

# Chapter 5

## Performance Management in Software Engineering

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### ABSTRACT

*Performance measurement in software engineering has to meet a multiplicity of challenges. Oftentimes, traditional metrics focus on sequential development instead of using incremental and iterative development. Output is measured on a pure quantitative (e.g., SLOC), quality-disregarding basis. A project's input is hard to assign properly using enterprise-unspecific forecasting tools which have to be calibrated at first and which do not account for time preferences. Requirements necessary for behaviourally adjusted project management and control are rarely discussed. Focusing on these shortcomings, this paper proposes an enterprise-specific approach which combines lifecycle and activity based costing techniques for software development following the incremental and iterative Unified Process model. Key advantages are calibration effort can be avoided, project management decisions are supported by a clear managerial accounting emphasis, precise milestone-depending cost objectives can be determined as the basis for personnel management and control of development teams, and cost and time variance analysis can be supported in a sophisticated way.*

### INTRODUCTION

The challenges of performance measurement as a tool of project management in software engineering are twofold. On the one hand an efficiency control requires adequate metrics to assess the productivity of software development by means of input-output-relations. The multitude of existing

metrics already clarifies the missing unambiguity in this field: for an up to date and broad overview of software metrics research see Kitchenham (2010) and for details Anseimo and Ledgard (2003), Choi and Kim (2005), Foulds and West (2007), Kitchenham and Mendes (2004), Maxwell and Forselius (2000) or Pfleeger (2008). Farooque and Farooque (2009) provide empirical evidence

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on performance measurement. Yet, some problems arise by focusing metrics on traditional sequential software development processes instead of using incremental and iterative development (IID) techniques (Tan et al., 2009; Yu, 2010). On the other hand anticipative personnel project management aims to activate behaviour in accordance with the software development objectives. Requirements discussed in responsibility accounting, for example the realistic but challenging setting of objectives or the controllability of influencing variables needed by developers, have to be fulfilled (e.g., Baker, 1992; Baker, 2002; Choudhury, 1986; Otley, 1999; Zimmerman, 2003).

Considering both starting points together, there is some room for improvement: oftentimes, widespread software metrics suppose simple structures of impact by focusing on coding and disregarding other input drivers such as design, analysis or management activities. Besides, the definition of output not only has to account for development progress measured in source lines of code (SLOC) but also for soft facts such as the fulfilment of customers' demands for example. Hence, output has to be measured with a multi-criterial basis, which accounts for quantitative and qualitative indicators (Krishnan, Kriebel, Kekre, & Mukhopadhyay, 2000). Otherwise, a metric based on SLOC could signal high productivity, whereas in fact the outcome of the project is endangered. Possible risks are unfitting system architectures and user interfaces or the deficient consideration of all stakeholders' needs. Such accumulation of overseen conceptual non-conformity and the thereby caused bias in productivity more likely deals with traditional process models which are lacking a permanent alignment of objectives. The well-known waterfall archetype for example assumes freezed customer demands for all subsequent stages of development and thus implies a shift of risks towards the future and cost-intensive adjustments (see Figure 1).

Moreover, the clear assignment of input to a single project is hard to obtain when the same

staff simultaneously work for several projects. Time-Driven Activity Based Costing (TDABC) -based on classical Activity Based Costing (ABC) - is a new approach for a better determination of cost and capacity utilisation of processes (Kaplan & Anderson, 2007). However, TDABC still contains elements of full costing and therefore is not an appropriate basis for decision-making. Even worse, it has been designed as a static accounting scheme while the long-lasting process of developing complex software systems requires an accounting scheme such as lifecycle costing (LCC) which accounts for time preferences. Only some attempts have been made to combine ABC and LCC-elements (e.g., Emblemståg, 2003). Besides, precise project-specific milestones and, linked to that, milestone-depending cost objectives are needed to allow for an ongoing performance measurement. They have to deal with the complexity of software development (see Figure 2), for example the identification of competent software engineers (e.g., Colomo-Palacios, Tovar-Caro, Garcia-Crespo, & Gomez-Berbis, 2010), the formation of software development project teams (e.g., André Ampuero, Baldoquín de la Peña, & Acuña Castillo, 2010), and the ongoing coordination of the activities of team members and the role of leadership (e.g., Abernethy, Bouwens, & van Lent, 2010).

Taking these shortcomings into account, this paper presents a new project cost management approach, which:

1. Is enterprise-specific and calibration-free,
2. Is based on iterative and incremental software development,
3. Combines elements of activity based and lifecycle costing and therefore accounts for time preferences,
4. Has a managerial accounting emphasis to support decision-making,
5. Allows for the determination of precise milestone-depending cost objectives which can be used as performance measures,

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