(Ten Fundamental Questions, continued from page 6)

someone use an agile methodology or any other approach to develop it.

What will probably distinguish the measurement of an agile project and other traditional methods are the artifacts that are being used to perform the analysis. In a more conventional approach, for example similar to the Rational Unified Process (RUP), artifacts used for measurement will probably be use case specifications, which are detailed descriptions of the functionality from the viewpoint of a user while interacting with the software.

Agile projects have a greater emphasis on delivering working software than producing a detailed documentation of what will be done. Therefore, it is more likely that user stories will be used in an agile methodology to specify requirements, which are brief descriptions of the desired functionality by the user.

However, user stories are not enough to provide all information necessary to measure function points (although they are sufficient to provide an estimate/approximation of the size in FPs). So how are we able to measure a project?

Sometimes, the developer cannot build the software only with the information provided by the user stories. More detailed requirements are necessary for one to build the desired software. Where can a developer attain more detailed information to build the desired software besides user stories? It is very likely that the developer will turn to the user. The agile methodology advocates that the user join the development team, having a very close interaction with the developers.

Therefore, assuming that the developer attains more detailed information about the requirements to build the software, that same information will be useful when counting FPs.

The Function Point Based Pricing Model in Brazil

By Mauricio Aguiar, TI Metricas

1. Introduction

Founded in 1986, The International Function Point Users Group (IFPUG) is probably the oldest software measurement association in the world. As of April 2015, Brazil was the number one country in IFPUG memberships, with 37% of all IFPUG members, followed by Italy (18%) and the U.S. (17%). IFPUG certifies individuals that pass the IFPUG exams: CFPP and CFPS. As of April 2015, Brazil had 35% of all IFPUG certified individuals, followed by Italy (32%) and India (11%) [1]. These numbers make Brazil the number one country in function point utilization. As a result, several software measurement companies and independent consultants appeared in the Brazilian market in the last decade. Even though there is no publicly available data, a single Brazilian company has claimed to count 60,000 function points per month [2]. At the cost of $1,000 USD per function point [3], that number could mean $60,000,000 USD changing hands each month based on function point counts performed by just one Brazilian software measurement organization.

There are several possible explanations for the growth of software measurement in Brazil in the last several years. The following paragraphs intend to shed some light on this topic.

2. A Very Short History of Software Measurement in Brazil

The first Brazilian book on software measurement was Aguinaldo Aragon's "Gerencia Efetiva de Software Atraves de Metricas" ("Effective Software Management through Metrics") published in 1995. Aragon's book included sections on function point analysis, COCOMO, and linear regression as effort estimating techniques. It also presented several applications of metrics to software management [4].

Function point analysis has been in use in Brazil since the eighties. However, it became more popular in the nineties, when UNISYS Eletronica became its main local sponsor. This was the first Brazilian function point movement, or the "First Wave". UNISYS Eletronica joined IFPUG in 1989 and started sending employees to IFPUG conferences in 1990. UNISYS Eletronica promoted function point user meetings in Brazil, called ENUPFs, from 1991 to 1994, featuring several international participants. UNISYS Eletronica sponsored a Certified Function Point Specialist (CFPS) exam in Brazil where a few of its employees became CFPS. Unfortunately, for internal reasons that company severely reduced its FPA sponsoring efforts around 1995 so there were no significant changes in the Brazilian measurement market until 1998. The first Brazilian function point analysis book was published in 1996 [5].

In 1998 a group of Brazilians joined IFPUG and founded the Brazilian Function Point Users Group (BFPUG) that had a significant role in promoting software measurement and function point analysis in Brazil. This was the second Brazilian function point movement, or the "Second Wave". BFPUG received

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(Pricing Model in Brazil, continued from page 7)

active support from IFPUG starting 1999. As a result, a Brazilian was elected to the IFPUG Board of Directors in 2000. After a couple of years another Brazilian joined the IFPUG Board of Directors. A Brazilian – this author – was elected IFPUG President from 2005 to 2007. Also as a part of the Second Wave, the second Brazilian function point analysis book was published in 2003 [6].

The CFPS exam came to Brazil for the second time in 2001 and became a regular event, being held twice a year in three or four major Brazilian cities until its automation in 2008. A total of 1098 exam candidates sat for the exam in Brazil from 2001 to 2007. Many received the CFPS designation.

A possible reason why The Second Wave was more successful than the first is that the former came because of Brazilian government initiatives. The Brazilian government was concerned with the cost of software development. Therefore, they were looking for ways of managing and possibly reducing that cost. Caixa Economica Federal ("CAIXA"), a Brazilian government bank, was the leader of that movement. CAIXA was the first government organization to transition its software development projects to a "price per function point" model. They launched a large function point based RFP in 1999. Other government agencies such as the Brazilian Post Office ("Correios") and the Brazilian IRS Data Processing Service ("SERPRO") soon followed. A government directive known as "IN04" was issued in 2008 (updated in 2010) and stated that IT services should not be billed based on effort (person-hours) or job positions (persons-month) [7, 8]. This confirmed function points as the measure of choice for software development contracts in the Brazilian government. Those facts got the attention of private organizations such as banks, telecom companies, airlines, and others that would soon adopt variations of the method.

The success of function point analysis in Brazil led IFPUG to hold its 2010 annual conference in Sao Paulo, Brazil's largest city. ISMA Cinco (ISMA is the International Software Measurement & Analysis Conference. "Cinco" is Portuguese for "Five") was successful both in terms of international participation as well as local attendance. BFPUG has held an annual software measurement and analysis conference in Brazil since 2009, featuring international speakers from the software & systems measurement arena. ISMA 8 was held in Rio (2013), and ISMA 11 will be held again in Sao Paulo (2015).

In November 2010, the Brazilian government, through its Ministry of Planning, published guidelines to the application of function point analysis to software development contracts [11].

As more organizations adopt the "price per function point" method in Brazil, it is likely that more measurement-related methods and techniques will become popular. For instance, the COCOMO II estimating model and the Practical Software & Systems Measurement framework are currently used in Brazil; The Netherlands Software Metrics Users Association (NESMA) methods for early size estimating and enhancement counts are also used; the COSMIC measurement method is increasing its popularity, as well as the new IFPUG Software Non-functional Assessment Method (SNAP).

3. Challenges

Even though there are many benefits associated with the use of functional sizing in software development contracts there are still many issues to be resolved. Brazilian acquirers and suppliers from both the government and private sectors have addressed those challenges.

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(Pricing Model in Brazil, continued from page 8)

3.1. Predictive versus Prescriptive Models

One issue has to do with the differences between predictive and prescriptive models. Because most of the software development market still uses conventional effort-based pricing, specialists tend to focus on predictive models to estimate effort. However, in Brazil the most important use of functional sizing is in pricing and billing. Even though there are similarities between predictive and prescriptive models, there are also differences to consider before using them. A few of the differences are listed on Table 1.

Table 1: Differences in Estimating vs. Pricing

Estimating (Predictive Model)	Pricing (Prescriptive Model)
1. Model inputs must be known in advance	1. Model inputs may be known before or after the fact
2. Model is expected to give approximate results	2. Model is expected to give exact results
3. Different estimators may produce different values (depending on their expertise and skill)	3. Different model operators must produce the same values
4. Model inputs do not need to be objective – may depend on estimator's opinion/assessment	4. Model inputs must be objective – must not depend on estimator's opinion/assessment

Both estimating and pricing models share the goal of producing values that should be as close to the actual values as possible. Even though neither will be able to match the actual values exactly, both are expected to approximate them in the end.

Estimating model inputs must be known (or estimated) in advance; otherwise, it will be impossible to compute the estimated values. On the other hand, pricing model inputs may be known after the fact; it will still be possible to compute prices. For example, an effort-based pricing model will necessarily have its main input (effort) known only after the fact – when the project is complete.

Estimating models are expected to give approximate results. A slight change in the inputs may not be reflected in the outputs. On the other hand, pricing models are expected to give exact results. A small change in the inputs should result in a (hopefully small) change in the outputs.

Different estimators are expected to produce different results. A more skilled and more experienced estimator is expected to produce a better estimate than a novice does, whereas an operator of a pricing model is expected to follow exact rules and produce exactly the same result as any other trained operator.

Estimating models often have subjective parameters. For example, the COCOMO II estimating model has parameters such as ACAP (Analyst Capability) and PCAP (Programmer Capability) with ratings 15%, 35%, 55%, 75%, and 90% [9]. An analyst or programmer team that falls in the 15% level is rated very low – at the estimator's discretion. Two distinct estimators could potentially disagree on those levels. Estimating models often have to be customized before they can be used for pricing purposes. Pricing models, on the other hand, have no room for ambiguity or subjectivity.

3.2. Items Not Covered by Functional Sizing

By definition, functional sizing does not consider non-functional items. This leaves room for unaccounted effort variation in projects where effort is predicted or prescribed using only functional measures. A simple solution is to define several different project types and assign them different productivities, hoping those will account for all non-functional effects. However, there will always be variation even in a well-specified and calibrated model. Another solution would be to use a parametric model such as COCOMO II, where all variation due to factors other than size would be accounted for by model parameters (there are 22 of them in COCOMO II). This works well for estimating, but suppliers and acquirers are not happy when variation is not accounted for. In Brazil, some suppliers have built tables that transform certain non-functional characteristics into an equivalent number of function points. That type of solution has been used in government bids [10]. Other ways of dealing with so-called "non-measurable items" for several types of activities including documentation and testing are defined in Roteiro de Metricas de Software do SISP – Versao 2.0 [11]. Many of those methods add equivalent function points to the functional size, or multiply the functional size by a specified factor.

Even though adding "equivalent function points" to the functional size violates several measurement principles, the Brazilian industry has been using workarounds for lack of a better solution. The industry will typically adopt

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(Pricing Model in Brazil, continued from page 9)

an imperfect solution as long as it is (or seems) better than the alternatives. The software measurement community still has a lot of work to do on non-functional assessment models such as IFPUG SNAP to fix this situation.

3.3. Sizing Enhancements

A significant part of the software measurement community in Brazil believes that the IFPUG method for sizing enhancement projects is not optimal for pricing models. They prefer to use the NESMA enhancement sizing method instead. That method assigns different weights for added, deleted, and changed function points [12]. According to some Brazilian users, the NESMA method provides more accurate results than the IFPUG method.

4. Benefits and Challenges of Using Functional Sizing in Software Development Contracts

The "price-per-function-point" method potentially leads to better productivity and represents an improvement over previous effort-based methods. It brings transparency and objectivity to the negotiation process, being good for any application domain, development process, and technology.

Special care must be taken when determining initial productivities in order to establish a balanced relationship between acquirer and supplier. While a good pricing model will reduce variation to an acceptable level, it is important to note that bad requirements do not favor accurate sizing. Poor requirements will increase the uncertainty in the sizing process. Any functional sizing method may be used, but it is highly recommended that measurement be performed or at least supervised by certified professionals. This will reduce differences in the interpretation of counting rules, especially between acquirer and supplier. Sizing may also be outsourced to a neutral third party organization in order to improve transparency and minimize conflict. Non-functional items will continue to be a challenge until a non-functional measurement solution is found and accepted by the measurement community. So far, the most promising solution is the IFPUG SNAP method. Most of all, one should keep a win-win attitude and be aware that when using functional sizing in pricing models there will be gains and losses, but at the end of the day things will balance and everybody will win.

5. Conclusion

This article has presented a short description of the utilization of software measurement in Brazil. After providing a historical perspective, several relevant topics were addressed, such as the difference between predictive and prescriptive models, and why the latter is so important in Brazil; how Brazilian organizations in the government and private sectors use functional sizing for estimating and pricing; the main technical difficulties that have been encountered and how they have been addressed.

We hope that this report will contribute to raise interest in the use of functional sizing in pricing models, since so much work is still needed to improve those models.

6. References

[1] IFPUG, unpublished internal reports, IFPUG, Princeton Junction, 2015.

[2] Aguiar, Mauricio, "Domain-Oriented Modeling, Estimation and Improvement for Commercial and IT Systems Domains" (presentation), 26th International Forum on Systems, Software, and COCOMO Cost-Modeling", USC, Los Angeles, 2011, http://csse.usc.edu/csse/event/2011/COCOMO/presentations/Panel_Aguiar_2011-11-03.ppt

[3] Jones, Capers, "Applied Software Measurement – Global Analysis of Productivity and Quality", 3rd Edition, McGraw-Hill, New York, 2008, pg. 310.

[4] Fernandes, Aguinaldo Aragon, "Gerencia Efetiva de Software Atraves de Metricas", Atlas, São Paulo, 1995.

[5] Braga, Antonio, "Analise de Pontos de Funcao", Infobook, Rio de Janeiro, 1996.

[6] Vazquez, Carlos E., Simoes, Guilherme S. e Albert, Renato M., "Analise de Pontos de Funcao: Medicao, Estimativas e Gerenciamento de Projetos de Software", Erica, Sao Paulo, 2003.

[7] Santos, Rogerio S., "Instrucao Normativa No 4", SLTI, Brasilia, 2008.

[8] Santos, Maria da Gloria G., "Instrucao Normativa No 04", SLTI, Brasilia, 2010, http://www.governoeletronico.gov.br/biblioteca/arquivos/instrucao-normativa-no-04-de-12-de-novembro-de-2010/download

[9] Boehm, Barry et al., "Software Cost Estimation with COCOMO II", Prentice-Hall, New York, 2000.

[10] Caixa Economica Federal, "Concorrencia No 001/2006, Anexo I: Projeto Basico – Item VIII", Caixa Economica Federal, Brasilia, 2006.

[11] MPOG/SLTI, "Roteiro de Metricas de Software do SISP – Versao 2.0", Ministerio do Planejamento, Orcamento e Gestao, Brasilia, 2012.

[12] Netherlands Software Metrics Users Association, "Function Point Analysis for Software Enhancement – Guidelines, Version 1.0", NESMA, 2001.