COSMIC Full Function Points: Additional to or replacing FPA

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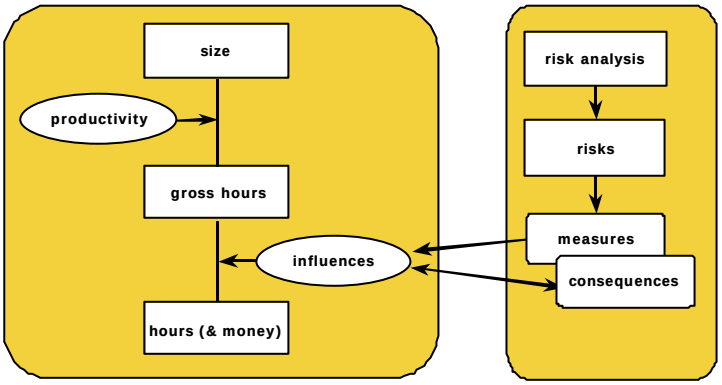
The Expertise Centre Metrics of the Dutch Rabobank experienced problems in using Function Point Analysis for estimating development effort especially in contemporary platforms. As a result confidence in metrics decreased and management asked the Expertise Centre to look for a measurement method that could solve the problems. After a useful experiment with the Functional Size Reference Model, COSMIC Full Function Point was chosen as a method next to Function Point Analysis. This paper shows the first results of the adoption of COSMIC Full Function Points as a sizing method next to (or replacing) Function Point Analysis.

Sogeti Netherlands

The introduction mentioned the Rabobank, however to be able to understand the situation it is also relevant to know what Sogeti is and how Sogeti is involved. Sogeti Nederland B.V. is a Dutch software services company with 1700 employees. In august 2002 IQUIP Informatica, Gimbrere & Dohmen and Twinsoft merged to form Sogeti. Since 1988 is IQUIP (named earlier IP/ and before that Interprogram) known in the Netherlands as a promoter and initiator of functional size measurement. Sogeti continues the leading role of IQUIP by means of the Expertise Centre Metrics of the Engineering & Projects division. In the context of this paper: this Expertise Centre Metrics of Sogeti was and still is strongly involved with and participates in the metrics programme of the Rabobank.

Measurement concept

Before going into details it has to be clear what the Rabobank intends to achieve by implementing a measurement programme. The main is to get a grip on software development costs. The metrics for the measurement programme are derived from the measurement concept. This concept suggests a correlation between effort and the size of the software developed. The development platform is relevant to productivity rate and specific project circumstances (expressed by risks) are variables in the process. When using the concept for estimation it is used top-down. Using it for evaluation / analysis the concept is used bottom-up.

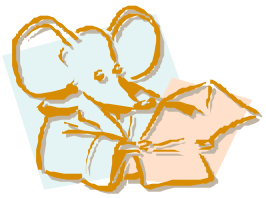


Metrics in the Rabobank

It took a long way for the bank to get to the successful operating Expertise Centre. The first attempts to set up metrics dates back to 1990. A great number of developers were trained in Function Point Analysis (FPA) [1]. The idea was that developers after training would use FPA to make their estimates. Some brave developers started but encountered difficulties in operations, inconsistencies in counting practises and had to justify the outcome of the analysis to management. At the end the metrics programme was stopped due to lack of an implementation plan. Although the first start was not successful the bank was still looking for a way to control costs of IT-development. In 1992 most of the IT activities were related to maintenance. In a joint pilot (bank and Interprogram) the method “FPA in

maintenance situations" was developed. With the extensions on FPA, this method enables analysts to estimate the size and effort of releases. This method was brought into a workgroup of the Netherlands Software Metrics Association (NESMA). It was the basis for the NESMA publication "FPA in enhancement situations" [2]. At first the operational activities of these analyses were outsourced but the bank felt the need for bringing counting and real analysis together for continuity and synergy purposes. A new trial started in 1994. Now the implementation was regarded as a project. This meant a project leader and an implementation plan. Sogeti had advised upon creating an independent body for metrics but at that time many organisations pursued a flat structure and as little as possible overhead. So the management of the bank decided that each project should have a developer assigned as analyst. This analyst was responsible for measurement and analysis. In the project guidelines the moments for FPA were indicated to ensure the use of these metrics. Again a great number of analysts were trained. In the first few months this worked in some projects. Not all projects participated and the projects using FPA experienced the usual start-up problems: differing outcomes of analysis, lack of productivity rates, the question of the added value and the daily work pressure. So this initiative ended after about a year and a half. All concerned were convinced that FPA was useful but not for his or her project and because of this metrics should be organised in a different manner. The latest and finally successful attempt to implement metrics was started in 1999. Apart from the decision to assign an independent body, the implementation model MOUSE [3] played a very important role. The Expertise Centre that is responsible for the metrics programme is still alive and kicking. Furthermore, other divisions of the bank (want to) use the Expertise Centre or intend to copy the set-up.

MOUSE



Similar experiences were found with other companies that tried to implement a metrics programme. Implementing a (functional size) method is more than just training people and prescribing the use of the method. All the lessons learned formed the basis for MOUSE, a model to help you to set-up the right implementation, to create the environment the method fits in.
Implementing a method can be compared with implementing a new information system. For an information system the 'business requirements' have to be identified. Then the 'functional requirements' that need to fulfil these business needs have to be specified. The same applies for implementing a method. An organisation has to identify the business needs and then find a way to specify the required 'functionality' to fulfil the needs. MOUSE helps to identify that 'functionality'. MOUSE describes all activities and services that need to be carried out to get a method up and running. A major aspect that needs to be filled in is how to get organised. Tasks, activities and especially responsibilities have to be assigned. When all variables are filled in the next step is to draw up the corresponding implementation (project) plan.

As mentioned, MOUSE comprises all activities and services required implementing a method successfully. MOUSE is arisen from the clustering of the activities and services into groups of key issues:

M	**O**	**U**	**S**	**E**
Market View	Operation	Utilisation	Service	Exploitation
1. Communication 2. Evaluation 3. Investigation 4. Improvement	1. Application 2. Review 3. Analysis 4. Advice	1. Training 2. Procedures 3. Organisation	1. Help Desk 2. Guidelines 3. Information 4. Promotion	1. Registration 2. Control

To be more concrete the activities and services are explained in relation to the implementation of a functional size measure method within the Rabobank.
The recommend organisational structure for a measurement programme (and in Sogeti's opinion the only suitable structure) is to concentrate expertise and knowledge in an independent body. This can be a person (co-ordinator metrics) or a group (competence centre). When activities are assigned to individuals in projects, many additional measures have to be taken to control the quality of the analyses and continuity of the measurement programme. The previous attempts have shown that that did not work. So the bank concentrated activities and services in an independent Expertise Centre FPA (ECF). The ECF is located within the bank and positioned within the banks organisational structure. However the analysts of the ECF are analysts of the Expertise Centre Metrics of Sogeti and this has an impact on the implementation.

***M**arket view*
Communication in the context of MOUSE is a bi-directional exchange of information with both the own organisation (internal market) and external organisations (external market). The ECF uses company publications and an intranet website to share information.
Communication with external organisations is important to stay informed about the latest developments. The International Function Point User Group (IFPUG) and local organisations like Netherlands Software Measurement Association (NESMA) and the Australian ASMA are the platforms for FPA. COSMIC and NESMA (workgroup COSMIC) are platforms for CFFP. Because Sogeti has various connections with these organisations, the bank knows about developments through Sogeti and does not need to implement specific activities to keep up-to-date on the latest developments.
Because the ECF is part of the bank, a direct and open discussion is possible with stakeholders of the projects. A more formal way to acquire information is evaluation, basically an assessment of the measurement process. All stakeholders of a project that is being measured will be involved.

Some of the information is direct input for continuos improvement of the measurement process. Depending upon the type of signal (operational, conceptual or managerial) further investigation maybe required. Investigation can be theoretical and empirical. Theoretical investigation consists of studying literature, visiting seminars or following training sessions. Empirical investigation consists of trying selected tools for measurement and the analysis of experience data. Usually these two ways of investigation are used in combination. Sogeti carries out a lot of research and development for proprietary purposes. Results are passed on to the bank through the analysts. In case of a specific problem in the bank this is passed on to Sogeti. The search for a replacing method for FPA can be seen as an example of this process.

Signals that lead to enhancement or improvement of the measurement process or measurement method are discussed with all parties involved. When bottlenecks are reported, solutions or suggestions for a solution will be proposed. When necessary changes will be adapted in guidelines and procedures.

***O**peration*
Operations include all activities, direct related to the application of the method. In this case activities like executing measurement activities (function point count, tallying hours spent and identifying project variables) are performed by the analysts of the ECF.

The best way to guarantee quality of the measurement data is by carrying out reviews. The purpose of reviewing is threefold:

- ensure correct use of the method (rules and concepts);
- keep track of applicability of the method;
- keep up-to-date with actual development.

In the project management guidelines of the bank the moments for measurement are indicated. The measurement is executed at the start of a project (global size measurement), during the project (detailed size measurement) and when the project is finished (detailed size measurement). In the first two situations the results of the measurement are input for an estimation (advice) that helps the project manger to make a realistic project plan. Apart from size the most important variable is the productivity rate. The productivity rate is an output of the analysis. The results of the justification are input for analysis. The actual effort is corrected for project specific circumstances. The adjusted hours and the actual (delivered) size are used to calculate the productivity rate. When no productivity rates are available the productivity rates of the International Software Benchmark Standards Group (ISBSG) are used. The ISBSG database is also used for benchmarking [4]. The bank sends in all evaluated projects to ISBSG to get an independent analysis and to support the initiative of ISBSG.
The tool SIESTA (Sizing and Estimating Application) is used for registration of the size measurement. SIESTA supports all available measurement methods that comply with ISO/IEC standard 14143 [5]. The tool is developed by Sogeti to support own services.

U*tilisation*

Next to basic training it is necessary to maintain the knowledge at the appropriate level. The analysts should have refreshment training on a regular basis, referring to new developments in the area of the applied methods. When training is 'purchased', it is important to keep track of the training offered on the market. In case of the bank, Sogeti is responsible for keeping the knowledge up-to-date. The analysts use Sogeti training material to inform stakeholders at the bank about the methods used and the measurement programme.
To guarantee the correct use of a method procedures describing processes and activities related to measurement are necessary. Procedures in the bank are:

- project management guidelines;
- the measurement process (estimation);
- change management control (managing the changes during development and maintenance projects);
- project registration (hours spent and activities);
- (project) evaluation.

The decision to concentrate knowledge and activities in the ECF simplifies the organisational process. One only has to assign the activities and services of the ECF to the persons responsible. When activities and services are assigned to individual persons more attention should be paid to the organisation of the measurement programme. Furthermore measures must be in place to guarantee consistency and continuity. This applies to almost all items recognised in MOUSE.

S*ervice*

To support the analysts a help desk needs to be in place. The help desk should be able to answer questions with limited impact immediately. It is important that the help desk reacts adequately to all kinds of requests related to operations. Decisions made regarding questions concerning the suitability of the guidelines of the methods need

to be recorded in organisation specific guidelines. Because of the situation in the bank, the analysts at the bank contact the Sogeti help desk when there are questions or issues that cannot be resolved within the ECF.

The success of the measurement programme depends on the data gathered. It is important that suppliers of data are willing to provide this data. The best way to stimulate this is in return to give them information about the data analyses. This should provide answers to frequently asked questions, such-as: "What is the current productivity rate for this specific platform?", "What is the reliability of the estimations?", "What is the effect of team size?". The experience database of the bank, Sogeti and ISBSG can usually answer most of the questions. A proactive stance is promotion; marketing the benefits of measurement (methods) and the 'selling' of the services. This is necessary for continuity and extension of the measurement programme. Although project management accepts the ECF, the ECF needs to be alert and not lose the momentum.

***E**xploitation*
The administration and registration of the information related to the measurements consists of two components: the measurement results and the analysis data. Because all size measurements are registered in SIESTA, measurement results are already filed digitally. The analysis data needs to be stored in an experience database. It is important that the derived data (productivity rate, project characteristics and risk database) has to be made available for estimation. This data is used as input for reporting (information service) and available on the intranet. Detailed data is kept by the ECF for all kinds of analyses.
Control is required for procedures, guidelines, SIESTA files and the experience database.

FPA: use before …
In the division of the bank the ECF is operational, the systems development process is changing. In the 'before' situation, each product had its own system(s) and each system administered that one product. If a client wanted more then one product, various systems needed to be activated. The changing market and expectations of the clients made it necessary for the bank to look for new strategy. According to the new perception on business and client needs, the systems need to be more flexible and should respond upon events instead of following predefined processes. Other developments are the incorporation of hardware (e.g. cash dispenser) into the systems and the connection to Internet.
To fulfil the client needs, the systems should be able to treat the client as an individual person and not as just another customer of a product. The product related systems are slowly migrating to a multi-layer architecture with service components. At system level a distinction is made in distribution systems, client systems and product-orientated systems.

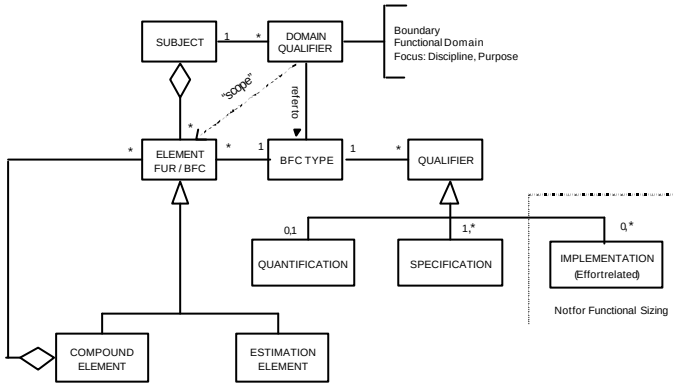
FPA was developed in the early 80's when the automated systems were stand-alone and dedicated to a single product or process. For those kind of systems FPA is still an excellent sizing method. FPA is based upon systems consisting of functions that manipulate data and the functions are triggered by a user action. The way FPA looks at a system is from the point of view of the (end) user. Taking into account the latest developments in systems development, this view is becoming more and more outdated. One of the requirements of a measurement method is a stable basis. Starting to fumble with the basis is fumbling with the method. This will certainly cause a lot of discussion and possibly give unpredictable and unreliable results.

The challenge of the division of the bank in systems development were:

- develop software in a layered component based architecture;
- develop event-driven systems;
- maintain the old systems that are gradually migrated to components in the new architecture.

In the ECF this challenge became visible and difficulties in applying the guidelines in the new platforms caused more and more discussions. Furthermore the project managers are not so sure that estimates for the new platforms are useful. So the confidence that was built up over the last few years in the more 'classic' platforms faded away. For that reason the management asked the ECF (Sogeti) to investigate whether there was a better method available or a new method had to be developed.

A new method for Sizing Object Oriented software



Early 2002 Sogeti had developed a new functional sizing method for object oriented development for another division of the bank. For this new method the Functional Size Meta Model [6] was used as a reference. This model is a derived from ISO/IEC standard 14143-1.

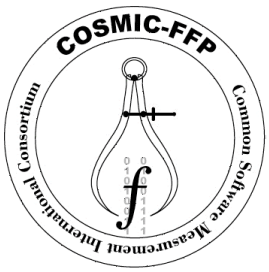
Filling in the model for FPA: The functional system design can be considered as the gathering of Functional User Requirements (FUR's). The data stores (Internal Logical Files and External Interface Files) and transaction types (External Inputs, External Outputs and External Inquiries) are the Base Functional Components (BFC's). The components are rated upon Data Element Types, and either Record Element Types or File Type Referenced. The reason for recognising the transaction types is because there is a relation with the effort-driven components of the software (initially identified by computer programs).
This train of thought is used to develop a new method. The software components that take up most of the development time were identified.

The development experts recognised four relevant components: man-machine interface, process, model and services. Similar to FPA for each component two variables are measured to rate the component.

Estimating Element (BFC)	Qualifier
Man-Machine Interface	Data Element Types (Static) Data Element Types (Dynamic)
Process	Interactions Business Rules
Model	Data Element Types Classes
Services	Data Element types Groups

Early experiments showed promising results. Still one issue overshadowed this attempt to renew size measurement. When adopting this new method the bank would use a non-standard method. Benchmarking would not be possible. So the answer should preferably be found in a universally accepted measurement method.

COSMIC Full Function Points



Not only the bank but also many major organisations use contemporary systems development methods. The difficulties the bank encountered are therefore not unique. The Common Software Measurement International Consortium started an initiative aiming to develop, test, bring to market and seek acceptance of new software sizing methods to support estimation and performance measurement. This resulted in COSMIC Full Function Points (CFFP). CFFP [7] is designed to be applicable for classical developed business applications, applications developed with contemporary methods, real-time software and infrastructure software. The method comprises of possibilities to measure multi-layer architecture, incorporation of hardware, event-driven applications and component development. All technical conditions of the bank seemed to be fulfilled with CFFP. But CFFP has to fulfil not only the measurement conditions but also organisational conditions. Management needed answers to the following questions before giving the 'green light':

- How mature is CFFP;
- Which companies use CFFP;
- How to benchmark with CFFP;
- Which initiatives will be started in the Netherlands.

Although CFFP is quite new, the publication of version 2.1 showed that the concepts of the method are well considered and comply with ISO 14143-1. In field trials [8] CFFP proved to be applicable for various platforms. A convincing manifestation of maturity was the request for certification. In December 2002 CFFP, FPA (IFPUG), FPA (NESMA) and Mark II are accepted by ISO/IEC. In January 2003 COSMIC released version 2.2 which is adapted to meet standard ISO/IEC 19761, the document comprising the certified concepts of CFFP.
It was very difficult to get the names of 'big' companies using CFFP. When it was announced that Nokia would present some results at the International Workshop Software Measurement conference 2002 at least one name of companies that use was made public.
At the same conference COSMIC announced an initiative in co-operation with ISBSG for a benchmark study. This initiative is now published on the COSMIC website [9]. The bank participates in this initiative by sending in all evaluated projects.
In the Netherlands NESMA announced the start of a workgroup COSMIC (initiated by Sogeti). This group is now operational.

The answers to the last three questions were not overwhelmingly convincing. Nevertheless the management of the bank responsible for the ECF gave permission to continue. The ECF was asked to draw up a plan for the migration to the Expertise Centre Metrics (ECM) and the implementation of CFFP.

The implementation of CFFP

The plan should pay attention to the level of measurement (viewpoints), scalability, productivity rates and impact on the organisation (ECM and customers of ECM).

In the table showing the scheduled activities in detail, the estimated time, the real effort, the reference to MOUSE and some remarks. Learning Points (LP) will be explained later.

	Activity	Plan	Real	MOUSE	Remarks
1	**Planning & Control**				
1.01	Implementation Plan	80	40	M4	
1.02	Project control	80	96	-	LP1
2	**Preparation**				
2.01	Extend evaluation with CFFP	4	4	M2, U2	
2.02	Change document Regression analysis	4	-	O3, U2, E1	LP2
2.03	Change Configuration Items	80	35	U2, U3, E2	LP3
2.04	Decision Viewpoints, change guidelines and procedures	40	287	M2, M3 U2, S2	LP4
2.05	Create summary CFFP	4	-	M1	LP4
2.06	Change web-site ECM	16	19	M1, S3, S4	
2.07	Create reference measurement CFFP	8	-	O1, O2, S2	LP4
2.08	Adapt PROBE for CFFP	8	-	A3, U2, E1, E2	LP2
2.09	Create intake criteria CFFP	4	-	U2	LP4
2.10	Create guideline viewpoints	16	-	U2, S2	LP4
2.11	Draw up conditions system specifications	24	-	U2, S2	LP4
2.12	Pilot: 3 small applications	72	138	A1, A2	8 applications
2.13	Pilot: 3 average applications	96	25	A1, A2	1 application
2.14	Pilot: 3 big application	108	48	A1, A2	1 application
2.15	Regression Analysis	8	131	A3	LP2
2.16	Configure SIESTA	12	0	U3, E2	Sogeti
2.17	Prepare presentations	8	8	M1, S3, S4	
3	**Implementation**				
3.01	Presentation to Division Mgt	4	2	M1, S3, S4	LP5
3.02	Presentation to Project Mgt	4	2	M1, S3, S4	LP5
3.03	Transformation to ECM / CFFP	4	2	M4, U3, S3	LP5
4	**Closing**				
4.01	Support QA department	8	-	S1	LP4
4.02	Clean-up and file documents	4	-	E1	LP4
4.03	Closing Report	24	0	-	No interest
	TOTAL HOURS	720	837		

Learning Points:

1. Project Control
   The most important participant in the transformation was an analyst from Sogeti trained in CFFP. He was new in the team, so it took some additional time to become familiar with the procedures in place. Time spent was booked on project control (overhead costs).
   Because of additional effort on analysis (see LP2), project control required more time as well.
2. (Regression) Analysis
   The new analyst had a mathematical background. To gain benefits from the FPA investments in the past, management asked him to investigate whether there is a possibility to reuse the measurements done in the past. The strategy was to resize 10 projects with CFFP that were previously sized with FPA, instead of using new projects in the pilot. The next step was to analyse this data statistically. The aim was to find a possible conversion factor between function points (fp) and cosmic functional size units (cfsu). The time spent for analysis is booked under analysis. The outcome of the statistical analysis was input for PROBE, the estimation tool (excel) developed by the ECM.
3. Configuration items
   Most configurations already existed, only time was needed to change documentation and name conventions.
4. Transformation
   This was the real underestimated activity. It was more difficult for experienced FP analysts to learn to apply CFFP. The analysts tried to apply CFFP with FPA rules

in their mind. Because of the different approach to data (groups) CFFP requires a different mind-set. This is the most important lesson learned and this has to be taken into account for future transformations.

5. Information
   To project managers it does not matter whether they get function point or cosmic functional size units. Both represent size and the measurement concept is still applicable. The estimation process does not change, only the values of some variables change. The information they needed was just the highlights of CFFP and that was all.

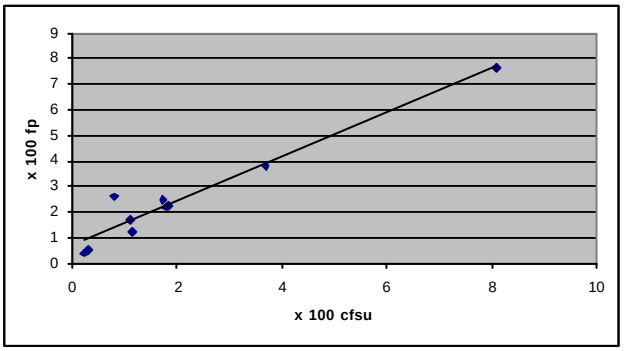
First results

Management was eager to know if their decision to migrate to CFFP was correct. The first results from analysis of the 10 projects sized with CFFP prove that CFFP is useful and can be applied in the same area as FPA. In the meantime 3 other projects that showed difficulties when sizing with FPA, could be sized easily with CFFP. The range of software (specifications) that can be sized with CFFP is definitely wider then the range covered by FPA.
Next to applicability, management is always very interested in what effort (= costs) is required for sizing. Time spent on sizing the 10 pilot projects with FPA was on average 30 - 35 hours per project. The effort to size with CFFP was on average 21 hours. This matches the feeling that sizing with CFFP is easier. The effect of resizing was limited because another analyst did the resizing.
The lack of well-documented sizing guidelines was felt clearly when sizing with CFFP. Although the concepts are described accurately, practising the concepts in real projects is not so easy. The ECM started to record for the time being their own sizing rules. As a consequence of all kinds of discussions between analysts in the bank and Sogeti, a number of change requests was sent to the Measurement Practices Committee of COSMIC. A kind of 'counting guideline' delivered by COSMIC will avoid a lot of 'useless' discussions and will increase acceptance of CFFP. Also benchmarking will show more consistent results when the counting practices are clearer, the size measurements will be performed using the same basis. For the same reason IFPUG and NESMA publish counting practises manuals.
Analyses should give an answer to the question of reusability of previous measurements. Is the productivity rate determined for a number of platforms in the bank still usable for estimation when sized with CFFP? Statistical analysis (linear regression) is used to find a correlation between function points (fp) and cosmic functional size units (cfsu).

The analysis produced following regression line:

Y (fp) = 68,2 + 0,92 X (cfsu).

project	fp	Cfsu
1	23	39
2	29	52
3	81	260
4	109	170
5	115	120
6	173	249
7	181	218
8	182	224
9	368	380
10	810	766



Conversion of productivity rates is done based on 1 fp/hour = 0,9 cfsu/hour.

This conversion factor is used for estimating the projects that encountered difficulties when sizing with FPA and were sized only with CFFP. The estimates made for projects in new development platforms showed better coherence with expert estimates. Project managers in contemporary platforms are slightly positive that CFFP can help them with estimation and performance measurement. One should bear in mind that the regression line is just based upon 10 projects and that these projects were small.

Conclusions

First results are promising. With some reservations productivity rates derived from earlier measurements can be re-used. CFFP seems to apply easier then FPA. In the area were FPA is (easy) to apply, CFFP can be used just as well. CFPP is also applicable in the contemporary platforms in the bank. The Rabobank and Sogeti expect CFFP will replace FPA in the (near) future. It will speed up when a 'counting practices manual' is in place and benchmarking is possible.

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