applies only to unadjusted FP	ISO/IEC 20968:2002 Recommended method for HM Government (UK)	ISO/IEC 19761:2003/2011 BCS Technology Award Winner in 2006 Recognised as National Standard in Spain, Japan & Mexico
3	Counting Practices Manual available to an international body of users	Available to IFPUG members English & some other language versions available to members	Available for sale Dutch-language version English-language version	Available - public domain English-language version	Available - public domain 9 language versions: Arabic, Chinese, Dutch, English, French, German, Italian, Japanese, Spanish
3a	Standard guidance on Verification & Audit is available to an international body of users	Proprietary audit processes available from some service providers	Proprietary audit processes available from some service providers	Proprietary audit processes available from some service providers	Available – public domain COSMIC 'Guideline for assuring the accuracy of measurements' published February 2011
4	Used by	Public & private sector organisations, large & small, both customers & vendors, around the world	Public & private sector organisations, large & small, both customers & vendors, primarily for	Originally HM Government's preferred method for sizing & estimating software. Now	Public & private sector organisations, large & small, both customers & vendors, around the world

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		Mostly MIS users Stable user base – international	work in The Netherlands Mostly MIS users Stable user base in The Netherlands, declining elsewhere; approach to Enhancements growing amongst IFPUG users	used by a few public sector customers & their vendors Declining user base – mostly United Kingdom	Mix of MIS and Engineering users Growing user base – international
5	Certification of trained measurement staff	Yes Certified Function Point Specialist (CFPS)	Yes NESMA Certified Function Point Analyst (CFPA)	Yes UKSMA Certified Function Point Analyst (CFPA)	Yes COSMIC Practitioner Certification
6	Supported by the International Software Benchmarking Standards Group (ISBSG)	Yes	Yes	Yes	Yes
7	Pool of comparative data	Large Compiled over many years – the utility of antique data is questionable	Large Comparisons use IFPUG data	Small Some native data; can be compared to IFPUG data if care is taken	Moderate and growing Data since 1997; ISBSG benchmark released 2009; can be compared to older data if care is taken
8	Terminology used	Founded in the 1970s	Founded in the 1970s	Uses structured methods terminology	Compatible with OOA/D, & software eng. principles
9	Oriented toward user-required functionality	Yes	Yes	Yes	Yes
10	Helps verify consistency & completeness of user-required functionality	Yes	Yes	Yes	Yes
11	Analyses can be used as basis for construction of tests independent of code & test activities	Yes	Yes	Yes	Yes
12	Measures functional size of dynamic (behavioural) aspects of system (expressed as e.g. use cases, conversational dialogues, user stories, epics & themes, etc)	Yes	Yes	Yes	Yes

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13	Measures functional size of static (data storage) aspects of a system (expressed e.g. as files, tables, entity types, classes, etc)	Yes	Yes	Regarded as 'double accounting' – only information processing measured	Regarded as 'double accounting' – only information processing measured
14	Measures development of new requirements	Yes	Yes	Yes	Yes
15	Compatible with modern methods of requirements analysis	Partially (1975/85s concepts) requires data model	Partially (1980/85s concepts) requires data model Guidelines for using UML-based requirements documentation is available	Yes (1980/95s concepts) requires data model	Yes (1995/2010s concepts) incl. incremental Guidelines available for: Business Applications, SOA & Data Warehouse
16	Measures adaptive maintenance (enhancements)	Yes	Yes	Yes	Yes
17	Measures corrective maintenance (fixes)	No	No	No	No
18	Measures perfective maintenance (refactoring for improved performance)	No	No	No	No
19	Measures algorithmic complexity	No	No	No	No
20	Measures reuse of code	No	No	No	No
21	Designed for MIS systems - flat & indexed files, batch systems, OLTP systems	Yes	Yes	Yes	Yes
22	Designed for MIS systems - Relational DBMS	No But mapping rules have been developed	No But mapping rules for RDBMS are embedded	Yes	Yes

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#	Characteristic	IFPUG FPA r4.3	NESMA FPA v2.2	Mark II FPA r1.3.1	COSMIC FSM r3.0.1
23	Designed to be applicable to real-time and/or embedded systems	No MIS concepts only	No MIS concepts only	No terminology can be re-interpreted for real-time	Yes one common model applicable across MIS, real-time & embedded systems – Guideline in preparation (Aug-10)
24	Can be used to measure complex, layered architectures	No Rules assume monolithic system – infrastructure & middleware is 'invisible'	No Rules assume monolithic system – infrastructure & middleware is 'invisible' Guidelines for application in an SOA environment is in preparation (Aug-10)	Yes Limited – can recognise 3-tier architecture	Yes Designed to recognise 'layered architectures' – measures all functional requirements allocated to software systems
25	Can be used to measure Functional User Requirements before design, code & test	Yes	Yes	Yes	Yes
26	Can be used to measure Functional User Requirements after design, code & test	Yes	Yes	Yes	Yes
27	Early estimates of functional size can be made based on incomplete knowledge of Functional User Requirements – enabling consistent use of one size scale for estimating & measurement throughout project	Yes Various methods: e.g. Fast Eddy, File-Based Approach, Transaction-Based approach	Yes Various methods: e.g. Fast Eddy, File-Based Approach, Transaction-Based approach. Guidelines for early estimation are available.	Yes Various methods: e.g. Data Model Approach (CRUDL), Transaction-Based approach	Yes Various methods: e.g. Event-Based Approach, Object-Based Approach, Story-Based Approach Guide for early estimation in preparation (Aug-10).
28	Can be used to (re)estimate during product life-cycle	Yes	Yes	Yes	Yes
29	Size can be used as input into top-down software cost models such as COCOMO.II.2000, SLIM, SEER, Price-S, etc	Yes	Yes	Yes	Yes

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30	Can be used to construct product burndown charts, calculate takt time, #sprints, etc	Yes	Yes	Yes	Yes
31	Independent of product non-functional requirements	Yes	Yes	Yes	Yes
32	Independent of project constraints	Yes	Yes	Yes	Yes
33	Independent of developer experience	Yes	Yes	Yes	Yes
34	Independent of process, project management & development methods	Yes	Yes	Yes	Yes
35	Scale type: Nominal – distinguishes members of sets, unordered Ordinal – relationship between sets, unequal intervals Interval – comparisons, equal intervals, arbitrary zero Ratio – comparisons, equal intervals, a natural zero ref: ISO/IEC CD 15939.	'Nominal/Ordinal' Scale Unequal intervals between Low & Average, and between Average & High	'Nominal/Ordinal' Scale Unequal intervals between Low & Average, and between Average & High	'Ordinal/Interval' Scale Weights derived so that 1 MkII fp = 1 IFPUG fp approximately comparing functional processes	Ratio Scale Empirical data suggests 1 cfp ~ 1 IFPUG fp approximately comparing functional processes
36	Permissible arithmetic & statistical operations	Categories assigned relative weights: Data can be 'ranked', but 'quantifying' differences between values is difficult due to 'cut off' (Low is c. half of High) – ratios are problematic	Categories assigned relative weights: Data can be 'ranked', but 'quantifying' differences between values is difficult due to 'cut off' (Low is c. half of High) – ratios are problematic	Ordered, synthetic scale with a natural zero: Data can be ranked; differences & ratios between values can be quantified within limits but are problematic due to the use of weights	Ordered, constant scale with a natural zero: Data can be ranked; differences between values can be quantified; ratios make sense (i.e. 20 is twice the size of 10, and 2000cfp is twice 1000cfp).
37	Accounts for information processing by:	Sizing static data and dynamic behaviour	Sizing static data and dynamic behaviour	Sizing dynamic behaviour, the use of data	Sizing dynamic behaviour, the use of data

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#	Characteristic	IFPUG FPA r4.3	NESMA FPA v2.2	Mark II FPA r1.3.1	COSMIC FSM r3.0.1
38	Models the functional user requirements as:	File Types and Elementary Process (= Input-Process-Output)	File Types and Elementary Process (= Input-Process-Output)	Logical Transactions (= Input-Process-Output)	Functional Processes (= Input-Process-Output)
39	Equivalent of stimulus/response message pair (i.e. a ‘thread of control with some input, related processing, and some output)	Elementary Process either: External Input (EI), External Output (EO) or External Query (EQ) depending on ‘primary intent’	Elementary Process either: External Input (EI), External Output (EO) or External Query (EQ) depending on ‘primary intent’	Logical Transaction (LT) All stimulus/response message pairs regarded at LT irrespective of ‘primary purpose’	Functional Process (FP) All stimulus/response message pairs regarded at FP irrespective of ‘primary purpose’
40	Rules for measuring size	Different rules apply depending on elementary process type	Different rules apply depending on elementary process type	Same rules apply to all logical transactions	Same rules apply to all functional processes
41	Base Functional Component(s)	Internal Logical File External Interface File External Input External Output External Query	Internal Logical File External Interface File External Input External Output External Query	Input Data Element Entity Reference Output Data Element	Data Movement (either: Entry, eXit, Read, or Write depending on direction of movement)
42	Contributors to functional size	Per File Type: #static Data Element Types & #Record Element Types Per Transaction Type: #dynamic Data Element Types & #File Type References	Per File Type: #static Data Element Types & #Record Element Types Per Transaction Type: #dynamic Data Element Types & #File Type References	Per Logical Transaction: #Input Data Elements #Entity References #Output Data Elements	Per Functional Process: #Data Movements i.e. the movement (Entry, eXit, Read or Write) of one Data Group
43	Unit of measure	Different weights assigned to 5 function types depending on their relative ‘complexity’ Unit = 1 fp (IFPUG)	Different weights assigned to 5 function types depending on their relative ‘complexity’ Unit = 1 fp (NESMA)	Weights assigned to the ‘minimum size logical transaction’ add to 2.5 to establish comparability between MkII and IFPUG Unit = 1 fp (MkII)	1 Data Movement = 1 COSMIC Function Point Unit = 1 cfp

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#	Characteristic	IFPUG FPA r4.3	NESMA FPA v2.2	Mark II FPA r1.3.1	COSMIC FSM r3.0.1
44	Sensitivity to small changes to requirements	Low (only detects changes at boundaries between Low, Average, High categories)	Low (only detects changes at boundaries between Low, Average, High categories)	High (detects changes of single data element types and single entity references)	Moderate (detects changes to single data-groups)
45	Integrity of measures (how well do the measures reflect the thing measured?)	Artificial limits (weights, thresholds, uneven intervals) limit size of function types measured. Integrity is limited.	Artificial limits (weights, thresholds, uneven intervals) limit size of function types measured. Integrity is limited.	No artificial limits imposed on size of functional process. Integrity is good.	No artificial limits imposed on size of functional process. Integrity is excellent.
46	Sensitivity to variation in functional size of dynamic model of system i.e. functional processes	Stepped: minimum step 3fp maximum step 7fp	Stepped: minimum step 3fp maximum step 7fp	Stepped: minimum step either 0.26, 0.58 or 1.66 maximum step infinity	Accommodates size variation from zero to infinity in steps of 1 cfp
47	Sensitivity to variation in functional size of static model of system i.e. data stores	Stepped: minimum step 5 fp maximum step 15 fp	Stepped: minimum step 5 fp maximum step 15 fp	Data stores are considered to deliver functionality only when the data is referenced in transactions	Data stores are considered to deliver functionality only when the data is used in functional processes
48	Smallest feasible functional process	3 fp	3 fp	2.5 fp	2 cfp
49	Smallest feasible enhancement	3 fp	3 fp	0.26 fp	1 cfp
50	Availability	Available only to members of IFPUG (but easy to join organisation)	Public domain -– download from NESMA	Public domain – download from UKSMA	Public domain – download from COSMIC
51	Design Authority (independent of vendors)	International Function Point Users Group (IFPUG) www.ifpug.org	Netherlands Software Metrics Association (NESMA) www.nesma.nl	United Kingdom Software Metrics Association (UKSMA) www.uksma.co.uk	COmmon Software Measurement International Consortium (COSMIC) www.cosmicon.com

Types of measurement scale and permissible operations using them

The type of scale depends on the nature of the relationship between values on the scale. Four types of scale are commonly defined:

- Nominal – arbitrary labels, classification data, no ordering – the measurement values are categorical but it makes no sense to state that one category is 'greater than' another. For example: Yes/No; Black/White/Yellow/Red; male/female, animal/vegetable/mineral; the classification of defects by their type.
- Ordinal – ordered but differences between values are not important – the measurement values are rankings. For example: restaurant 'star' ratings; political parties on left to right of the spectrum are given labels Red, Orange, Blue; Likert scales that rank 'user satisfaction' on a scale of 1..5; the assignment of a severity level to defects.
- Interval – ordered, constant scale, but no natural zero – the measurement values have equal distances corresponding to equal quantities of the attribute. For example: dates, temperature on Celsius or Fahrenheit scales – differences make sense, but ratios do not (e.g., 30°-20° = 20°-10°, but 20° is not twice as hot as 10°! Other examples: cyclomatic complexity has the minimum value of one, but each additional path increments the count by one.
- Ratio – ordered, constant scale, natural zero – the measurement values have equal distances corresponding to equal quantities of the attribute where the value of zero corresponds to none of the attribute. For example: height; weight; age; length; temperature on Kelvin scale (e.g. absolute zero = 0°K, and 200°K is twice as hot as 100°K); the size of a software source listing in terms of Non-Commentary Source Statements (or Source Lines Of Code).

The method of measurement usually affects the type of scale that can be used reliably with a given attribute. For example, subjective methods of measurement usually only support ordinal or nominal scales.

Only certain operations can be performed on certain scales of measurement. The following list summarizes which operations are legitimate for each scale. Note that you can always apply operations from a 'lesser scale' to any particular data, e.g. you may apply nominal, ordinal, or interval operations to an interval scaled datum.

- Nominal Scale. You are only allowed to examine if a nominal scale datum is equal to some particular value or to count the number of occurrences of each value. For example, gender is a nominal scale variable. You can examine if the gender of a person is F (female) or to count the number of Ms (males) in a sample. Valid statistics: mode, chi square.
- Ordinal Scale. You are also allowed to examine if an ordinal scale datum is less than or greater than another value. Hence, you can 'rank' ordinal data, but you cannot 'quantify' differences between two ordinal values. For example, political party is an ordinal datum with the Liberal Democratic Party to the left of the Conservative Party, but you can't quantify the difference. Another example are preference scores, e.g. ratings of eating establishments where 10=good, 1=poor, but the difference between an establishment with a 10 ranking and an 8 ranking can't be quantified. Valid statistics: mode, chi square, median, percentile.
- Interval Scale. You are also allowed to quantify the difference between two interval scale values but there is no natural zero. For example, temperature scales are interval data with 25C warmer than 20C and a 5C difference has some physical meaning. Note that 0C is arbitrary, so that it does not make sense to say that 20C is twice as hot as 10C. Valid statistics: mode, chi square, median, percentile, mean, standard deviation, correlation, regression, analysis of variance.
- Ratio Scale. You are also allowed to take ratios among ratio scaled variables. Physical measurements of height, weight, and length are typically ratio variables. It is now meaningful to say that 10 metres is twice as long as 5 metres. This ratio holds true regardless of which scale the object is being measured in (e.g. metres or yards). This is because there is a natural zero. Valid statistics: mode, chi square, median, percentile, mean, standard deviation, correlation, regression, analysis of variance, geometric mean, harmonic mean, coefficient of variation, logarithms.

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