Assessment of Maintenance Maturity in IT Departments of Public Entities: Two Case Studies

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Abstract. This paper presents the results of two capability maturity assessments done in two IT Departments belonging to public entities. We investigated their maturity in the Software Maintenance Process. The results obtained and the special characteristics of these organizations (produce, maintain and use its own software) invite us to do several reflections on the adequacy of maturity models to this kind of organizations.

1 Introduction

The assessment of software processes has become a common practice in many organizations. It provides a framework for evaluating the organization capabilities, allowing benchmarking and comparisons with respect to others. In this manner, the evaluated organization can know its weaknesses and strengths.

From the knowledge of its good and not so good practices, the evaluated organization is in conditions of putting into practice different types of measures (processes improvement) to reach higher levels of maturity. With this, organizations may estimate its technological level or know what kind of organizations can potentially become customers, since to reach and to stay at a certain level of maturity is an important added-value which may suppose a meaningful, enough guarantee for customers.

Therefore, to reach high maturity levels is important for software organizations; however, when the evaluated organization produces and consumes its own software, maybe some of the issues taken into account by assessment models are not so interesting for them as for organizations that develop software for a third-party. This is the case of IT Departments of public entities. Usually, these departments are repeatedly involved in similar projects, mainly related to the management of their relationships with citizens (taxes collection, vehicles enrolment, etc.) and of themselves (personnel management, documents management, etc.). Technical characteristics of these projects are also similar, since they use similar development environments and tools,

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databases, etc. People in charge of these projects are also the same (mobility of public employees is quite less than those which work in private enterprises), being involved in all the stages of the life cycle of the software products: they analyze requirements, design the system, generate and test the code, put the system into operation and do its maintenance. Also the customer organization is the same, typically another group of employees in the same institution, although with different functions.

In the sense of [1], it is obvious that projects in these organizations have very high similarity. It is very possible they have all the characteristics to be at least at the Level 2 of the Capability Maturity Model (CMM).

In the other side, most of the work done by these organizations is maintenance (Singer reports that the 61% of the professional life of programmers is devoted to maintenance [4]).

For doing the assessment we used the IT Service Capability Maturity Model from the Vrije Universiteit [2]. As stated in [3], improvement models used for evaluating the Development process should be adapted to be used with other processes, as for example Maintenance. In fact, Maintenance has more characteristics of a service-oriented process more than product-oriented.

Assessments started with the Level 2 questionnaire, thinking in both cases that probably we should do later additional new assessments for Level 3. However, this last step was not done since results thrown by the Level 2 questionnaire placed both organizations in an uncertain situation between levels 1 and 2.

The IT Service CMM is specially adapted to Maintenance, as this process has characteristics enough to difference it from other processes, in such manner than Software Maintenance may be considered as a service more than as a product [3].

As it is well known, Level 2 at CMM is called “Repeatable”, since organizations at this level repeat earlier successes with similar service levels for similar projects. As we have previously noted, the evaluated organizations have many characteristics that would do us to think about situating them directly at Level 2; however, the reality was very different.

In this paper we show the results of these assessments, as well as several reflections on them. The paper is organized as follows: in Section 2, we provide a brief description of the Level 2 questionnaire we have used. Section 3 describes the characteristics of both Data Centres and presents a summary of the results of the interviews with both organizations. An objective analysis of the results is shown in Section 4, using the interpretation guidelines found and inferred from [2]. In Section 5, we present some reflections and conclusions.

2 Maturity Questionnaire

The questionnaire used contains 65 questions related to the seven Key Process Areas (KPA) identified by Niessink and van Vliet for Level 2 [2]:

1. **Service Commitment Management**. Questions in this KPA check that the delivered services, the specified service levels and the customer’s service needs are realistic and reviewed with the customer on a regular basis, adjusting the service level agreement when necessary.

2. **Service Delivery Planning**. The ten questions in this KPA checks that there is a plan for service delivery which is used as the basis for delivering the services.
3. **Service Tracking and Oversight**. This KPA checks the tracking of the service delivery (comparisons between specified and delivered services, corrective actions taken, etc.).
4. **Subcontract Management**. With this KPA, the selection of qualified subcontractors is checked.
5. **Configuration Management**. This KPA is used to test the politics in Configuration Management.
6. **Event Management**. This KPA is used to check how events (problem reports, etc.) are managed.
7. **Service Quality Assurance**. Through this KPA, the adequate management of quality procedures is evaluated.

The 65 questions of the questionnaire must be answered with:

- Yes always (YA)
- Not always (NA)
- Never
- Don't know

Also a "motivation" for the answer is solicited, in order to explain the circumstances which produce such answer.

3 Interviews

We maintained interviews with the responsible people of two IT Departments of two public entities: the Provincial Center of Informatics (CENPRI), belonging to the Provincial Council of Ciudad Real (Spain), and a second department of a Public organization that prefers remain anonymous.

The Provincial Council develops software for its own management, for the management of the 100 municipalities of the province and for managing its relationships with citizens. This includes taxes collection, properties seizures, public infrastructures, permissions for private works, salaries and personnel, etc. It also interfaces with several applications of banks, of the Ministry of Finance and of the region government.

The second Centre develops software for managing a big public institution, with several thousands of employees and also with many types of relationships with citizens and other institutions.

Both organizations use a tool for registering and tracking problem reports received from users. The anonymous organization uses a web tool for introducing them, whereas the Provincial Council receives requests by telephone or by a document.

Previously to performing the interviews we did an study of the distribution of modification requests received by these organizations per type of maintenance. In Table 1 the results for the Provincial Council is shown. This fact was one of the main reasons that invited us (both the authors and the responsible people of the IT Departments) to perform assessments of the maintenance process.

Table 1. Distribution of modification requests according to its type of maintenance.

Type of maintenance	% of MR
Corrective	13.30%
Perfective	62.21%
Adaptive	13.23%
Preventive	11.25%

Tables 2 to 8 show the seven Key Process Areas taken into account in the questionnaire. Their respective questions and the answers provided by both organizations are also shown. Only in some meaningful cases we have included a brief summary of the motivation. Furthermore, when the answers have been similar in both organizations, we have joint both responses into just a cell.

4 Analysis of Results

Key Process Areas for Level 2 are concerned with the establishment of the processes that enable the organization to repeat earlier successful services in similar situations. As it is seen in the previous tables, only the Provincial Council would be probably qualified as a "Level 2 organization", since the other one has answered "Never" to near all questions.

Setting aside the evidence of the greater maturity of the provincial council, it surprises that satisfaction questionnaires passed to software users in both organizations produce similar results. It is important to take remember that these users constitute the customer organization of the IT Departments. Therefore, if customers are satisfied with the maintenance service provided, and maturity questionnaires do not highlight these results, maybe these ones should be adapted for considering the special characteristics of this kind of organizations.

In the following subsections, we propose some ideas that maybe should be taken into account in order to adapt this questionnaire (and maybe other questionnaires and assessment methods for other processes) to evaluate Level 2 maturity.

4.1 Experience of These Organizations

IT Departments of public entities produce always very similar software for the same people, to resolve similar problems; excepting new versions, development tools also remain across time.

All the KPA's of the questionnaire we have used contain one or more questions on the existence of documented procedures. As we see, only in the 5th KPA (Subcontract Management) both organizations coincide in the possession of documented procedures, and this is due to the obligation of contractual laws with public entities.

When an organization "always does the same", with little personnel mobility, its experience in the development probably may substitute the existence of documented,

written procedures to do its work. We believe these questions should not be considered for these organizations at Level 2. We maintain only one exception in the afore mentioned 5th KPA.

4.2 KPA "Service Commitment Management"

In our opinion, experience is also a factor with more importance for this KPA than the absolute tracking of service needs and commitments. Project managers, analyst and programmers know well characteristics of these repetitive programs: they quickly know and find where is the cause of an error, or what tables and modules must be changed to add a new functionality. The high similarity and the experience provides information enough to limit the controls in this KPA to event-driven assessments.

Certainly, emotional (and often physical) proximity of developers and users and the sharing of goals ("the institution must work") facilitates the communication among both groups of people and the adequate resolution of problems.

4.3 KPA "Service Delivery Planning"

This KPA makes much insistence on the existence of documented procedures for a number of issues. This KPA is mainly related to the internal control of the IT Department. An interesting point to be taken into account for this KPA is that users always use the same version of a given software product; i.e.: if an error has been found in a program, the IT Department fixes it and updates all samples of that program. Moreover, in many cases the new version must be corrected or updated only on the server machine, since users employ terminals that are connected to a mainframe.

Therefore, some issues related to the service delivery plan may not be so important as in organizations that produce software for others.

This KPA also put special attention to the control of risks. However, similarity of the most influencing risk factors is so high, that both organizations coincide in the absence of risks in their projects. This comment (pronounced by our interlocutor at the Provincial Council) may seem exaggerated, but it is reasonably supported by the well-known problem domain, tools and people.

4.4 KPA "Service Tracking and Oversight"

This KPA contains questions for controlling some aspects related both to the relationship with the customer (mainly the questions: 1, 4 and 13) as to some internal issues of the service tracking and oversight.

We believe all issues in this KPA are important, even for organizations as those we are describing. In fact, the anonymous IT Department has, specially for perfective maintenance, a number of problems related to the need of overtime, which rarely appears in Provincial Council, that makes here a more rigid control.

4.5 KPA "Subcontract Management"

The importance of the right functioning of public entities for the daily life of citizens is so big, that we feel all relevant issues related to questions in this KPA must keep under the most absolute control.

As we see in Table 5, both organizations maintain their subcontractors under an adequate level of control. However, we think that the anonymous IT Department should make more emphasis in the planning and tracking of the service levels required to their subcontractors. This IT Department covenants service commitments with subcontractors, but only evaluates them when there are problems. This possibility should be avoided with a more rigid, periodical control of subcontractors.

4.6 KPA "Event Management"

Both organizations track adequately the events occurred and reported by users. Maybe experience could decrease the need of maintaining this control. However, event libraries and the related documentation constitute a very useful help when, for example, new personnel will be incorporated to the organization.

4.7 KPA "Service Quality Assurance"

Neither the Provincial Council nor the anonymous organization have adequate quality procedures. The reason of this is the great experience of both IT Departments and the high similarity of projects, tools and people. Spite this, and due precisely to the same exigency of public service mentioned in Section 4.5, public organizations should be much more strict with the Quality Assurance of their software.

In our case, this need is much more urgent in the anonymous organization: in this one, the people in charge of modifying a program is responsible of its testing, what is a unrecommended practice.

5 Conclusions

This paper has shown the results of the assessments realized in two IT Departments of two different public entities. These departments possess special characteristics that, in our opinion, should require specific maturity questionnaires and, maybe, specific adaptations of maturity models.

We have done some reflections on these adaptations. The main idea is that they should take into account the implicit "Repeatable" characteristics that these organizations have.

As future work, we are interested in using a more complete capability maturity model with a deeper taxonomy of maintenance activities as in the framework of the

CM^3 model (Corrective Maintenance Maturity Model) developed by the Software Maintenance Laboratory in Sweden [5, 6].

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Appendix

Table 2. KPA 1: "Service Commitment Management".

Question	Provincial Council	Anonymous org.
1. Are the IT service needs of the customer identified according to a documented procedure?	Yes, always (YA): a commission follows a docum. procedure	Never: there is no a documented procedure
2. Are the IT service needs of the customer documented?	NA (Not always): the planned ones are; the unplanned are not.	YA
3. Are the service commitments documented?	YA	Never
4. Are the service commitments evaluated with the customer on both a periodic and an event-driven basis?	YA	Never
5. Is the actual service delivery evaluated with the customer on both a periodic and an event-driven basis?	NA: only event-driven	

Table 3. KPA2: " Service Delivery Planning".

Question	Provincial Council	The other
1. Is the service delivery plan developed according to a documented procedure?	YA	Never: there is no a documented procedure
2. Is the service delivery plan documented?	YA	Never
3. Are the service delivery activities to be performed identified and planned according to a documented procedure?	YA	NA
4. Are software and hardware products that are needed to establish and maintain control of the service delivery identified?	YA	YA
5. Are estimates for the service delivery workload derived according to a documented procedure?	NA: there is no a written, documented procedure, but there is a “oral” plan known by everybody.	Never
6. Are estimates for the service delivery effort and costs derived according to a documented procedure?	Idem	Never
7. Is the service delivery schedule derived according to a documented procedure?	YA	NA
8. Are the risks associated with the cost, resource, schedule and technical aspects of the service identified, assessed, and documented?	Never: tools used, people, procedures, etc. are always the same, and risks are not evaluated. “There are no risks”, he said.	Never
9. Are plans prepared for the service facilities and support tools?	YA	Never
10. Are service planning data recorded?	YA	NA

Table 4. KPA 3: "Service Tracking and Oversight".

Question	Provincial Council	The other
1. Is a documented service delivery plan used for tracking the service delivery activities and communicating status?	NA: status is verbally communicated; tracking always fulfils the same procedure, but is not documented.	Never
2. Is the service delivery plan revised according to a documented procedure?	NA: there is plan, but not documented	Never
3. Are approved changes to the service delivery plan communicated to the members of the service delivery group and other related groups?	YA	Never
4. Are actual service levels tracked against the specified service levels, and are corrective actions taken as necessary?	NA: there are revisions; they are not compared (there are no specified service levels)	
5. Is the service delivery workload tracked, and are corrective actions taken as necessary?	YA	Never
6. Are the service delivery activities' costs and effort tracked, and are corrective actions taken as necessary?	YA	Never
7. Are the service facilities tracked, and are corrective actions taken as necessary?	YA	Never
8. Is the service delivery schedule tracked, and are corrective actions taken as necessary?	NA	Never
9. Are the service delivery activities tracked, and are corrective actions taken as necessary?	NA	Never
10. Are the service delivery risks associated with cost, resource, schedule and technical aspects of the services tracked?	NA: only when new tools will be used or new people will be incorporated.	Never
11. Are actual measurement data and replanning data for the service recorded and made available?	YA	Never
12. Does the service delivery group conducts periodic internal reviews to track activity status, plans, actual service levels, and issues against the service delivery plan?	YA: one monthly	NA: there are reviews, but there is no a plan
13. Are formal reviews conducted with the customer to address the accomplishments and results of the services at selected moments according to a documented procedure?	NA: there are formal reviews, but there is no a documented procedure.	
14. Are formal reviews conducted internally to address the accomplishments and results of the services at selected moments according to a documented procedure?	NA: one monthly (question 12), but there is no a documented procedure.	NA: only when there are problems, but there is no a documented procedure

Table 5. KPA 4: "Subcontract Management".

Question	Prov. C.	The other
1. Is the service to be subcontracted specified and planned according to a documented procedure?	YA	
2. Is the subcontractor selected, based on an assessment of the subcontract bidders' ability to deliver the service, according to a documented procedure?	YA	NA: "ability is a factor, but there are much more"
3. Is the contractual agreement between the prime contractor and the subcontractor used as the basis for managing the subcontract?	YA	
4. Is the documented subcontractor's service delivery plan reviewed and approved by the prime contractor?	YA	
5. Is the documented and approved subcontractor's service delivery plan used for tracking the service activities and for communicating status?	YA	
6. Are changes to the subcontractor's service commitments, service delivery plan, and other commitments resolved according to a documented procedure?	YA	Never
7. Are subcontract service commitments evaluated with the subcontractor on both a periodic and an event-driven basis?	YA	NA: not periodically, only event-driven
8. Is actual service delivery of the subcontracted services evaluated with the subcontractor on both a periodic and an event-driven basis?	YA	NA: not periodically, only event-driven
9. Are formal reviews conducted with the subcontractor to address the accomplishments and results of the services at selected moments according to a documented procedure?	YA	Never
10. Does the prime contractor's service quality assurance group monitor the subcontractor's service quality assurance activities according to a documented procedure?	YA	Never
11. Does the prime contractor's configuration management group monitor the subcontractor's configuration management activities according to a documented procedure?	YA	Never
12. Does the prime contractor's event management group monitor the subcontractor's event management activities according to a documented procedure?	YA	

Table 6. KPA 5: "Configuration Management".

Question	Provincial Council	The other
1. Is a configuration management plan prepared for each service according to a documented procedure?	NA: only for the most important services	Never
2. Is a documented and approved configuration management plan used as the basis for performing the configuration management activities?	YA	Never
3. Is a configuration management library system established as a repository for the configuration base-lines?	YA	Never
4. Are the products to be placed under configuration management identified?	NA: only some products	Never
5. Are action items for all configuration items/units initiated, recorded, reviewed, approved, and tracked to closure according to a documented procedure?	NA, because there is no a documented procedure	Never
6. Are changes to configuration baselines controlled according to a documented procedure?	NA, because there is no a documented procedure	Never
7. Are (software) products from the configuration baseline created and released according to a documented procedure?	NA, because there is no a documented procedure	
8. Is the status of configuration items/units recorded according to a documented procedure?	NA, because there is no a documented procedure	
9. Are standard reports documenting the configuration management activities and the contents of the configuration baselines developed and made available to affected groups and individuals?	NA: there are no standards.	Never
10. Are configuration baseline audits conducted according to a documented procedure?	NA, because there is no a documented procedure	Never

Table 7. KPA 6: "Event Management ".

Question	Provincial Council	The other
1. Is an event management plan prepared for each service according to a documented procedure?	YA	Never: there is no plan
2. Is the documented and approved event management plan used as the basis for performing the event management activities?	YA	Never
3. Is an event management library system established as a repository for the event records?	YA (there is a tool)	
4. Are events identified, recorded, analyzed, reviewed, and resolved according to a documented procedure?	NA, there is no a docum. procedure	YA
5. Are affected groups and individuals informed of the status of events on both a periodic and event-driven basis?	YA	
6. Are standard reports documenting the event management activities and the contents of the event repository developed and made available to affected groups and individuals?	YA	
7. Are event repository audits conducted according to a documented procedure?	NA, because there is no a documented procedure	

Table 8. KPA 7: "Service Quality Assurance".

Question	Provincial Council	The other
1. Is a SQA plan prepared for the service delivery according to a documented procedure?	Never: there is no SQA plan neither documented procedure	
2. Are the SQA group's activities performed in accordance with the SQA plan?	NA, because there is no a documented procedure	Never
3. Does the SQA group participate in the preparation and review of the service commitments and service delivery planning, standards and procedures?	NA: there is no a specific SQA group, but people participate	Never
4. Does the SQA group audit the service delivery activities to verify compliance?	NA: there is no a specific SQA group, but there are audits	Never
5. Does the SQA group periodically report the results of its activities to the service delivery group(s)?	NA: reports are done, but not by the SQA group because there is not	Never
6. Are deviations, identified in the service activities and delivered service, documented and handled according to a documented procedure?	Never, since there is no SQA plan	
7. Does the SQA group conduct periodic reviews of its activities and findings with the customer's SQA personnel, as appropriate?	Never: there are non-periodic reviews; there is no SQA group	