Functional size measurement – accuracy versus costs – is it really worth it?

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Abstract

Functional Size measurement (FSM) methods like NESMA FPA [1] and COSMIC [2] can be done in the standard way, in which the in detail described counting rules and guidelines are applied, but these measurements can also be carried out in an approximate way.

The authors, who work for the department of Sizing, Estimating & Control of Sogeti Nederland B.V., have analyzed a large number of projects, measuring them with both the detailed methods and the approximate methods. This paper will describe the accuracy percentages found for the different approximate methods as well as the difference in time spent for the various analysis methods.

The study gives a detailed overview of the differences in accuracy between the methods and the differences in effort needed to perform such measurements. This results in a accuracy/cost tradeoff that can be used by organizations to assess the measurement method that is required for a specific project.

1. Introduction

A functional size measurement method (FSMM) needs to comply to certain criteria in order to be able to be certified by ISO [3]. One of the main criteria is that the method follows the ISO reference model, in which the measurement is based on identifying FUR's (Functional User Requirements) and BFC's (Base Functional Components). The idea is to identify the BFC's in each FUR and then apply a weighting scheme to assign a certain number of (function/COSMIC/MKII)-points to these BFC's.

This means that it is only possible to apply a FSMM when the functional documentation of an information system is complete and all functionality is described in a way that the FUR's and the BFC's are identifiable. Moreover, there should be enough detail to apply the specific counting guidelines that result in the number of points per BFC. For example, to be able to assess the right complexity of an External Input (EI) in the NESMA method, it is required to know the number of attributes that go across the boundary (from the user into the information system) and it is required to know how many logical files are needed to perform this function.

There are a number of occasions, however, that this level of detail is not present in the documentation specified. Usually FSMM methods are applied in order to estimate the costs of a software project and at the moment the estimation has to be made, the project is in such an early stage that a detailed functional description is not yet available. In our daily practice, we sometimes have to deliver fixed-price fixed-date estimations already in the stage after the user draws up his initial requirements. This type of documentation is not nearly detailed enough to apply the detailed versions of the FSMM methods mentioned before.

Another trend is that functional documentation nowadays becomes less detailed and a lot of essential information is just missing from the designs. This leads to the problem that although the user will state that the functional documentation is complete, it is still not possible to apply the detailed guidelines of an FSMM.

In order to deal with this problem, the FSMM methods are usually extended with ‘scaled methods’ in order to be able to apply the method to functional documentation that lacks the level of detail to be able to apply the full method.

In addition to the FSMM methods NESMA FPA and COSMIC, in this paper the following methods are discussed:

- NESMA FPA – estimated approach
- NESMA FPA – indicative approach
- COSMIC – Average Functional Process approach
- COSMIC – Equal Size Bands approach

This paper investigates the accuracy of these methods in relation to possible cost reductions when measuring an application with one of these ‘scaled’ approaches.

2. NESMA Method

The NESMA FPA method was founded by the NESMA (Netherlands Software Metrics Association) in 1989 because the members back then had some other ideas about the IFPUG [4] counting guidelines, which were mainly technical oriented at that time, for instance about the use of logical files that can be considered a ‘code table’. Through time, a lot of differences in opinion have been resolved, which means that the NESMA FPA method is nowadays almost equal to IFPUG. A list with remaining differences can be downloaded from the NESMA website [5].

2.1. NESMA detail counting guidelines

The NESMA method identifies five different BFC-types in the FUR’s that are considered to be part of the scope of the measurement. These BFC-types are[1]:

- ‘Interne Logische Gegevens Verzameling’ (ILGV). In IFPUG: ILF.
- ‘Koppelingsgegevensverzameling’ (KGV). In IFPUG: EIF.
- ‘Invoerfunctie’ (IF) - In IFPUG: EI.
- ‘Uitvoerfunctie’ (UF) - In IFPUG: EO.
- ‘Opvragingsfunctie’ (OF) - In IFPUG: EQ.

The method can be visualized as follows:

[1] In this paper, the English abbreviations from the IFPUG-method are used for the BFC-types to improve the readability of this document.

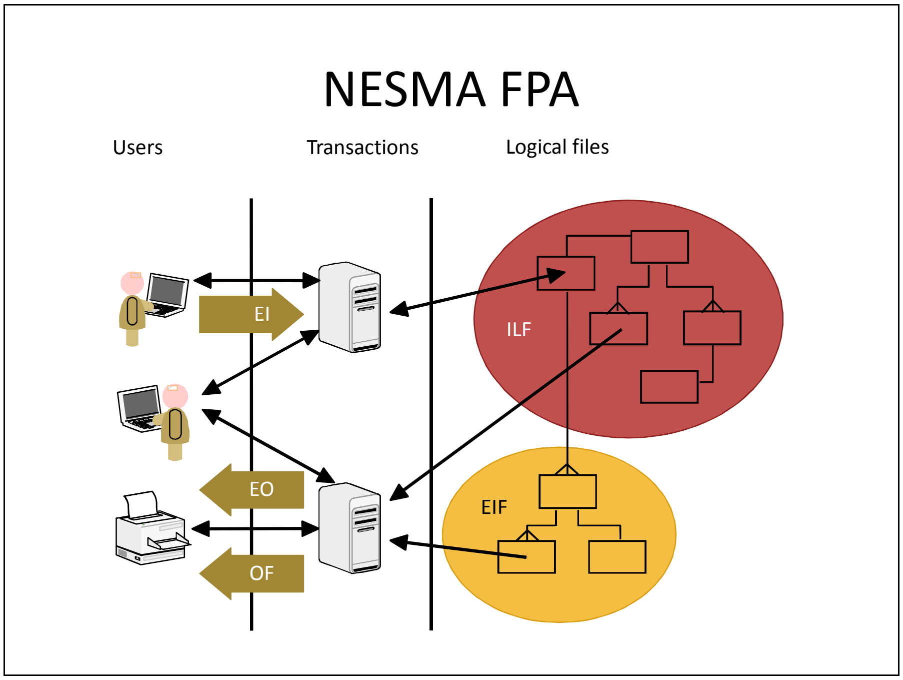

Figure 2.1: NESMA FPA method

In NESMA FPA, the weighting scheme to assign the number of function points (FP) for the different BFC-types is as follows:

*Table 2.1: weighting scheme **detailed** NESMA FPA*

BFC-type	Simple	Average	Complex
ILF	7 FP	10 FP	15 FP
EIF	5 FP	7 FP	10 FP
EI	3 FP	4 FP	6 FP
EO	4 FP	5 FP	7 FP
EQ	3 FP	4 FP	6 FP

There are many detailed guidelines described in the manual in order to:
1. Identify the BFC's in each FUR
2. Assess the complexity of the BFC identified

For the assessment of the complexity of the BFC's identified, the following information is necessary:
- For ILF and EIF: The number of data attributes that are present in the logical file
- For ILF and EIF: The number of record types that together form the logical file. These record-types can only be identified after the data model is de-normalized into a conceptual data model. Denormalization guidelines are also part of the NESMA manual.
- For EI/EO and EQ: the number of data elements (attributes) that are transported in the function over de border (into the system or to the outside of the system).
- The number of logical files that are needed to perform the function.

When not all of this information is present, the NESMA analyst can either decide to make a number of assumptions or to apply an estimated or indicative NESMA analysis.

2.2. NESMA estimated approach

The estimated approach of the NESMA counting guidelines can be applied when it is possible to identify all the FUR's that belong to the scope of the measurement and all the BFC's that are present in each of these FUR's. The estimated approach can also be applied when the information that is needed to assess the complexity of the BFC's is missing or incomplete. If it is possible to identify the ILF's, EIF's, EI's, EO's and EQ's in the FUR's being measured, but for instance the information is missing regarding the attributes that cross the boundary in the descriptions of the functions, the detailed NESMA FPA method is not applicable, but the estimated approach is!

The estimated approach does not assess the complexity into detail, but just applies the following counting guidelines:

All logical files (ILF's and EIF's) are considered to be of simple complexity
and
All transactions (EI's, EO's and EQ's) are considered to be of average complexity

This results in the following weighting scheme:

*Table 2.2: weighting scheme **estimated** NESMA FPA*

BFC-type	Simple	Average	Complex
ILF	7 FP	10 FP	15 FP
EIF	5 FP	7 FP	10 FP
EI	3 FP	4 FP	6 FP
EO	4 FP	5 FP	7 FP
EQ	3 FP	4 FP	6 FP

The idea is that, on average, this weighting scheme leads to approximate the same result as when using the detailed method. The NESMA has investigated this idea by double measuring 100 applications and reports the following findings [6] :

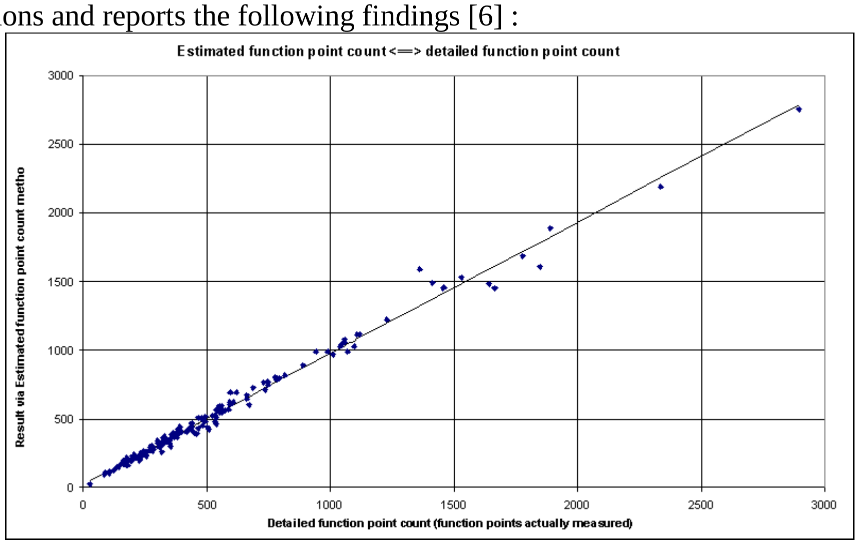

Figure 2.2: Detailed NESMA FPA vs. estimated NESMA FPA

There is an almost straight line and very few outliers. This indicates that there is indeed a very strong correlation between the functional size measured in detailed NESMA and the functional size measured in estimated NESMA FPA. However, the research does not mention whether a different weighting scheme would have resulted in even a better (or a worse) correlation.

2.3. NESMA indicative approach

The NESMA indicative approach can be used when there is no (or incomplete) information available regarding the BFC-types EI, EO and EQ. This means in practice that indicative FPA can be used when only a data model is available to the measurer, or when the measurer is capable of constructing a data model from the documentation himself. Depending on the type of data model, the indicative NESMA method applies the following counting guidelines:

In a conceptual data model:
All ILF's are considered to represent 35 Function Points
All EIF's are considered to represent 15 Function Points

In a normalized (in 3rd normal form) data model:
All ILF's are considered to represent 25 Function Points
All EIF's are considered to represent 10 Function Points

This results in the following weighting scheme:

*Table 2.3: weighting scheme **indicative** NESMA FPA*

BFC-type	Conceptual Data model	Normalized Data model
ILF	35 FP	25 FP
EIF	25 FP	10 FP

The assumption is that with every ILF, there usually is functionality to add the ILF, functionality to update the ILF and functionality to delete the ILF. Furthermore there usually is functionality to show the ILF to the user (on screen or in a print list, etc.). This means that for a usual ILF, the following weighting scheme can be applied:

*Table 2.4: **indicative** NESMA FPA assumptions*

	BFC-type	**Size ILF**	**Size EIF**
Logical file	LGV	7 FP	5 FP
Add ILF	EI	4 FP	-
Update ILF	EI	4 FP	-
Delete ILF	EI	4 FP	-
Show ILF 1	EQ	4 FP	4 FP
Show ILF 2	EO	5 FP	5 FP
Show ILF 3	EO	5 FP	-
Generic functionality		2 FP	1 FP
Total		**35 FP**	**15 FP**

The idea is that, this weighting scheme leads to a good approximation of the size. The NESMA has investigated this idea by double measuring 100 applications and reports the following findings [7] :

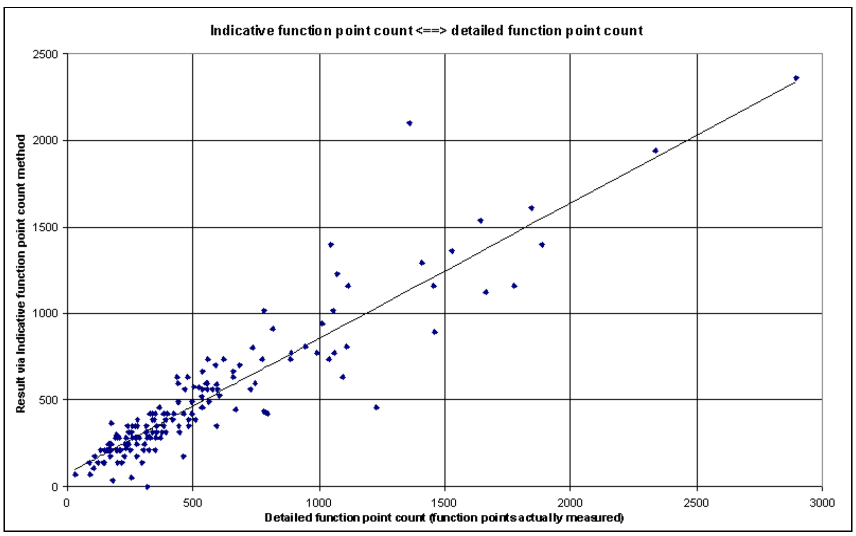

Figure 2.3: Detailed NESMA FPA vs. Indicative NESMA FPA

The figure shows many outliers from the straight line, but also shows that the indicative can still be used as an approximation. Although accuracy is lower than in the detailed and estimated variant, the method gives the possibility to measure the size in a very early stage of the project or based on documentation with a very low level of detail.

Of course one should take into account the type of application before applying the indicative NESMA FPA. When an information system to be measured does not match the assumptions in table 2.4, the accuracy of this method may be very low. When this method is for instance being used to measure the size of a data warehouse system, the accuracy is very likely to be very low. However, when the method is applied to a ‘usual’ end-user system, like for instance a system in which clients and orders are being managed, the accuracy of the indicative method may be fairly high.

3. COSMIC Method

The COSMIC method was developed in 1998 by an international group of scientists and practitioners who shared the goal to develop a new FSMM. This new FSMM should be equally applicable to MIS/business software, to real-time and infrastructure software (e.g. as in operating system software) and to hybrids of these. NESMA FPA (and IFPUG) is only applicable to MIS/business software. There are four main COSMIC documents at the moment that define the COSMIC method:

- Method Overview [8]
- Documentation overview & Glossary of terms [9]
- Measurement manual [2]
- Advanced & Related Topics [10]

The detailed COSMIC method is described in the measurement manual, while in the document Advanced & Related Topics [10], a number of 'early', 'rapid' or 'approximate' sizing methods are given. These are:

- the Average Functional Process approach
- the Fixed Size Classification approach
- the Equal Size Bands approach
- the Average Use Case approach

In our research, only the Average Functional Process approach and the Equal Size Bands approach have been used, so these are the methods that are described in this paper.

3.1. COSMIC detail counting guidelines

In COSMIC, the FUR's are divided into Functional Processes and Functional Processes consist of at least two, but in theory unlimited, sub processes. A sub process can either be a data movement or a data manipulation. However, in COSMIC it is assumed that the portion of data manipulation is evenly distributed over the data movements, which is the reason that for simplicity reasons, only data movement types are measured. A visualization is given in figure 3.1.

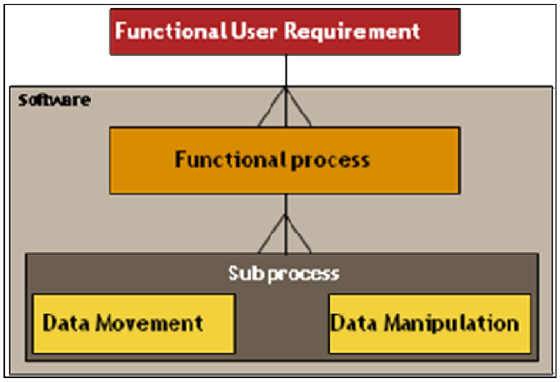

Figure 3.1: FUR, Functional Processes and sub processes

The COSMIC method first identifies the functional processes in each FUR inside of the measurement scope. Functional processes are initiated by a user after the user identifies a trigger outside of the software which forces him to start the functional process. These functional processes are very similar to the user transactions in NESMA FPA. When the functional processes are identified, the number of data movements are measured. In order to do this, first the Objects-of-Interest for a user have to be identified. An Object-of-Interest is any logical group of data to the user with which the software has to do something (store, process or manipulate). There are four different datamovement types in COSMIC:

- The **Entry** moves a datagroup of an Object-of-Interest from the user into the functional process
- The **Read** moves a datagroup of an Object-of-Interest from persistent storage into the functional process
- The **Write** moves a datagroup of an Object-of-Interest from the functional process into persistent storage
- The **Exit** moves a datagroup of an Object-of-Interest from the functional process to the user

A visualization is given in figure 3.2.

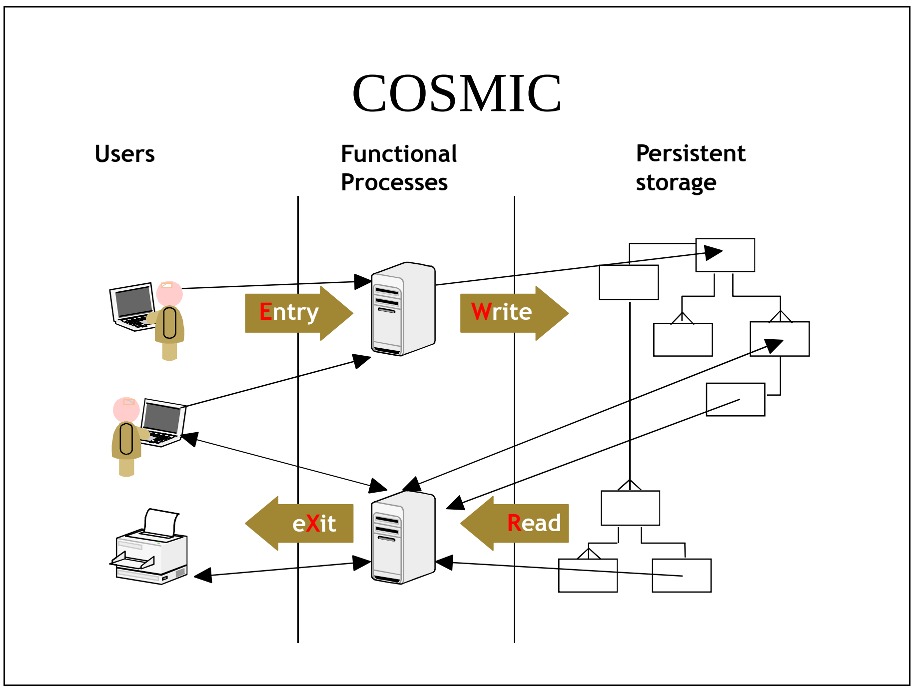

Figure 3.2: The COSMIC method

*Table 3.1: weighting scheme **detailed** COSMIC*

BFC-type	**Entries**	**Exits**	**Reads**	**Write**
Functional Process	ΣE * 1 CFP	ΣX * 1 CFP	ΣR * 1 CFP	ΣW * 1 CFP

The size of a functional process is the sum of all the Entry, Exit, Read and Write data movements that are identified in that functional process. The total size of a COSMIC measurement is the sum of the size of all the functional processes that reside within the measurement scope.

The detailed COSMIC guidelines are written in the COSMIC Measurement Manual [2].

In the detailed version of the COSMIC method, the following information is necessary;

- It must be possible to identify the measurement strategy of the measurement. This results in a specific measurement scope, the functional user-types and the ‘level-of-granularity’ on which the measurement takes place is determined.
- It must be possible to identify all the functional processes in all the FUR’s that reside in the measurement scope
- It must be possible to identify all the Objects-of-interest for the functional users, the persistent ones as well as the ‘transient’ ones.
- It must be possible to identify all the data movements into and out of the functional processes.

In practice, the COSMIC method is applicable in more situations than FPA, because the method requires less detailed functional documentation. However, it’s not always possible to apply the detailed COSMIC guidelines on a set of functional documentation. If the information listed above is not present, the detailed method is not applicable, but in some cases a derived method can be used, like for instance the COSMIC Average Functional Process approach or the COSMIC Equal size bands approach.

3.2. COSMIC Average Functional Process approach

This method assumes that it is possible to define the measurement strategy, which means that the goal, the measurement scope and the functional users can be identified. Furthermore, this method assumes that the number of functional processes can be estimated from the documentation available. This method can therefore be used when there is no detailed or no complete information available on the Objects-of-interest for the functional users and/or it is not clear which datagroups of which Objects-of-interest are moved in the different functional processes.

Vogelezang [11,12] has determined the average size per functional process for software measured in the business application domain to be **8 COSMIC Function points (CFP) per functional process**. However, the Advanced & Related Topics document specifically states that this value should be calibrated locally as it will probably differ per organization. This local calibration can easily be done by performing a number of detailed analysis and then divide the total number of CFP by the number of functional processes.

*Table 3.2: weighting scheme **Average Functional Process** COSMIC*

BFC-type	Size
Functional Process	8 CFP

The size of a functional process is the locally calibrated average number of CFP per functional process (or 8 CFP when there is no locally calibrated values are available). The total size of a COSMIC measurement is the number of functional processes times this average number of CFP per functional process.

3.3. COSMIC Equal Size Bands approach

In the Equal Size Bands approach, the functional processes are classified into a small number of size bands. The boundaries of the bands are chosen in the calibration process so that the total size of all the functional processes in each band is the same for each band. (So if, for example, the choice is to have three bands, then the total size of all the functional processes in each band will contribute 33% to the total size of the software being measured.)

Vogelezang and Prins [13] have reported on using this approach for early sizing, having carried out a calibration using measurements on 37 business application developments, each of total size greater than 100 CFP. It was decided to use four size bands. The average sizes of each band when the 2427 functional processes of the 37 (MIS) applications were distributed over the four bands (and the names given to these bands) are:

*Table 3.3: weighting scheme **Equal Size Bands** COSMIC*

BFC-type	**Small**	**Medium**	**Large**	**Very Large**
Functional Process	4.8 CFP	7.7 CFP	10.7 CFP	16.4 CFP

To interpret these figures: 25% of the total size of these 37 applications is accounted for by 'Small' functional processes, whose average size is 4.8 CFP, another 25% of the total size by 'Medium' functional processes of average size 7.7 CFP, etc.

These values also should be locally calibrated, as the values will probably differ per organization.

4. Study

Comparing the scaled methods to detailed methods

During the time period January 2006 until December 2008, a number of projects have been analyzed with the different methods. In this time period, 42 projects have been measured with the detailed, estimated and indicative NESMA FPA method and 24[2] projects have been measured with the detailed, Average Functional Process and Equal Size Bands COSMIC method. The NESMA FPA data is shown in table 4.1 in appendix A. The COSMIC data is shown in table 4.2 in Appendix A.

Measuring performance

Next to that, the performances of analysts performing FSM's were analyzed. During the time period January 2007 until February 2009, the performances of analysts in 259 FSM-projects were measured, expressed in the number of (Function/COSMIC)-points that were determined per hour of analysis. The results found were aggregated per FSMM used, in order to compare the performance-indicators of the various FSMM's.

4.1. Results

Comparing the scaled methods to detailed methods

In the appendices, the size measured with a detailed approach for each of the projects is shown, as well as the size measured with both scaled methods. Next to that the difference in the results per project are given, expressed in a percentage of the detailed result.

[2] Actually, 50 projects were measured with the three mentioned COSMIC method but 26 of them were already used to compose the weighting schemes that are shown in table 3.2 and 3.3. Therefore, they could not be used to found the results of this study.

By aggregating the results per FSMM, an average difference was found. This average difference is directional for an expected variation of a FSM result found by using a scaled approach, in comparison to a detailed approach of the same project. The results tell us that:

- the results found with NESMA estimated FSM's have an average difference of 1,52% from results found with NESMA detailed FSM's, with a standard deviation of 6,83%. 90% of all results in the study, found with a NESMA estimated approach fall within a reach of -6% to +15% of the corresponding result found with a NESMA detailed approach.
- the results found with NESMA indicative FSM's have an average difference of 16,30% from results found with NESMA detailed FSM's, with a standard deviation of 36,48%. 70% of all results in the study, found with a NESMA indicative approach fall within a reach of -15% to +50% of the corresponding result found with a NESMA detailed approach.
- the results found with COSMIC Equal Size Bands FSM's have an average difference of 1,26% from results found with COSMIC detailed FSM's, with a standard deviation of 10,31%. 90% of all results in the study, found with a COSMIC Equal Size Bands approach fall within a reach of -15% to +25% of the corresponding result found with a COSMIC detailed approach.
- the results found with COSMIC Average Functional Process FSM's have an average difference of 1,98% from results found with COSMIC detailed FSM's, with a standard deviation of 36,36%. 55% of all results in the study, found with a COSMIC Average Functional Process approach fall within a reach of -25% to +50% of the corresponding result found with a COSMIC detailed approach.

Measuring performance

By comparing the performance-indicators of the various FSMM's, the following indicators were found:

- a NESMA estimated FSM is performed 1,5 times as fast as a NESMA detailed FSM.
- a NESMA indicative FSM is performed 5,6 time as fast as a NESMA detailed FSM.
- a COSMIC Equal Size Bands FSM is performed 1,6 times as fast as a COSMIC detailed FSM.
- a COSMIC Average Functional Process FSM is performed 2,9 times as fast as a COSMIC detailed FSM.

It's important to state the characteristics of the measurements:

- The measurements are of many different systems, from many different organizations
- The measurers did not have any knowledge of the application before the measurement started
- The measurers are NESMA certified CFPA. All measurements have been reviewed by a peer NESMA certified CFPA analyst.
- The measurers have many years of experience in both the NESMA and the COSMIC method.
- The measurements have been recorded in the Sizing and Estimation Tool (SIESTA) [15].
- All of the measurements have been administrated in a 'size report', in which also all assumptions and remarks are written.

The results are shown in table 3.4.

Table 3.4: Study results

Method	**Accuracy**	**Accuracy loss**	**Effort (hours)**[3]	**Effort win (hours)**
	Avg.		**Avg.**	
NESMA detail	100%	-	100	-
NESMA estimated	98.5%	1.5%	67	33
NESMA indicative	83.5%	16.5%	18	82
COSMIC detail	100%		126	-
COSMIC Equal Size Bands	98.5%	1.5%	79	47
COSMIC Average Functional Process	98%	2%	43	93

These results show that in cases where there is no need to actually know the details of the analysis, but only the outcome in (COSMIC) function points, it is possible to establish some easy cost savings without losing much accuracy. Especially applying the NESMA estimated approach and the COSMIC Average Functional Process approach will result in substantial cost savings, while on average only losing 1.5% to 2% of accuracy.

5. Conclusions

The comparison of the scaled methods to the detailed methods shows that the NESMA estimated approach and the COSMIC Equal Size Bands approach give accuracy results that are in the same order as the results found through detailed approaches of the same FSMM. The same can be said about the COSMIC Average Functional Process approach, albeit that there is a big dispersion in the individual results.

Because using a scaled FSM approach is faster (and therefore cheaper) than using a detailed approach, it is good to consider how important the level of detail of the result of the FSM is; especially knowing that less detailed approaches give results that are in the same order as the results found through detailed approaches of the same FSMM and knowing that you should always expect differences in the results of two or more detailed analyses of the same project, performed by different analysts[4].

6. References

[1] NESMA, “Definitions and counting guidelines for the application of function point analysis A practical manual, version 2.2”, Netherlands Software Measurement user Association, 2004 (in Dutch), www.nesma.org.

[3] For each method the column ‘Effort’ shows the number of hours needed to measure the same (fictive) project.
[4] Due to possible differences in the interpretation of both the counting guidelines of the FSMM being used and the functional documentation of the project being measured. See also [14].

[2] Abran, A., Symons C. e.a., "The COSMIC Functional Size Measurement Method Version 3.0, Measurement Manual - (The COSMIC Implementation Guide for ISO/IEC 19761: 2003)", September 2007, www.lrgl.uqam.ca/cosmic-fpp.

[3] ISO/IEC (1998), "14143 Software Engineering - Software Measurement - Functional Size Measurement - Part 1: Definitions of concepts".

[4] IFPUG, "Function Point Counting Practices Manual, version 4.2", International Function Point Users Group, 2004, www.ifpug.org.

[5] NESMA site – list with differences between IFPUG and NESMA counting guidelines, www.nesma.nl/download/artikelen/FPA according to NESMA and IFPUG - the present situation (vs 2008-07-01).pdf

[6] NESMA site - 100 applications global FPA ←→ detail FPA, www.nesma.nl/sectie/fpa/

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[8] Abran, A., Symons C. e.a., "The COSMIC Functional Size Measurement Method Version 3.0, Method Overview", September 2007, www.lrgl.uqam.ca/cosmic-fpp.

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[11] Vogelezang, F.W., "Early estimating using COSMIC-FFP", Proceedings of the 2nd Software Metrics European Forum (SMEF 2005), march 16-18, 2005, Roma (Italy), www.dpo.it/smef2005

[12] Vogelezang, F.W., "Approximate sizing with the COSMIC method", Proceedings of the 4th Software Metrics European Forum (SMEF 2007), may 9-11, 2007, Roma (Italy), www.dpo.it/smef2007

[13] Vogelezang F.W. and Prins, T.G., "Approximate size measurement with the COSMIC method: Factors of influence", Proceedings of the 4th Software Metrics European Forum (SMEF 2007), may 9-11, 2007, Roma (Italy), www.dpo.it/smef2007

[14] Rule, P.G., "Compliant, Correct, Consistent, Complete: UKSMA's Improvement Plan", ICCE 1998.

[15] SIESTA – Sizing and Estimation Application (Sogeti Nederland B.V.). Downloadable from metrieken.sogeti.nl.

Appendix A: Detailed data of the size measurements analyzed

In this appendix, the measurement data is given. In table 4.1, the NESMA data is given, in table 4.2 the COSMIC data is given.

Table 4.1: NESMA FPA data, detailed, estimated and indicative size

Project	Size FPA detail	ILF	EIF	EI	EQ	EO	Size FPA estimated	Size FPA indicative	% est. -> det.	% ind. -> det.
1	245	5	3	22	3	21	255	155	-3,92	58,06
2	112	2	9	6	0	4	103	140	8,74	-20,00
3	1.366	84	27	114	0	48	1.419	2.370	-3,74	-42,36
4	32	0	5	0	0	1	30	50	6,67	-36,00
5	363	19	5	18	5	26	380	525	-4,47	-30,86
6	381	0	30	0	0	42	360	300	5,83	27,00
7	91	3	0	6	2	7	88	75	3,41	21,33
8	499	16	3	45	1	34	481	430	3,74	16,05
9	431	17	0	47	1	13	376	425	14,63	1,41
10	1.157	33	12	104	12	75	1.130	945	2,39	22,43
11	769	47	0	25	2	52	697	1.175	10,33	-34,55
12	257	8	7	14	7	16	255	270	0,78	-4,81
13	3.455	65	11	271	2	376	3.482	1.735	-0,78	99,14
14	211	4	4	18	0	23	235	140	-10,21	50,71
15	286	12	1	20	4	23	300	310	-4,67	-7,74
16	1.578	56	5	158	23	110	1.691	1.450	-6,68	8,83
17	334	6	8	26	3	27	333	230	0,30	45,22
18	5.632	165	2	445	140	442	5.715	4.145	-1,45	35,87
19	186	7	1	13	1	20	210	185	-11,43	0,54
20	1.549	70	0	156	2	93	1.587	1.750	-2,39	-11,49
21	274	4	1	40	0	19	288	110	-4,86	149,09
22	1.153	45	0	70	2	86	1.033	1.125	11,62	2,49
23	2.292	79	11	171	2	162	2.110	2.085	8,63	9,93
24	832	20	10	83	2	43	745	600	11,68	38,67
25	499	17	0	36	2	47	506	425	-1,38	17,41
26	1.122	32	0	104	12	60	988	800	13,56	40,25
27	312	9	4	24	3	19	286	265	9,09	17,74
28	241	7	8	15	3	12	221	255	9,05	-5,49
29	755	21	12	52	5	66	765	645	-1,31	17,05
30	415	31	3	34	1	7	407	805	1,97	-48,45
31	430	8	27	2	1	36	383	470	12,27	-8,51
32	189	3	5	12	1	17	183	125	3,28	51,20
33	819	32	0	60	4	70	830	800	-1,33	2,38
34	286	12	0	37	2	17	325	300	-12,00	-4,67
35	1.202	36	12	111	13	75	1.183	1.020	1,61	17,84
36	623	17	12	45	0	60	659	545	-5,46	14,31
37	240	9	0	16	1	23	246	225	-2,44	6,67
38	928	27	1	48	3	96	878	685	5,69	35,47
39	3.579	87	0	247	33	387	3.664	2.175	-2,32	64,55
40	119	3	4	9	0	9	122	115	-2,46	3,48
41	1.056	28	1	50	3	115	988	710	6,88	48,73
42	301	10	1	32	1	22	317	260	-5,05	15,77

Table 4.2: COSMIC data: detailed, Equal Size Bands (ESB) and Average Functional Process (AFP) method

Project	Size CFP detail	#small FP	#avg FP	#large FP	#very Lrg FP	Size CFP ESB	Size CFP AFP	% ESB -> det	% AFP -> det
1	311	48	13	4	0	373	520	-16,69	-40,19
2	571	17	33	14	5	568	552	0,62	3,44
3	139	12	3	4	1	140	160	-0,64	-13,13
4	852	54	22	19	12	829	856	2,81	-0,47
5	915	144	15	11	4	990	1.392	-7,58	-34,27
6	470	52	17	5	2	467	608	0,69	-22,70
7	378	18	6	7	10	372	328	1,75	15,24
8	118	0	6	0	4	112	80	5,55	47,50
9	141	18	4	1	1	144	192	-2,29	-26,56
10	369	63	7	4	1	416	600	-11,19	-38,50
11	422	60	17	3	0	451	640	-6,43	-34,06
12	378	17	15	6	6	360	352	5,09	7,39
13	174	14	1	4	3	167	176	4,25	-1,14
14	360	23	14	5	5	354	376	1,78	-4,26
15	349	9	6	10	7	311	256	12,15	36,33
16	65	13	1	0	0	70	112	-7,28	-41,96
17	235	0	6	0	9	194	120	21,26	95,83
18	72	11	2	0	0	68	104	5,57	-30,77
19	109	3	5	3	1	101	96	7,50	13,54
20	206	29	3	3	3	244	304	-15,44	-32,24
21	567	5	8	13	13	438	312	29,48	81,73
22	434	28	25	8	0	413	488	5,21	-11,07
23	393	17	11	6	9	378	344	3,94	14,24
24	357	51	7	3	4	396	520	-9,94	-31,35