STUDIA UNIV. BABEŞ–BOLYAI, INFORMATICA, Volume **XLIX**, Number 2, 2004

PERFORMANCE ANALYSIS MODEL FOR GOAL DRIVEN MEASUREMENTS IN SOFTWARE DEVELOPMENT PROCESS

D. RADOIU AND A. VAJDA

Abstract. The paper proposes a Performance Analysis Model (PAM) as base for analysis of goal driven measurements within software development process.

The model is developed on common view of the process for both acquirer and supplier enabling parties both to identify problem areas and to improve the overall process.

Keywords: Performance Analysis Model, Process Measurements, Outsourcing Process Management, Application Development, Improvement.

1. Introduction

The research was organized as a practical project at Infopulse[1] and a research project at Petru Maior University[2] of Tirgu Mures.

The paper firstly reviews the Acquirer and Supplier roles and responsibilities in a sourcing process, points on process areas which are within the control of both parties, proposes a set of relevant goal driven measurements, and a performance analysis model to interpret them.

Issues in sourcing are complex and multidimensional yet both Supplier and Acquirer have similar fundamental objectives such as:

- on time/schedule
- at cost/on budget
- with all required functionalities
- without defects/of required quality (no rework after delivery)

Received by the editors: December 2004.

2000 *Mathematics Subject Classification.* 68N30.

1998 *CR Categories and Descriptors.* D.2.9 [**Software**]: Software Engineering – *Management.*

[1]www.infopulse.ro

[2]www.upm.ro

We start from the assumption that the goal (for the proposed set of measurements) is enabling both parties to identify problem areas in the sourcing process and to improve the overall process. "The balanced set of measurements helps prevent dysfunctional behavior by monitoring the group's performance in several complementary aspects of their work that lead to project success."[5].

As the Acquirer and the Supplier have control and best insight on different process areas, the interpretation of measurements with regard to the above mentioned goals is inherently different. Therefore agreement over the Sourcing Process Model (SPM), roles, responsibilities, measurements and their interpretation to secure success, is required.

This can be done by developing a Performance Analysis Model (PAM) agreed by both parties.

The fundamental idea of this paper is that the agreed set of goal driven measurements interpreted through a commonly agreed performance analysis model enables:

a. Identification of problem areas and quick implementation of appropriate action
b. Process quality improvement
c. Better planning estimates based on historical data
d. Common view (for both Acquirer and Supplier) of the process

2. Sourcing Process Model

The Sourcing Process Model (SPM) is depicted in Figure1 [1]

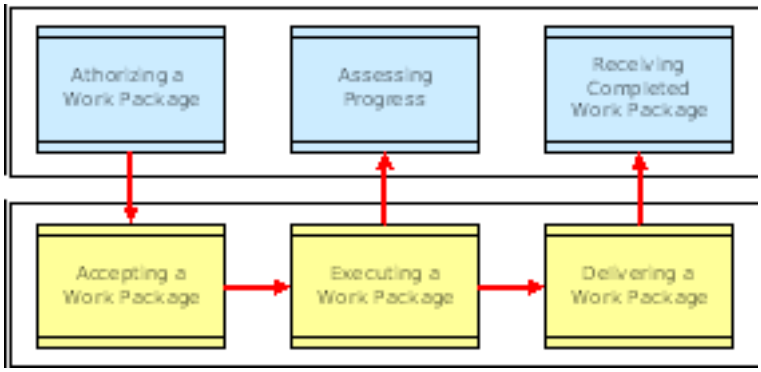

Figure 1. Sourcing Process Model (SPM)

Different terms are used interchangeably in available literature to describe the roles and the responsibilities of the parties involved in the sourcing process:

- Acquirer/Partner to describe the party authorizing a work package (acquisition) and
- Supplier/Vendor/Developer/Contractor for the party accepting the work package (contracting)

We start by identifying process areas and which party exercises control over it. The overall process consists of six major areas:

- Authorizing a work package (Acquirer)
  - Activities: requirements management, defining the work package and stating acceptance criteria for executed work
- Accepting a work package (Supplier)
  - Activities: clarifying work package definition, acceptance criteria, assessing risk
- Executing a work package (Supplier)
  - Activities: work package planning and execution, reporting progress (status). Activities are strongly influenced by directions and corrections, change requests, from Supplier and communication quality.
- Assessing progress (Acquirer)
  - Activities: monitoring progress, directions and corrections
- Delivering executed work package (Supplier)
  - Activities: check executed work package against acceptance criteria (usually changed according to post-award change requests due to poor requirements management) and timely delivery
- Accepting executed work package (Acquirer)
  - Activities: receiving executed work package and checking requirements satisfaction

Acquirer has full control over:

- Work package (WP) definition
- Work package (WPS) stability
- Requirements management (area that usually is poorly measured/managed problems being transferred to the Supplier)
- Project monitoring (status) and oversight (directions and corrections)
- Requirements satisfaction (by checking deliverables against acceptance criteria)

Supplier has full control over:

- Internal development processes
- Deliverables quality (e.g. executed work package, intermediate deliverables)

Supplier & Acquirer share control over:

- Communication effectiveness
- Relationship management
- Contract execution
- Communication channels
- Risk management

3. Goal Driven Measurements and Performance Analysis Model

Measurements goal is to insure successful software development by early identification of problem areas and implementation of corrective actions. Performance Analysis model (PAM, Figure 2) suggests both a set of relevant measurements [1] and a consistent way to interpret them.

3.1. **Authorizing and Accepting a WP measurements.** The sourcing process is initiated by the Acquirer which authorizes a WP and proposes it to the Supplier. A WP could be described in various ways, e.g. WP size, based on Functional Points (FP) and WP Accuracy (WPA), a quantitative estimation of how well the assignment is described through analysis documents, design documents, acceptance criteria.

Communication (e.g. questions and answers, QA) plays a very important role in clarifying WP accuracy related issues. QA could be quantified simply by their number. But regardless of their number it is important that questions are answered in a reasonable time (quantified by average response time, ART) and answers are specific and complete (quantified by communication quality, CQ).

Based on agreed estimating models (e.g. historical data) the parties can quantify measurements either quantitatively (numerical values) or qualitatively (e.g. color code levels). For instance, using the largely accepted color code, communication quality could be quantified as good ("Green"), average ("Amber") or poor ("Red"). Similarly

WPA could be also described using the same color code or quantitatively by:

$$\text{WPA} = 1 - [\text{QA}/\text{FP}]$$

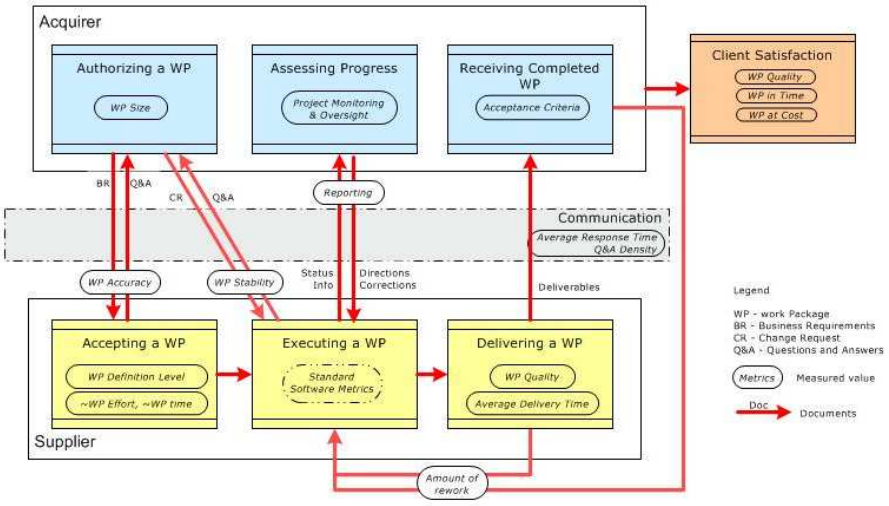

FIGURE 2. Performance Analysis Model (PAM)

3.2. **Executing a WP and Assessing Progress Measurements.** This phase is initiated by the Supplier by accepting a WP and acknowledging the acceptance criteria for the executed WP. Let us call the specific WP accuracy at the moment of awarding as WP definition level.

Although the development process starts by executing the WP at the definition level, frequently the initial request is changed via formal change requests (CR). If accepted by the Supplier, CR also modifies acceptance criteria. Consider a first approximation where the WP stability is also a measurement of acceptance criteria stability.

WP Stability (WPS) is a quantitative estimation of change requests (CR) per functional point (FP) after the WP has awarded by Acquirer and accepted by Supplier:

$$\text{WPS} = 1 - [\text{CR}/\text{FP}]$$

Based on statistics, WPS associated risk could be color coded as depicted in Figure 3.

Ideal stability means no change requests are made after the work package has been accepted by the Supplier (WPS = 1).

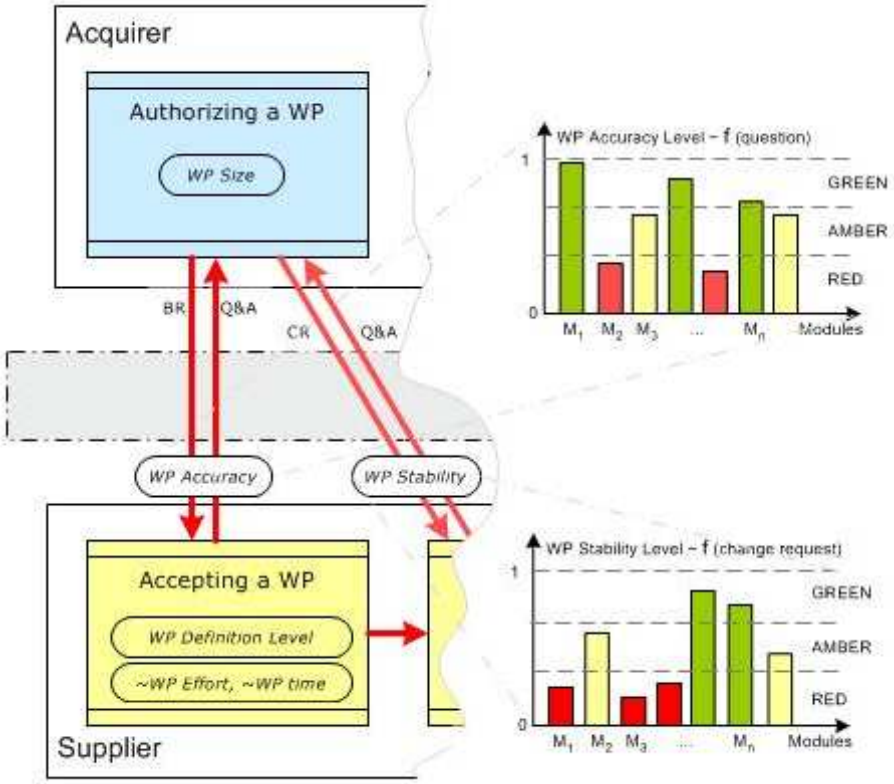

FIGURE 3. WP Stability influenced by change requests

3.3. **Delivering and Receiving a WP Measurements.** As in the previous stages, the focus is on co-operation issues (i.e. between the Supplier and the Acquirer) therefore measurements will not focus on WP quality, amount of rework, etc.

Average delivery time, defined as:

$$\text{ADT} = \text{delivery time/FP}$$

Could be used to assess delays introduced by different interference factors like change requests, communication quality, corrections and directions.

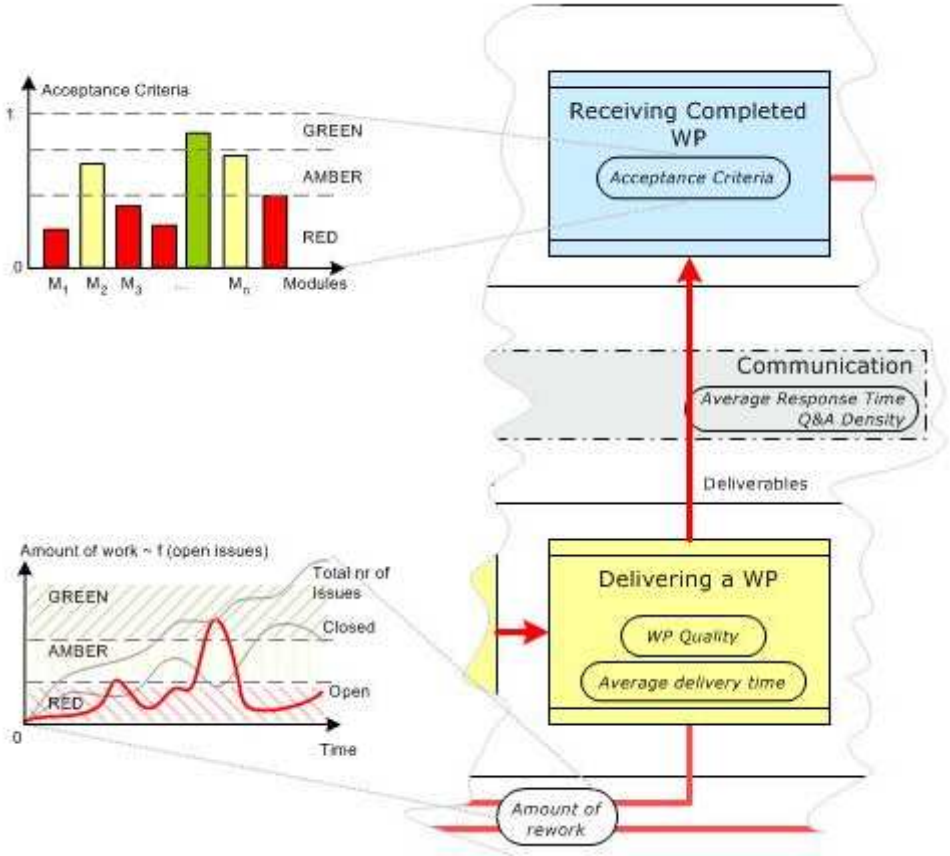

FIGURE 4. Delivering and receiving an executed WP

4. INTERPRETING MEASUREMENTS

Table 1 contains measurements to be used with our performance analysis model (Measurements have no meaning apart from their context).

Let us use them to quickly asses risks associated with accepting a work package. We will use qualitative measurements for WP accuracy and communication.

Table 2 reveals that a poorly described WP and a poor communication relationship certainly leads to failure (highest risk level, Red). Any combination of Middle-Low WPA and communication quality requires immediate corrective actions (medium risk level, Amber). A high level of WPA could lead to success

Measurements	Acronym	Value	Tracked Process/Project Issues
WP size	WP	FP	Product complexity, growth
WP accuracy	WPA	WPA = 1 – [QA/FP]	Requirements gathering quality, client expectations management, design quality
WP stability	WPS	WPS = 1 – [CR/FP]	Sourcing process efficiency, productivity, rework, schedule delays
Communication quality	CQ	Green, Amber, Red	Efficiency, productivity
Questions and answers	QA	number	Analysis and design quality
Average response time	ART	ART = $\frac{\sum \text{response time}}{\text{QA}}$	Efficiency, productivity
WP definition level	WPD	WP at the moment of starting execution	Product size, complexity, required effort, schedule, acceptance criteria
Directions and corrections	DC	Green, Amber, Red	Responsiveness and effectiveness
Average Delivery Time	ADT	ADT = delivery time/FP	Productivity

		WP Accuracy		
		High	Middle	Low
Communication Quality	High	Green	Green	Green
	Middle	Green	Amber	Amber
	Low	Green	Amber	Red

Table 2. Risk level for accepting a WP

(assuming a high stability of the requirements) almost regardless of the communication quality between parties (low risk level, Green).

Communication Quality&Directions	WP Accuracy and Stability: High	Middle	Low
High	Green	Green	Green
Middle	Green	Amber	Amber
Low	Green	Amber	Red

Table 3. Executing a WP Risk Level

Again, as the purpose of this PAM is to identify problem areas in a sourcing process, the focus is not on the software development process but on the co-operation between parties.

Executing a WP is influenced by WP accuracy and requirements stability. Requirements stability is an area usually not very well managed by Acquirer which means customer management issues are transferred to Supplier. Risks could be lowered though by a high quality communication and effective directions and corrections (Table 3).

Risk level is high (Red) when we have to deal with a poor described WP when execution is interfered by a relatively high number of change requests, poorly supported by directions via a poor quality communication. Yet, this table also reveals that very good communication and quality directions and corrections support even a poor WP accuracy interfered by CR.

WP delivery risk level is similarly evaluated in Table 4.

Acceptance criteria stability	WP Execution quality: High	Middle	Low
High	Green	Green	Green
Middle	Green	Amber	Amber
Low	Green	Amber	Red

Table 4. Delivery and acceptance risk level

5. Conclusions and further work

PMA was imagined to support sourcing process analysis for small teams and small to medium size projects. Although PMA is independent of the supplier's

team, increased team size brings more complexity and therefore requires more attention.

Quantitative measurements bring more insight into the overall process. For instance, based on historical data one can infer that a certain CR average score indicates that up to a certain percentage of the requirements were not known when the WP was awarded.

We must also observe that PMA does not take into consideration factors outside control of Acquirer and Supplier (e.g. end user).

References

[1] Radoiu D., Vajda A., "Process-Oriented Metrics for Application Development Outsourcing", internal report

[2] Jeannine Siviy, Goethert W., Ferguson R.,Trading Places: Measurement and Analysis in the Eyes of the Acquirer and the Supplier, SEPG 2004, March 2004

[3] McGarry J., Card D., Jones C., Layman B., Elizabeth Clark, Dean J., Hall F., Practical Software and Systems Measurement A Foundation for Objective Project Management, Guidebook, Addison Wesley Professional, October 2001, http://www.psmsc.com/PSMBook.asp

[4] Florac, Park, and Carleton, Practical Software Measurement: Measuring for Process Management and Improvement, CMU/SEI-97-HB-003, 1997

[5] Paulk, Weber, Garcia, Chrissis, Bush, Key Practices of the Capability Maturity Model, Version 1.1., CMU/SEI-93-TR-25, ESC-TR-93-178, 1993

Department of Mathematics and Computer Science, Petru Maior University, Târgu Mureş, Romania