The Brazilian´s model for software contracting using function points

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Abstract — **The model of contracting for development and maintenance of software that has been most used in Brazil in recent years establishes the remuneration of the vendor based on a measurement unit of a no technical business perspective: Function Points. This article presents the motivation for the search in Brazil of a new contratation model for software services, the existing problems in hiring models used so far, explaining this new contracting model and what is Function Point Analysis, the difficulties associated with this model and future trend.**

Keywords: Function Point Anaysis, Software acquisition, Software Functional Mensurment.

I. INTRODUCTION

The model of contracting for development and maintenance of software whose use has intensified in Brazil in the last ten years is the remuneration of the vendor by unit price, using a measuring unit from an external perspective to the work, in this case of function points (PFs). Function point is a method for measuring functional software called FPA - Function Point Analysis (FPA or - Function Point Analisys), created by Alan Albrecht at IBM in the mid-70s [1]. Currently this method is a public domain and is maintained and developed by IFPUG (International Function Point Users Group) through its Counting Practices Manual [2]. Other methods of measuring software functional derivatives have also emerged [1], such as Mark-II [5], COSMIC [6] and Nesma [7], but the method most frequently used in the world is the IFPUG method.

Although the federal government of Brazil has been one of the main thrusts for the adoption of function points in the hiring of software services, today this practice is widespread also among private companies and other levels of government (state and municipal) and spheres of power (legislative and judicial, and executive power). Organizations such as Babco do Brazil, Banco Central do Brasil, BNDES, Bradesco, Brasilprev, Caixa Econômica Federal, Oi, TAM, Petrobras, Correios, Porto Seguro and Polícia Federal, comprise a small proportion of all firms that use function points in contracts in Brazil. In [3] and [4] you can find a more extensive list of Brazilian public organizations that adopt function points in the hiring of software services.

Although the APF has been designed to support studies of productivity in software development, its use was eventually expanded to other purposes such as estimating the cost and effort of software projects, generation of quality indicators and productivity of the development process, support scope and management of software design, software product measurement and measurement of contracts, as you can see at [2] and [3].

Until the beginning of the last decade, the use of Function points in Brazillian companies was more restricted to the estimation of software projetct and support initiatives to improve software process, such as the adoption of CMMI maturity models and MPS.BR.

II. MOTIVATION

The 90s were characterized by several trends in business management, including outsourcing, and this was adopted in Brazil perhaps with more intensity than in other countries. The Information Technology sector was very impacted by this movement in the outsourcing business. Much of the development and maintenance of systems left to be done internally by the home team and is now done by outsourced teams, whether in the form of outsourcing of labor recruitment or under the projects implemented by software factories.

But this move brought unexpected side effects (and unwanted) for many organizations that have adopted this initiative. One problem concerns the hiring practices of these outsourced. In the next two subsections we are going to comment most common forms of contracting services in Brazil for software development so far.

A. Hiring for allocating labor

In this mode, also known as body shopping or time and material, the client hires professionals for allocation in software development, usually in conjunction with your own team, not always with only one supplier of manpower, and use their own logistics infrastructure. The remuneration of the supplier is calculated based on the level of qualification and experience of professionals working in the hours established and other possible expenses. In practice, the hired worker acts as a contracted employee of the client.

This is a type of contract where the supplier's remuneration is process-oriented "internal" to the production of software. The final price is determined by some aspects like:

how much work it is involved; about the worker qualification and how many professional we have on the team; and its management complexity. The price control is in the hands of the supplier, wich in case have more competence in these technical aspects of the project to the clientWhose business is usually other than the development or maintenance of software.

This model is simple to administer and provides great flexibility for both the client and the vendor. Once you have established business relationship, the client is able to be more agile in meeting the peak demand for service. In the case of changing requirements is not required renegotiating a new contract with the supplier. However, increasing scope result in increased stress (hours) as well as design cost. It is right that the supplier is paid for this additional effort, since the scope management and requirements is the direct responsibility of the customer.

The most critical aspect of this type of contract is that the customer is responsible for managing the entire team, including the productivity. This requires a level of competence that may not be available internally. Furthermore, the remuneration of the supplier is not bound by the results produced, but only the number of hours performed. There is no stimulus to the supplier to maintain or increase levels of productivity and quality, what should be their sole responsibility. The stimulus is negative: the more effort sue the supplier, the higher the pay. It is the antithesis of productivity!

Other obstacle is about the warranties of the service delivered. If the service execution have more then one supplier, is harder to isolate responsibilities and demand warranties. In practice the client pays for a service and also for subsequent corrective maintenance associated with it.

B. Hiring as fixed global price

This mode, also known as fixed price, favors the design approach with a defined beginning and end (and of course, the scope). Requires higher level of organization of both the client and the supplier. The better defined are the requirements, the less chance of friction between the parties.

However, in general, the supplier doesn't have much information about the problem domain or has no time for detailed analysis of the requirements for the preparation of your business proposal. As a result, there will be an undersizing or oversizing of the proposed budget. When the competition is severe, it is likely that the first case occurs.

Both previous cases are undesirable. At first, the supplier will have problems to give what the customer wants. If the requirements were not well defined, it is likely that there is an impasse and a new negotiation will have to be done, often worn for both parties. Although the requirements have been well defined, the budget proposed by the supplier may have been undersized so that product quality is seriously affected or even that the project is completed.

This model have a risk transference from cliente to supplier; in scope risk case (some changes will come without adicional costs?) and produtivity (which control over the costs vectors agregated to work?)

The supplier makes the price considering this kind of risks.

Complicating the use of this approach is to assume that the requirements will not change (or change little) after the start of the project. As the environment in which the organization is dynamic it is inserted, the requirements are too. The longer the duration of the project, the more likely there is a change in requirements. And it is difficult to estimate how these changes affect the budget originally proposed by the supplier. According to [8] more than 2% of monthly changing requirements after the requirements phase. In this case, it is probably necessary renegotiation. If this is the case, the customer will hardly get the same original condition, because depending on when the project is, there is no competition, nor a drive to compare the price originally charged with the price charged for the requested new features.

In this mode, the control over how much to pay is also under the control of the supplier. It is very common that the rational price formation is structured in terms of project work breakdown structure and the amount and profile of professional hours allocated to that activity. The same is happening in the changes (or supposed changes) that occur during the project. To the extent that the price structure is made that way, like the hiring of labor allocation, the control is the one who has the technical knowledge of software engineering and application of their disciplines.

C. The search for an alternative model of hiring

Over time, some organizations began to experiment with alternative forms of employment of software services that promote better distribution of risks and outcomes. In the allocation model of labor productivity is the management burden of the client, when the fair would be the concern of the supplier. The management scope is also the responsibility of the customer, but it's just that this is so because the supplier has no control over the requirements. In the model of flat price, productivity is the responsibility of the supplier, which is fair, since he is responsible for the work process. However, any change or uncertainty of the requirements that the customer's responsibility, undermine this model contract.

Therefore, an optimal contracting model would pay the vendor based on units of the result of service performed. This promotes the balance of risks and responsibilities between customer and supplier. In this case, productivity is the responsibility of the supplier, as there is a risk of injury if there is delay in the production units. Moreover, in the case of an increase in scope, should be constructed more units for service and the provider is remunerated for it.

The great challenge of this approach is to find a unit that can be unequivocally recognized, uniform and consistent for

both customer and supplier. Examples of units could be: screens, reports, tables, use cases, lines of code, stored procedures, function point, among others. But not all of these units meet the criteria to be recognized by both the client and the supplier of uniform and consistent.

When analyzing more technical units, piece by a lack of visibility of these units by the customer. The relationship (if any) between lines of code, for example, and something of tangible value to the customer is very weak. Not always the customer has full technical responsibility for assigning value to a service that involved writing a certain number of lines of code. Many times, one of the motivations to outsourcing is search for a supplier with specialization in one subject that the cliente don't want to learn about. When analyzing a less technical units such as screens, tables, reports, use cases or function points, have units that are easily recognized and understood by both parties. The question now is to find a uniform and consistent definition for this unit. In the case of screens, tables, reports, and use cases that there is no standardized definition. Although there are good practices and common sense dictating what should be or not a use case or a screen, this is not enough to use these units as a measure of contracts. Taking the limit, the client could direct the service to the entire system is specified in a single use case to minimize cost, as well as the opposite would occur: the vendor split the specification of the system in many use cases as you want to increase their remuneration.

The unit function points has been considered in contracts precisely because it is a measure of non-technical, with a standard definition, and consistent.

Moreover, the employment service delivery based on the results allows the client to have more control over the costs that the supplier [9].

III. THE FUNCTION POINT ANALYSIS

The Function Point Analysis, according to the IFPUG standard, measures software by quantifying the tasks and services (functionalities) that the software provides the user, primarily based on the logical design [2]. The objectives of this measuring method are:

- The functionality implemented in software, the user requests and receives;

- The functionality impacted by the development, improvement and maintenance of software, regardless of technology used in the implementation.

This measurement process seeks to be:

- Simple enough to minimize the additional cost introduced by the measurement process;

- A consistent measure among various projects and organizations.

The software features measured by function points are of two distinct natures:

- Processing: represent the requirements of user processes, or transactions.

- Storage: represent the storage requirements of the user, ie data.

Briefly, the measurement process is to identify all the features of the project or application examined, classify these features as the rules of the manual counting practices and assess the complexity of each feature identified and classified in an objective way to assign a weight of the function points. The functional size is determined by the sum of all the functions identified, classified and measured project or application analyzed.

This whole measurement process uses as input only the software requirements specified by the user. Therefore, the functional size is a direct numerical representation of something that is in full command of the user: the requirements.

In order to ensure consistency in measurements, publishes the IFPUG counting practices manual, which has the following objectives [2]:

• Maintain compliance with ISO / IEC 14143-1:2007 Information technology - Software measurement - Functional size measurement - Definition of concepts;

• Provide a clear and detailed description of the point spread function;

• Ensure that scores are consistent with the practices of members of the IFPUG counting;

• Provide a guide to facilitate the counting function points from the deliverables of the most popular techniques and methodologies;

• Provide a common understanding to allow tool vendors to provide automated support for counting function points.

Another initiative to promote the IFPUG measurement is consistent certification program specialists in function points (CFPS / CFPP) which aims to formally recognize the professional who demonstrates an expertise in content (and application) of manual counting practices.

IV. FUNDING MODEL FOR POINT FUNCTION

The cost model for the provision of services by function point software used in Brazil can be represented by the following formulas, which in practice are similar.

$$Effort = Size \times Delivery\ Rate \quad (1)$$

In the first formula, used in most Brazilian private market, estimated effort (in hours) of the project to be executed taking

into account the size (in function points) and a delivery rate of pre-defined (points per hour function). This delivery rate is defined, and agreed with the supplier in a study of productivity in a sample of projects already implemented on the client. The project cost is derived by simply multiplying the calculated effort by a value-hour commercially agreed between customer and supplier.

$$Cost = Unit\ Price\ x\ Size \quad (2)$$

The second formula is used in public procurement, the project cost is calculated directly by the size in function points multiplied by a unit price of the function point. This is the price that was offered by the winning supplier competition. To set the price to be offered, bidders should take into account the whole process of work defined by the customer in the announcement of the competition.

Both formulas are equivalent, since the effort can be converted to cost, as well as the unit price is (or should be) defined on the basis of expected productivity for the contract. As the characteristics of the services to be demanded in the contract, the model can be refined (and usually this is done) with the use of different indicators of delivery rate (H / PF) or unit price ($ / PF), calibrated to specificities of each type of service.

For large organizations and the Brazilian public sector, procurement processes are often lengthy and expensive. Therefore the model described above is usually applied for the loan, not an individual project, but a volume of pre-defined function points to be used in several projects over a period usually of 12 to 60 months. And this volume is usually determined based on projects planned for the area of strategic planning systems.

As the function point analysis is performed based on the external view of the user, in contrast to an internal view of software engineering, the customer has effective control and management of scope. Do not enter the substance (each time) and complexity of the work, the profile of professionals mobilized or their quantity. It is a model where the function point analysis does not fulfill the role of estimating effort or cost, but to prescribe how much you will pay regardless of their actual cost or effort.

As in the global fixed-price contracts is a risky business, however, better distributed. The considerations about the complexity of the work in its various dimensions (except scope of functions requested and delivered by the user), the profile and amount of allocated professional should be made in a preliminary moment: when defining the unit price ($ / PF) or delivery rate (H / PF).

Once you determine the unit price, he, together with the amount of function points measured, prescribes how the supplier will be paid for each service delivered.

In a specific analysis of each service / project delivered, the value (or effort) paid usually varies either up or down when compared to the actually performed. This is expected because

the model uses as a basis of average price (or average yield) for the derivation of the cost. Since there is a good definition of price parameters for the model, these variations among the projects tend to cancel each other when considering the set of projects carried out in the contract in a longer time horizon (eg one year).

Why to use function point in this model?

A. *Why to use function point in this model?*

One reason is that the vocabulary of function point analysis uses terminology and define elements of analysis that are independent of the technology used to develop the software. The entire measurement process only considers the business perspective as understood and validated by the customer. Eliminating these technicalities facilitates understanding between the parties and is an important driver for communication between client and supplier. Another reason is that it is a standard method for measuring functional. Moreover, there are five methods of measurement functional possible to use: IFPUG (ISO / IEC 20926), Nesma (ISO / IEC 24570), Mark II (ISO / IEC 20968), COSMIC (ISO/IEC 19761) and FISMA (ISO / IEC 29881).

The choice of the standard IFPUG in the case of Brazil is due to the fact that this is the largest worldwide spread and because it is the oldest and most mature. As an organization, the IFPUG has over three thousand members on five continents. But the number of users of function points is much higher than for members.

One reason, more specific public sector, but also relevant is that the contracting of services by function points provides the external audit of contracts, something that can not be so strictly on a contract for the allocation of manpower. Suppose that a public agency has paid a fee to a service contract. In a contract paid by the hour, the external audit would determine whether there is record of appointment of hours consistent with the amount paid. But this record is easy to forge, which allows fraud in order to pay for more hours than they actually were executed. And in fact, fraud in procurement of Information Technology issues were common in Brazilian news in recent years.

For contracts based on function points, fraud in order to pay more than PFs were effectively delivered are easily detected by the audit. As the PFs reflect functionality delivered by the projects, there is no way they were forged.

B. *Not everything can be measured in function points*

Whereas the FPA measures the functional requirements of the user, it is clear that only part of the requirements of a project are captured in the measurement. Any non-functional requirement of the project is ignored in measuring function points. According to [2], examples of user requirements that are Non-functional requirements of the User include, but are not limited to:

• Restrictions quality (eg, usability, reliability, efficiency and portability);

• Organizational Constraints (eg, operating locations, target hardware and adherence to standards);

• Environmental constraints (eg, interoperability, security, privacy and confidentiality);

• Implementation constraints (eg, language development, delivery schedule).

However, the project must meet both the functional requirements and nonfunctional requirements. And to meet any of these types of requirements is no effort involved. As the cost model is non-functional requirements?

They are treated indirectly by productivity or price adopted. That is, the more work there is associated with the care of these requirements, lower productivity and more expensive tends to be the $ / PF.

This approach works when the service involves functional and nonfunctional requirements. However when there is a need to execute a service which involves only a change in non-functional requirements (eg, improved performance and usability) or corrective maintenance, there is no function points to be measured.

Therefore there is the need to complement the template to treat as payment for services that have no function associated points. There is a standard practice among Brazilian organizations for these situations, but the most common is the development of specific metrics for them. It should be noted that these situations are a small fraction of all the services required during the contract. Typically more than 80% of the service points are measured by function.

C. Service Level Agreements (SLAs)

In a contracting model based on results, there is the supplier's direct interest in maximizing the flow of demands met, because it implies increase revenue. For the customer this is also beneficial because it provides more responsiveness to the needs of the organization's software. As there is also interest from the supplier to deliver quality service, since any corrections involve rework, but without associated revenue, ie, cost harm the profitability of the contract.

Soon we can see a convergence of interests on both sides for quick and quality delivery in the contract. However, this contracting model can not dispense with Service Level Agreements (Service Level Agreements - SLAs), specifically on time and quality.

When there is a delay in delivery of service, even if the client has the predictability of the amount to be paid, this delay can result in lost opportunity for your business. The same applies to defects, although there is no additional cost to your corrections, this can impact the delivery date of a solution or even result in significant harm if the defect manifest after

deploying the solution. Therefore, it is good practice, the use of SLAs in contracts per function point. Even some of the indicators are derived from the SLAs functional size. For example, [10] uses the term COCOMOII formula, calibrated to its context, whose input parameter is the size in function points of the project to be executed. As also uses the size PFs associated number of defects to establish the level of indicator in defect density (defects / PF) which will guide the SLA quality.

V. DIFFICULTIES FOR THE NEW MODEL

The main difficulty for adopting the model contract for function points is the low maturity of IT practices and lack of culture projects in many organizations. For those who are in a contracting model for allocation of manpower, there is a big impact to promote this change. The employment by PF is the essence of working in the system design, which involves good planning and scoping. However, lack of planning, documentation and visibility of the results produced usually in the tonic for allocating contracts.

Another difficulty is related to the power game within the organization. The contract for the allocation of labor, allocated professionals often act as employees, not the IT department, but the user departments. For these managers is very convenient to have professionals available for use as needed. There is generally no major planning needs and the feeling of speed in solving problems is great.

When changing the contract model, these managers "lose" these are professionals and need to formalize your needs with a minimum documented scope, for the department to serve them. Therefore, it is common complaint of increased bureaucracy and loss of agility.

And one reason for failure in the transition of this contracting model is the use of cost models copied from other organizations, but without the necessary calibration sites. Some organizations opt for the easy way to copy what works in another organization, but without taking the trouble to study the differences in context between the two. In practice, they use the same parameters yield (or unit price) of another organization. In general this results in a contract that can raise the cost of other services or software supplier to the point oppress him withdraw from the contract.

Another difficulty is related to measurements in PFs. The measurement function is an exercise in abstraction from all aspects of implementation, focusing exclusively on business needs. For professionals who are directly involved in the implementation, there is often a difficulty in abstracting the implementation when the measurement is functional and this is reflected in a number of PFs often incorrect (and usually the largest), plagued by technical issues.

VI. CONCLUSION AND OUTLOOK

The model service contract resulting software has been matured in Brazil over the past fifteen years. Initially restricted to a few companies were willing to be pioneers in this model, it was gradually being adopted by other organizations that observed the success of this initiative. In the federal government, from 2008, the contracting of services by allocating labor became almost vetoed the publication Normative Instruction 04 (reviewed later in 2010) [11].

This further stimulated the spread of this contracting model. Although the federal government the use of function points is more intense, the main state and local governments have also make use of this model, but with even less emphasis. In the private market, some of the leading buyers of software services also hire for function points, which creates a tendency for the rest of the market follow the same path.

In short, the contracting model for function points, although widespread, is still expanding in Brazil. And that is expanding, it was enough to make it the country with the greatest amount of function points users in the world. Brazil is the country with the largest number of members to the IFPUG and also has the largest number of certified experts in the subject.

The authors of this paper participated in the process of transition from the contracting model for allocation of manpower to function points in several companies, and overcome the initial barriers, it appears that there is an increased flow demands of the system (increasing productivity now benefits the supplier), improving the quality of documentation requirements (because without it one can not measure PFs) and visible results that are delivered.

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