

Improving Organizational Performance Through Reward Systems

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1. Introduction

In order to improve the results of projects, senior management of software development companies define programs to measure and improve productivity. This interest is related to the need to monitor whether the results of teams are aligned with organizational strategic goals and whether they are achieving the levels of productivity expected, such as, for example, the levels set for finance, customer satisfaction, product quality levels, and so forth (Austin, 1996).

There are several strategies for improving productivity that are researched in the area of software development. The large majority are related to some previously studied factors that affect the productivity of teams. For example:

- Quality of management: the low productivity of teams is directly related to poor project management (Scacchi, 1984);
- Size of teams: small teams tend to be more productive (Behrens, 1983);
- Length and size of the project: increasing the length of the project or its size tend to decrease productivity (Maxwell *et al.*, 1996);
- Use of tools: the impacts of the increase or decrease in productivity related to introducing and using tools in the software development process (Bruckhaus *et al.*, 1996);
- Reuse of software artifacts (Boehm, 1999);
- Instability of the requirements (Yu *et al.*, 1991) and of the software architecture (Cain & McCrindle, 2002).

However, besides the areas related to tools, methodologies, work environment, management and reuse, the area of personal incentives, raised in a study by Boehm (Boehm *et al.*, 1982), should be considered as one of the initiatives to be integrated into a program for improving productivity.

Aligned to Boehm's way of thinking, DeMarco (1999), in his research studies on the productivity of teams, reported that the main problems of our work are not only of a technological nature. Many are sociological in nature.

The theories of motivation argue that the people who contribute more to a company should receive more for doing so (Campbell, 1998). This expectation has a significant influence on the design of incentive systems, and payment by merit programs reflects this influence. However, they do not always achieve their objectives.

Clincy (2003) pointed out some areas that can increase productivity in software development: software development processes, testing tools, defining the architecture and reward systems.

Based on the above thoughts, the importance of this issue is related to the fact that the recommendations proposed may be useful for solving day-to-day problems and need to consider the nature of reward systems so as to obtain a gain in productivity.

Figure 1 illustrates the examples cited above by using a time line, between 1982 and 2003.

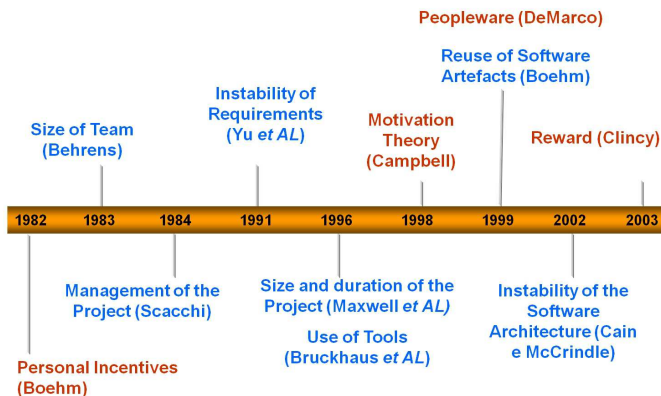


Fig. 1. Time-line related to some strategies for improving productivity.

In addition, this chapter will continue the discussion of a topic that is less emphasized in the software area compared with other strategies for improving productivity, since currently it is more related to technological aspects.

At the same time, this theme is widely discussed and implemented in the disciplines of Economics and Social Sciences (Holmstrom & Milgrom, 1991; Laffont & Martimort, 2002), where various aspects related to incentives have been applied and can be considered as lessons learned for software organizations software.

1.1 Context

There are several practices related to productivity in organizations that develop software, for example, productivity analysis (metrics of productivity and factors which affect productivity); techniques, processes, tools and environments for improving productivity; and estimating and measuring software.

Figure 2 presents an overview of how the problem of productivity can be mapped by using a framework that contains a set of solutions so that organizations may undertake an effective program of productivity. It consists of the following parts:

- *Infrastructure for productivity measurement programs*: resources (tools, roles and responsibilities, hardware, etc.) which gives support to implementing a program of productivity metrics;
- *Program of productivity metrics*: a metrics-based model that enables the assessment of productivity in different projects to be evaluated;
- *Productivity metrics*: metrics which may evaluate the productivity of software development projects;
- *Code quality and productivity*: the influence of the quality of software code on the productivity of the team, by means of an examination of the metrics of code that influence the quality of the code's architecture and metrics that influence productivity;
- *Productivity factors*: the main factors that influence productivity so as to serve as a guide for organizations which wish to start programs to improve productivity in software development projects;
- *Strategies to improve productivity*: a systemic view on the practices related to productivity in software development, thus the correlation between the solutions to be documented;
- *Model for improving productivity*: a model for continuously improving productivity following the standards used by CMMI (SEI, 2006) & MPS-BR (SOFTEX, 2006);
- Reward Systems.

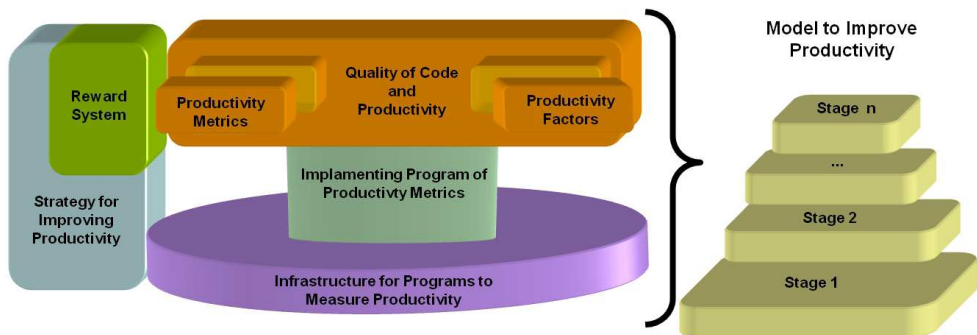


Fig. 2. Context of the proposal.

Based on this context, reward systems are the focus of this chapter, with the goal of being one of the strategies for improving productivity in software organizations.

Setting out from the correct definition and implementation of a reward system, also known as an incentive system, the organization seeks to measure some aspects related to team productivity. Based on these measures, teams are rewarded, for example, with financial recognition, promotions, awards and benefits. It is expected, therefore, to obtain a gain in productivity and, consequently, to improve quality and the indices of project performance (Austin, 1996).

This chapter seeks to answer the following question: In order to stimulate increased productivity, are reward systems effective as part of the organizational strategy to improve the productivity of a software company? And, moreover, what are the good practices that should be considered and the pitfalls that must be avoided when implementing a reward system?

To answer these questions, this chapter provides a set of recommendations in the form of guidelines that can guide managers to define and implement a reward program, in an organization, as part of the organizational strategy for increasing the productivity of teams engaged on software development projects. In addition, it addresses the negative impacts that these programs can cause to the productivity of teams, by generating the effect of the dysfunction of the measuring system, when the indicators are poorly defined or badly used.

2. Measurement systems

According to Deming (1986), a measurement system is a set of actions that should be performed with respect to the collection, validation and analysis of data used for decision making. It is the set of all definitions, methods and activities used to measure a process and its resulting products for the purposes of characterizing and understanding the process.

The search for metrics that represent certain dimensions of the software, such as size or cost, has been one of the greatest challenges in software development organizations. One way to implement practices to obtain indicators that represent the status of a project or organization is by using measurement systems. They aim to establish and sustain a culture of taking measurements and conducting quantitative analysis in organizations. Thus it may be seen that measurements help us to understand the world and to take decisions that are more correct (Pfleeger & Fenton, 1997). However, there are views that disagree with the influence of the practice of measurement on the activities performed by individuals within organizations.

In a recent paper, DeMarco (2009) is self-critical about his famous phrase "*You can't control what you can't measure*," published in his book *Controlling Software Projects* (DeMarco, 1982). Twenty-seven years later he says that implicit in this phrase is the idea that the control may, perhaps, be the most important aspect of a software project. But it is not. Many projects have been conducted almost without control, and produced wonderful products, like Google Earth or Wikipedia. And he adds:

"For the past 40 years, for example, we've tortured ourselves over our inability to finish a software project on time and on budget. ... , this never should have been the supreme goal. The more important goal is transformation, creating software that changes the world or that transforms a company or how it does business. ... Software development is and always will be somewhat experimental" (DeMarco, 2009). Earlier in the same article, DeMarco (2009) says he now believes *"...the more you focus on control, the more likely ... (your) project ... (will) deliver something of relatively minor value"* prior to which he wrote *"So, how do you manage a project without controlling it? Well, you manage the people and control the time and money"* and he says of his current views: *"...I'm advocating a management approach, one that might well steer the team toward agile methods, at least toward the incremental aspects of the agile school"*.

2.1 The real intentions of a measurement system

Insofar as software engineering matures, measurement begins to play an increasingly important role in the understanding and control of software development (Fenton, Kitchneham & Peeger, 1995). Organizations seek to measure characteristics of the software so as to check if the requirements are consistent and complete, if the project is of good quality or if the code is ready to be tested or delivered to the client. But what are the real intentions of a measurement system?

It is expected that organizations are seeking to understand and improve their development process, thus facilitating decisions that are taken by using information. To understand the real intentions of organizations, it should be realized that the measurement starts at the project level, where it is of great help to the manager. With the measurements, he/she can make decisions by making use of objective information on the following points (Jones *et al.*, 2001):

- Communicating more effectively;
- Monitoring specific project objectives. The measurements of the project can provide more precise information on the status of the project and the product which is being generated;
- Identifying and anticipating the correction of problems, which favors the manager taking a pro-active view;
- Making key decisions. All software projects are subject to restrictions. Cost, schedule, capacity of team and its technical quality, and performance have to be negotiated and prioritized in relation to the best cost benefit to ensure that the objectives of the project are achieved.

Austin (1996) explains the two categories of the real intentions of making use of a system of measurement: the motivational and information ones. He does not completely invalidate the benefit of the measures, but discusses extensively the question of whether the measure is to generate information or motivation. In the first case, there is the chance of success. In second, the system will tend to be circumvented, and so some additional care must be taken.

Measurement with motivational intent is explicitly targeted on affecting the people who are being measured so as to prompt a greater demand for efforts in relation to the organizational goals.

The purpose of measurement that targets information is to identify any situation that may occur in the project and can be divided into two forms: measurement to improve the process of project development and measurement of coordination, namely, to provide information that may permit some management on the progress of the project, for example, adding new people to a project that has fallen behind schedule. This measurement, in turn, is not intended to change people's behaviour.

While the intentions of the measurement systems are known and pursued, as are tools and methodologies, measurements alone cannot ensure the success of a project. However, they favour factual decisions, visibility and the pro-activity of the manager. Thus, projects, besides reaching their objectives, bring the organization closer to meeting its goal.

In this context, methodologies, models, standards or tools such as the Balanced Scorecard (BSC), the Goal-Question-Metric (GQM), Practical Software & Systems Measurement (PSM) and Capability Maturity Model Integration (CMMI) are widely used in the identifying, defining and refining business objectives, initiatives, metrics and indicators to be implemented.

2.2 Dysfunction in a measurement system

In organizations, despite the good intentions on creating effective systems of measurement, there is a phenomenon called dysfunction, which impairs the performance of companies.

While the managers of a measurement system believe they are giving visibility to the performance of the organization through its indicators, in fact they are actually diverting the attention and efforts of the teams to numbers that distort reality.

In the organizational context, dysfunction can be defined as the consequences of changing people's behavior that interfere with the intended results or lead in the opposite direction from the real intentions of the organizational objectives defined (Austin, 1996).

According to Austin (1996), measurement is something potentially dangerous. When any performance indicator is measured, the risk of making it worse is incurred. The simple fact of measuring sees to it that the person, more and more, focuses only on the dimension which is being measured. However, this does not mean that one should not define indicators for monitoring and improving projects and process, but some care needs to be taken when defining the real intentions of what is being measured.

Boehm (Boehm *et al.*, 1982) states that to obtain significant gains in productivity requires integrated efforts in several areas, for example: improving tools, methodology, work environment, education, management, personal incentives, software reuse, among several other factors. That is to say, that in order to measure productivity, i.e., how much value-added the projects produce per unit of value consumed, it is necessary to understand what the various dimensions are that need to be considered when analyzing organizational performance. However, very often, these dimensions are not easily identified and measured.

This can occur for various reasons, such as: lack of knowledge of what needs to be measured in relation to the strategic objectives; lack of knowledge or difficulty about how to collect a certain dimension; and cultural barriers; etc.

Very often, the indicators are created because they are easy to collect; for example, the number of lines of code produced per unit of time. From the moment at which a team is judged by this single dimension, the natural tendency is for people to focus their work on producing the lines of code, more and more quickly, thus leaving aside other aspects related to the quality attributes of the product generated, which are not being observed and are as or more important than the lines of code (Aquino *et al.*, 2009).

Therefore, the dysfunction occurs when the way the team works to achieve a target controlled by the organization leads to a decrease in actual performance, which is not reflected in the indicators measured, as illustrated in Figure 3. Dysfunction, thus, increases when any critical dimension increases which expends effort, is not measured.

Jackson (2002), Meyer (2002) & Bruijn (2002) have also addressed this phenomenon, in more recent studies. They call it the "perverse effect" or "gaming".

As seen previously, a measurement can be used to provide information and, thus, to improve the process used for or give support to taking management decisions based on facts, such as, for example, to decide to increase the human resources in a project. On the other hand, the measurement can also be used to generate motivation. In this case, the measurement system becomes vulnerable to human behavior, since it can cause reactions in those being measured; for example, the measurements used in reward programs.

Flamholtz (1979) says that, in the context of organizations, the role of measurement is not merely represented by the technical aspect; it has a social and psychological dimension.

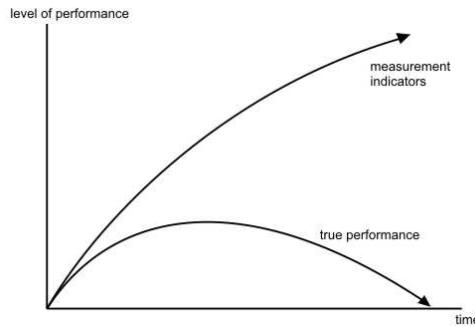


Fig. 3. The effect of dysfunction on measurement systems (extracted from Austin, 1996).

3. Reward systems

3.1 Reward

Rewards can be classified as tangible or intangible. In the first case, they are defined as being awards granted to employees on the basis of tasks performed, which meet or exceed the expectations initially established. In the second, they are defined as praise granted in public by virtue of achievements widely approved in the context of organizational culture (Stajkovic & Luthans, 1997).

Within this scope, it is worth stressing that reward systems are designed with the objective of increasing organizational productivity, and rewarding those who achieve an expected level of performance. The central question is how to define appropriate indicators to ensure the productivity of teams and to prompt motivation without causing dysfunction in the measurement system and action that has little effect (Austin, 1996).

According to Zanelli (2004), the reward system of an organization has repercussions on motivating work when workers are rewarded in a tangible way (cash bonuses, salary increases) or intangible (praise or public recognition) because they have demonstrated behaviors considered desirable for the organization.

The main challenge of an effective reward system is related to defining criteria on how the reward should be distributed among people. The use of standards of differentiation that people consider are fair and the consistency of these standards with the context of the organization are essential for there to be commitment to the company and the work to be performed.

3.2 Motivation and the Theory of Expectancy

There are various theoretical frameworks on motivation: Maslow, Herzberg, McClelland, Expectancy, Equity, Geertz, Bergamini (Vergara, 2000). But, it is worth declaring, based on field research, that no motivational theory on its own can fully explain human motivation.

In this chapter, expectancy theory, as proposed by Victor Vroom, will be addressed, since it is a more contemporary theory and possesses a direct relationship between performance and reward.

Expectancy theory was proposed by Vroom in the 60s. He states that an employee will be motivated to work hard when he/she believes their efforts will produce a performance which, when recognized, will lead them to having rewards that have value to them (Vroom & Kenneth, 1968).

This theory is targeted on the workplace. It is considered a theory of process, and not simply of content, because it identifies relationships between dynamic variables that explain the behavior of people at work (França *et al.*, 2002).

Vroom developed a multiplicative model between the three variables: *Valence*, *Instrumentality* and *Expectancy*. According to him, what motivates a person to make a decision is a product of these three variables: of how much a person desires a reward (*valence*); his/her estimate of the probability that effort will result in successful performance (*expectancy*); and his/her estimate that that performance will be a means to get the reward (*instrumentality*).

Thus, a person will reduce their efforts if he/she believes that they will not achieve the required performance, if they believe that it is impossible to achieve the rewards or if they believe that the reward is undesirable. According to Vroom, achieving rewards to which a large value is assigned leads a person to making more intensive efforts.

3.3 Reward systems – Overview

Economists began to consider the measuring motivation more deeply based on articles published by Ross (1973) & Holmstrom (1977). The Economic theory, known as *agent-principal*, is concerned with the fact that as an individual, the principal (the employer), can construct a compensation system (a contract), which motivates another individual, his/her agent (the employee) to act in the interest of the principal. The *agent-principal* problem occurs when it involves some effort that cannot be monitored and measured by the principal and, therefore, cannot be rewarded directly. The solution to this type of problem is to establish some kind of alignment of interests of both parties (principal and agent) (Holmstrom & Milgrom, 1991; Laffont & Martimort, 2002).

In 1990, a conference was held, organized by Harvard Business School, prompted by the unsatisfactory amount of knowledge about how organizations measure and evaluate their performance and how incentive systems were defined and implemented. Ten articles written by sixteen professors from universities in the United States and Europe were presented and discussed by sixty-six executives, consultants and academics (Bruns, 1992).

They reported that although economists and psychologists have written extensively about how organizations should define these systems, the literature was still very sparse on how to solve the problems inherent in the system.

As to incentive schemes, the authors found evidence, using field studies, that, in most organizations, the purpose of these systems was, in fact, was to relate motivation to performance, given that one of the main difficulties was to find ways to measure and evaluate their performance without, however, producing the effect of dysfunction. They further report that a variable that the then models did not consider was the cultural aspect of organizations. And that many incentive schemes have failed to consider it.

There is much empirical evidence that suggests that reward systems influence the behavior and performance of the members of organizations (Maltz & Kohli, 2002, Furtado *et al.*, 2009).

According to Humphrey (1987) a reward is appropriate when the employee contributes in an extraordinary way to the profits of the organization. To qualify for a reward, the goal must be clear, meaningful and consistent with other rewards for similar goals. For a reward system to be effective and to be able to encourage motivation it needs to satisfy some individual need of an employee, in particular, besides keeping track of the changes in their needs. Otherwise, it is unlikely to achieve the performance desired.

In more recent studies, Kaplan (Kaplan & Henderson, 2005) states the importance of formal or informal incentives in organizations and their being used, in some companies, as a way of stimulating an increase in the performance of employees. He points out, however, the following concern regarding the measurement systems on which they are based:

"Incentive systems are usually based on measures that are subject to interpretation. Although the economics literature says that these parameters, despite being subjective, are instantly understood by everyone in the company, our argument is that building a common understanding of what the relationship is between actions and results is not such an easy thing to obtain". (Kaplan & Henderson, 2005).

Bowles (2009) suggests a reflection on the fact of defining incentive systems only based on economic theories. He says that at the same time as the promise of a bonus prompts high performance, it can also cause the opposite effect, by restraining the very behavior that it should encourage. He exemplifies with a study that economists discovered that offering money to women to donate blood reduces, to almost half, the number who are willing to donate, and that to allow the payment be passed on to a philanthropic body reverses the effect.

The main problem for most reward systems in organizations is not related to the measurement of performance, but rather to the distortions introduced by those which are being measured (Austin, 1996).

Aligned to this way of thinking, Baker (Baker *et al.*, 1994) states that the reason for any dysfunction caused by changing behavior is not related to *pay-for-performance* systems in themselves itself, but by inappropriate measures of performance on which these systems are based. He assumes that objective measures of performance are imperfect. Therefore, reward contracts based solely on these measures create distorted systems. Finally, he adds that the effectiveness of these systems depends on various social, psychological and economic factors.

According to Baker (Baker *et al.*, 1990), one way to mitigate the distortions in an incentive system which are caused by imperfect objective measurements, is by combining these measurements with subjective components. He says that even if subjective measures are not perfect, they can complement or improve the objective measures available.

4. Recommendations for implementing a reward system in software organizations

The purpose of this section is to present some recommendations with the objective of supporting managers of software organizations to implement a reward system as a strategy for increasing productivity.

The form of description of the recommendations is by means of guidelines, the format of which follows the standard listed below, which was based on how Sommerville described them for the requirements engineering and process improvement (Sommerville & Sawyer, 1997) and was adapted based on a form of notation used to describe software standards (Braga, 2001):

- **Title:** short phrase that identifies the guideline;
- **Problem:** establishes the problem that the guideline is meant to solve;
- **Description:** brief description contextualizing the field of application of the guideline;
- **Benefits:** some directions of the gains hoped for by the organization by adopting the guideline;
- **Form of adoption:** guidance for adopting the guideline in an organization.

4.1 Understanding the motivational aspects of individuals

4.1.1 Problem

It is important to understand the needs that motivate people. Rewards or other results to motivate people need to be desired by them. Managers need to identify results of value and not simply suppose that they know exactly what their staff desire, or to attribute their own needs or desires to other people (Robbins, 1999).

4.1.2 Description

It is hoped that an appropriate distribution of rewards may positively influence both satisfaction and performance. Both should be considered as two separate but interrelated results.

Therefore, well-administered rewards are considered the keys to create both satisfaction and a high-performance for the work. While surveys may show that people who receive large rewards are more likely to report high job satisfaction, they also conclude that the rewards must be contingent with regard to performance so as influence it. This means that the type of reward varies according to the person's level of achievement (Schermerhorn *et al.*, 1999).

4.1.3 Benefits of the adoption

The rewards may result in better performance if workers have the skills to enhance it, in fact, to desire the rewards being offered and if there are few physical and psychological restrictions (Spector, 2002).

Expectancy theory says that an employee will be motivated to make a high level of effort when he/she believes that the effort will lead to a good performance evaluation; that a good evaluation of performance will lead to organizational rewards, such as a bonus, a salary increase or a promotion; and that the rewards will satisfy the employee's personal goals (Robbins, 1999).

4.1.4 Form of adoption

The first step towards adoption is not to think that everyone wants the same reward. Motivation varies from person to person and also for the same person, it may vary over time.

According to Maslow's theory, if we wish to stimulate someone's motivation, we need to understand at what level of the hierarchy that person is at the moment and focus our attention on meeting the needs of that level or the higher one.

4.2 Clear definition of the plan of variable remuneration

4.2.1 Problem

When a variable compensation plan is poorly applied, it can provoke demotivation and impair the performance of teams. This occurs, for example, when the criteria for compensation are not well defined when there is no transparency in the process, or, even, when the cultural aspect of the organization is not considered.

4.2.2 Description

One of the forms that organizations use to reward their employees is through a variable compensation program, usually coordinated by Human Resource Management. This program allows some goals to be set that are aligned with the strategic objectives of the organization. Based on these goals, a set of indicators is established and used to define the degree of reward.

In this context, if the organization chooses to define a variable compensation plan, it is essential that it be clearly defined and advertised to all those who will be influenced by it.

4.2.3 Benefits of the adoption

The reward can be seen as a competitive differential, as long as it is implemented adequately. Some of the benefits that can be achieved with a variable compensation program are: the alignment of the activities of those involved with the goals expected by the organization; the stimulus to continuous improvement, by means of the link between reward and performance; encouraging people to make an effort to ensure projects are successful (Hipólito, 2006).

4.2.4 Form of adoption

The visibility of the criteria and benefits of the plan is fundamental to its success. It is important that the performance data be broadcast and all forms of measuring be available to all involved.

For a reward system to be effective, three elements must be present (Spector, 2002):

- The worker should have the possibility to expand his/her capacity. If he/she is working at full capacity, the introduction of a reward system will not maximize his/her performance;
- The rewards should meet the worker's needs and expectations. Not every employee wishes to work solely in exchange for money, i.e., so that a reward system is effective, it should converge with what the worker really wants from his/her work;
- There should be no physical or psychological limitations on the worker's performance.

4.3 Definition of baselines of comparison for productivity metrics

4.3.1 Problem

The use of reward systems based on productivity goals of the software development team may not be appropriate when the measurement of productivity is distorted because not all the relevant factors that affect it have been considered.

4.3.2 Description

Some measurement systems use indicators of physical (LOC/h) or functional (FP/h; UCP/h) size in order to measure the productivity of software development team. Whatever the indicator chosen, there are several other factors that can affect the team's productivity: programming language, tools, the experience of the team, etc. To state that the goal of productivity has been achieved or to compare productivity between projects, it is necessary to define for the specific organization which factors will be the ones that can influence the performance of teams and to categorize projects based on several parameters: size, duration, technology, type of client, etc.

There are several studies that report on the factors that affect productivity, for example, Yu *et al.* (1991); Boehm *et al.* (1982); Boehm (1999); Maxwell & Forselius (2000).

4.3.3 Benefits of the adoption

The following benefits can be achieved by adopting this guideline:

- Defining a standard for the characteristics of projects that allows productivity goals to be stipulated, in accordance with the attributes of the specific project;
- Defining a standard for the characteristics of projects that allows the performance of different teams to be compared, only between projects with similar attributes.

This type of orientation enables a situation, like the one described below, to be avoided. Figure 4 illustrates an indicator that measures the productivity of a software development project team, in hours worked, divided by use case points, i.e., how many hours are

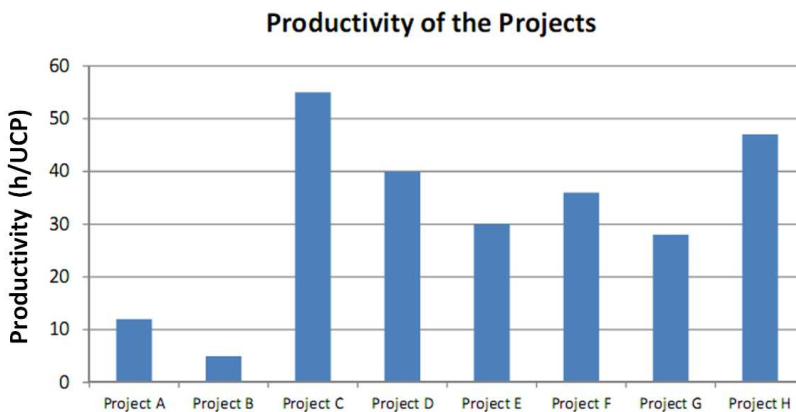


Fig. 4. Example of productivity indicator.

consumed to produce one use case point. The y-axis of this graph represents the productivity indicator (h/UCP) and the x-axis represents all the projects measured in a given period. Note that productivity varies from 5h/UCP to 55h/UCP, namely, a variation of 1,000% between the most productive project and the least productive project. However, not all projects have the same characteristics related to technology, business domain, maturity of the team, etc. This means that in a scenario like this, it is not possible to compare which project has obtained greater productivity in relation to the others and, consequently, to use this indicator as the basis for the reward program.

On applying this suggested guideline, the indicator would come to be analyzed by groups of projects with similar categories.

4.3.4 Form of adoption

The adoption of this guideline involves making an inventory of the existing projects in the organization and to classify them according to parameters that help to identify similar projects. For example: technology, contract type, team size, and so forth. Based on this survey, a precise infrastructure needs to be set up. This means using a tool to store the historical data of the projects and one that is available for consultation by similar projects.

Then the productivity indicators should be defined based on the characteristics of the projects previously raised. In addition, the goals to be achieved by the teams will be established from an initial baseline, collected from historical information¹.

4.4 Identification of the participants in the sale of the project

4.4.1 Problem

When estimates of effort, time or cost are established in the proposal for the sale of a project by the same people who will participate in carrying it out, proposals with that are over-estimated can be generated, if these people are later subjected to a reward system, e.g., a variable remuneration program for project managers based on complying with estimates.

4.4.2 Description

The people involved in the sale of a project, such as, for example, project managers, should not influence the estimates arising from a contract of results² into which they will be submitted while the project is being carried out.

From the moment that people who are involved in the sale of the project are not the same as those who will participate in its being carried, the risk is avoided of the estimate being over-sized. This type of behavior can occur, should the project manager be subjected to a contract of result that may control the variation of the budget or the end-date of the project. To avoid

¹ LOC: Lines of Code; FP: Function Points; UCP: Use Case Points.

² In this chapter, the term 'contract of result' is a set of goals periodically established between a person, or team, and the organization in which the service is being rendered or the product is being developed. Each goal is evaluated at the end of a period and a score is provided. It is common for the result of this agreement to be used by organizations as a form of reward, whether this is related to promotions, benefits, re-inclusions, etc., in accordance with the policy of reward and remuneration of each company.

a poor performance in its end result, estimates of the effort and cost may be increased by a percentage of risk that may increase the price of the project. This can make the company less competitive in the market and decrease the number of business deals contracted.

4.4.3 Benefits of the adoption

The main benefit of this guideline is the impartiality of those responsible for the schedule and estimates of cost, established in the proposal for the sale of the project. To the extent that these people are not rewarded for these dimensions, the tendency is that the proposals are not influenced by personal interests.

4.4.4 Form of adoption

The area responsible for allocating resources needs to understand the business domain and the technology into which the sale is placed in order to identify the possible professionals skilled at supporting the assembling of clients' needs and making estimates of effort and cost. Based on this list of people, the area responsible should select those who will have little likelihood of being assigned to be in charge of conducting the project, if the sale comes to fruition.

4.5 Definition of the success of the project

4.5.1 Problem

The criteria that define success or failure of a project are not always well aligned between the organization's top management and those responsible for implementing a project. And when these criteria are used as the basis for a reward system, the project results can be interpreted in different ways.

4.5.2 Description

The success of a project can be used as a criterion for evaluating the results of the contract manager or the team that conducted it. However, this definition of success may vary as a result of many factors. For example: the business model, the organization's strategic objectives, etc. Therefore, it is important that the concept of success is clear for each project before it starts to be carried out.

There are studies that confirm the success of a project is a multi-dimensional concept (Shenhar & Renier, 2002). Projects cannot always be evaluated based on the same dimensions. A project may provide an efficient solution for the client's needs, but still be considered a failure on account of the return that it brought the organization. Similarly, some projects are considered successful in the short term, but this may not be true in the long term, and vice versa. In some cases, some time must pass until the initial expectations are really met and the success evaluated.

4.5.3 Benefits of the adoption

Baccarini (1999) states that traditional metrics allow only a view with regard to the success of the process of project management, since they are focused on the design process, and in

particular, the successful achievement of the objectives of cost, time and quality. Willard (2006) suggests that additional metrics are identified to define the project's success. According to him, the metrics should be identified by taking into account how the implementation will benefit the main directives of the business of the organization.

Thus, the correct definition of how the success of a project will be measured will see to it that those involved in its being carried out are aware of the project's real goals and the criteria that will be evaluated in their results contracts.

4.5.4 Form of adoption

Defining the success of a project is an activity that will depend, mainly, on the alignment of this project with the organization's strategy and on the time at which the project was completed. In general, software organizations relate the success of a project to meeting its defined deadlines, budget and scope. This model makes sense in most projects. However, there are cases where the organization's strategy is geared towards obtaining a particular client or carrying out a strategic project of some other client, and there are others. In these situations, the project's success cannot be measured only by the three indicators mentioned above (deadline, budget and scope). The project could have succeeded even with the budget at variance, but the strategy with the client was met and this has come to have a greater weight for a specific context.

There are cases in which measuring the project in relation to meeting the deadline may impair the quality of the product which is being delivered. It is then necessary to define what the quality criteria are which should be measured so as to avoid the deadline being met, but the product not complying with the level of acceptance laid down for the project.

These criteria have a dependency with time, i.e. for a given project, the perception of success may change over time. This will depend on the time elapsed since its completion. For example, a project may have as its main focus to create future opportunities. Therefore, it is barely likely that it is seen as successful until these opportunities have effectively materialized.

Since the organization manages to have this real notion of what represents success within its portfolio of projects, the contracts of results will be better applied.

4.6 Definition of the model of team management

4.6.1 Problem

In general, reward systems use base indicators for decisions to encourage teams. If the definition of these indicators does not consider the model of team management, it is possible that some of them are not feasible for measuring and monitoring, thus making the targets set by the reward system unviable.

4.6.2 Description

The choice of the model for managing a software development team should be considered when trying to define how a contract of results will be applied results in a reward program. In general, we may consider three models of team management: no supervision, partial

supervision and total supervision. This categorization is in accordance with the model proposed by Austin (1996).

4.6.3 Benefits of the adoption

The correct understanding of what management model will be used to plan and monitor the activities of the teams is fundamental for defining which dimensions may be used in a contract of results. This will allow, early in the project, the expectations to be aligned with regard to the indicators that may be collected and which of these will be used to reward the team at the end of the project. Thus, it will be clear both to managers what the teams may be held responsible for, and to the teams, what will be considered at the time of their being rewarded.

4.6.4 Form of adoption

In the case of the model chosen being self-management, i.e. no supervision of the team will be carried out, it will not be possible to quantify clearly the goals associated with this team. Thus, the contract of results will not have objective data in order to reward people.

In the case of the model chosen being partial supervision, it will be necessary to identify which dimensions may be determined, collected and analyzed, and only then clearly define how the contract of results should be formulated. In this type of model, as the team is not fully managed, not all dimensions can be collected. For example: the project manager can only monitor if the deadlines are met, but cannot monitor if the effort made by the team is within a range planned. In a case like this, the contract of results of the team should consider only the goals related to the success obtained by delivering the products within the agreed deadlines, but it will not consider if it was necessary to work more or less hours in order to meet them.

Finally, if the management model chosen is that of total supervision, any dimension may be evaluated in the team's contract of results. For example: on-time delivery, meeting the estimates of size, effort and cost, the number of lines of code, the function points, the use case points, etc., produced per unit of time, density of defects, etc.

The definition of what management model will be used in a specific project should not only be a unilateral decision by the project manager. Other aspects should also be considered, for example: maturity and experience of the team, cost of managing the project and the strategic importance of the project to the organization.

Based on these characteristics, the organization should define which management model is most appropriate for the project. However, it will be for the organization to consider other characteristics to support this definition.

4.7 Definition of the performance indicators

4.7.1 Problem

The results contracts which are used to measure the performance of teams and reward them are not always adequately defined and aligned to the strategic objectives of the organization.

4.7.2 Description

The indicators used to measure the performance of the teams must be defined prior to the contract of results. These indicators may vary as a result of the organization's strategic objectives and should not follow a standard rule for all companies. For companies where the business model is related to a software factory, the indicators may be related, for example, to delivery on time and density of defects. On the other hand, for business models related to innovation, the indicators can be defined based on other dimensions. For example, the degree of impact of the product launched on the market or of learning a particular technology.

4.7.3 Benefits of the adoption

Defining indicators based on the correct dimensions arising from the company's business model sees to it that the objectives of the project being undertaken are aligned to the organization's strategy. Thus, the contract of result applied to the project team will be defined and measured so as to minimize personal interests interfering in the interests of the project.

According to Austin (1996), the main problem for most incentive systems in use by organizations is not the concern about performance measurements but rather with the distortions introduced intentionally by those who are being measured. This being so, making it clear to the project manager under what aspects he/she and his/her team will be evaluated throughout the project will help minimize the effect of the dysfunction in the collection and analysis of the indicators of customer satisfaction, since the manager will also be evaluated in terms of other internal aspects of the organization.

4.7.4 Form of adoption

Early in the project, senior managers of projects and the business manager should analyze with the manager responsible for conducting the project what the strategic objectives are that are to be achieved and how they are aligned to the objectives of the project. These goals should be part of accounting for the final performance indicator of the project.

The indicators used to measure the performance of a team must be defined using a system of measurement. There are several techniques and methodologies for this purpose. For example: the Balanced Scorecard, the Goal Question Metric and Practical Software and Systems Measurement. When implementing a measurement system, it is important that the indicators can be based on more than one dimension to avoid the effect of system dysfunction.

Since the indicators are defined, some criteria can be established to assign weights that ponder the importance of each indicator on a specific project. And, thus, can convey a greater sense of fairness to those who are being rewarded.

4.8 Setting up an independent committee to evaluate the results

4.8.1 Problem

It is common that even if quantitative measurements of the performance of the teams are set, the person being assessed or the assessor can manipulate the measurements, and therefore

they will not accurately reflect what they are predisposed to measure (Gibbs *et al.*, 2004). In addition, quantitative measures do not always manage to capture all the information needed so as to take decisions on reward systems.

4.8.2 Description

The process of implementing a rewards program is not completely objective and easy to follow. This will depend, among other factors, on the level of the criteria set by the organization to reward people and on the uncertainties that may exist in a measurement program that uses their as a form of incentive to the teams.

The use of subjectivity allows evaluators to explore any relevant information that arises during the period of measurement to benefit both the company and the employee. Moreover, it is known that even in the simplest environments, there will be factors that will be beyond the control of managers and therefore initially they will not form part of the measurement systems. For these factors, the use of subjectivity can facilitate the allocation of rewards (Gibbs *et al.*, 2004).

Several companies mitigate the effect caused by the distortion of objective performance measures by using subjective performance evaluations (Baker *et al.*, 1990).

It is suggested, therefore, that a committee be set up, which is able to analyze any distortions that may have arisen, and subjective data and has the autonomy to adjust indicators and targets, established previously.

4.8.3 Benefits of the adoption

The setting-up of an independent committee to evaluate the results may be able to correct any distortions that may have arisen and were detected during the process of collection and the analysis of indicators, as well as during the process of allocating rewards.

The evaluations of the results of a reward system may cause unfair outcomes because of the degree of subjectivity that some indicators may show, besides it being very difficult to predict all the criteria that will be used in the program. This is a process that takes time and requires the organization to be mature. When the committee has been set up, the opportunity will be created to "calibrate" the reward indicators and criteria.

4.8.4 Form of adoption

The form of adopting this guideline may vary depending on the size of the company and the way it is functionally organized. The organization should select a group of people who are impartial to the reward program. The ideal is for them not to be the line managers of the teams that will be evaluated.

This committee should meet periodically and needs to be formed by a team with representatives from different departments and to have decision-making powers in the organization. For example, executive oversight, human resources, senior managers, etc.

This multidisciplinary of the committee is also important so that certain aspects that were not originally defined can be taken into consideration. The context in which some projects

are conducted and their alignment with the organization’s strategies are subject to change over time. Even if the reward program and the indicators have not been revised in time, it will be for the committee to review each case and to consider these changes to the decisions already taken.

4.9 Relationship between the guidelines

Figure 5 illustrates how the eight guidelines are related, according to the categories described below, and their respective scopes of action and phase of activity:

- **Relation of support:** when the use of a guideline supports the adoption of another guideline;
- **Relation of influence:** when the adoption of a guideline can influence the behavior of another guideline;
- **Relation of use:** When a guideline can make use of (benefit from) another guideline;
- **Relation of restriction:** when the use of a guideline may restrict the application of another guideline;
- **Relation of Reevaluation:** when the use of a guideline may reevaluate the use of another guideline, by changing its behavior.

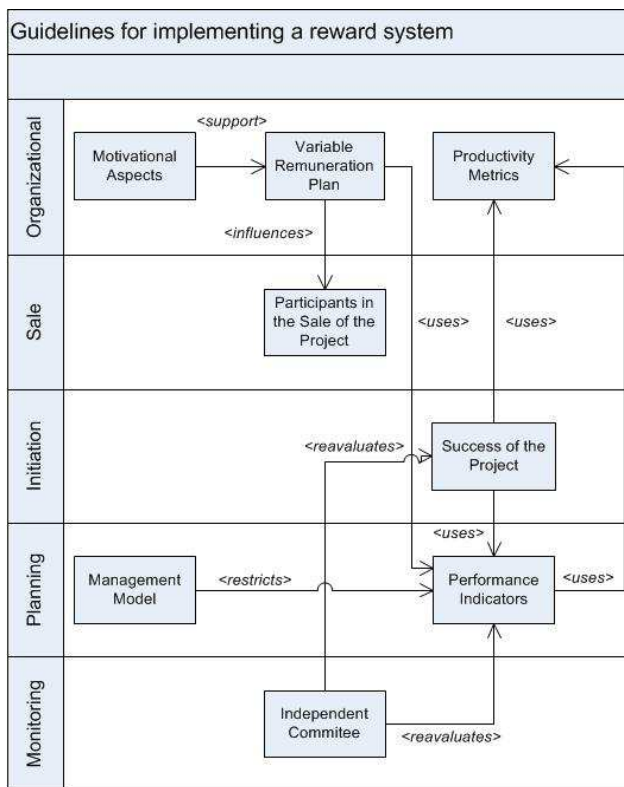


Fig. 5. Relationship between the guidelines.

5. Validation of the guidelines

The guidelines suggested in the previous section were validated by applying a questionnaire comprising the ten questions below:

- **Question 1:** What is the profile of the respondent (managerial or technical), the geographical region, time in the market and the number of people involved in management or software development?
- **Question 2:** Is it possible to set the same standard indicators for every type of project, with the aim of evaluating the productivity of a software development team?
- **Question 3:** Normally, is the success of a project evaluated using the traditional dimensions of 'cost, scope, length and quality'? Do you think it is possible to evaluate the success of the project based on different dimensions?
- **Question 4:** What is your response to the following statements? Each organization that develops software should define what the factors are that can influence the productivity of their teams and categorize projects based on several parameters: size, length of time, business domain, technology, customer type, and so forth. This categorization is important because it will enable the comparison of the productivity of different teams, only between projects with similar characteristics.
- **Question 5:** Are reward programs (e.g., variable remuneration, prizes/awards, public recognition, etc.) useful for improving the productivity of people working with software development projects?
- **Question 6:** Has a reward program (e.g., variable remuneration, prizes/awards, public recognition, etc.) been implemented in the company in which you work?
- **Question 7:** If there is a reward program in your company, do you think it was set up properly?
- **Question 8:** Is it important to have a list of recommendations/guidelines on how to guide managers to define and set up a reward program in software organizations?
- **Question 9:** If the people involved in the sale of a software development project are the same as those who will participate in carrying it out, will the estimates of length of time and time be influenced, should these people be put forward to a reward program (e.g.: the contract of results), while the project is being conducted?
- **Question 10:** Does the use of indicators in software development projects, as part of the process of evaluating individuals (e.g. contract results), change their behaviour such that these indicators are affected?

During 10 days in June 2009, 106 people answered the questionnaire. However, after analyzing the data, 15 responses were discarded because they were incomplete or because the company is not part of the target audience desired. Therefore, 91 responses were considered.

Based on this field research, we conclude that the predominant characteristics of the respondents are:

- Profile of respondents: management;
- Geographical region: the survey was conducted in several states of Brazil, but predominantly in the Northeast;
- Time in the market: 11 to 30 years;

- Number of people involved in software management or development: from 101 to 500 people.

All guidelines could be analyzed and there are strong indications that they are valid, considering the scope of the companies surveyed.

Figure 6 represents the responses on three scales group: 'I agree' and 'I fully agree'; 'I neither agree nor disagree'; 'I disagree' and 'I completely disagree'.

To validate the guidelines, it was expected that positive replies would be concentrated in Questions 3, 4, 5, 8, 9 and 10, and negative ones in Questions 2 and 7. In the chart below, it is these groupings that can be seen.

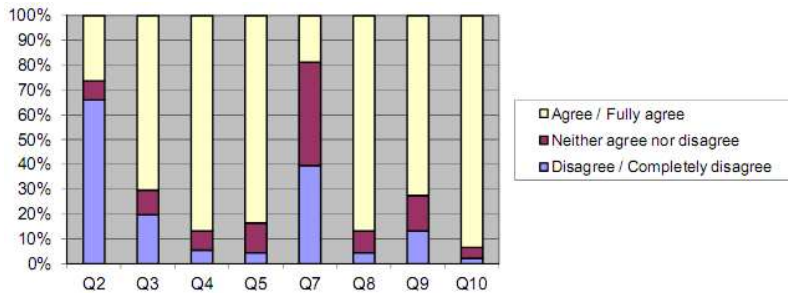


Fig. 6. Consolidation at three levels of the eight questions of the field survey which have the same scale and options as answers.

Given the results presented, it can be stated that there are indications that adopting the eight guidelines may be effective so that a software development organization may achieve higher levels of productivity.

Finally, it is important to point out that this chapter did not consider the application of the guidelines in conjunction with other strategies for improving productivity. This means that adopting it alone may not be sufficient, it being necessary to apply other known strategies, for example, using tools to automate the process of software development, reuse artifacts, improve the quality of the management of teams, and so on.

6. Conclusion

The process of measuring performance has received great attention due to the concern of organizations with increasing the productivity of teams. Several methodologies, models and tools are used to create measurement systems: the Balanced Scorecard, Goal-Question-Metric, Practical Software & Systems Measurement, Capability Maturity Model Integration, and so forth.

In this context, several strategies can be defined to increase productivity. One is through the use of the indicators in a measurement program as a way to define a reward system that may prompt the motivation of the teams through rewarding them.

Reward mechanisms aim to strengthen behaviors that should be repeated. That is, the achievement of goals of productivity and quality may be rewarded with a bonus or some

kind of extra premium for the purposes of showing the individual, and other participants, what the goals and hoped for behavior are.

In general, these systems are intended to attract, retain and motivate people. But for a person to be motivated, he/she needs to give value to the result, needs to believe that additional effort will lead to better performance and that the better performance, subsequently, will result in some form of recompense or better results.

Financial recompense is an important component of the reward system, but there are other factors that prompt employees to be motivated and influence their performance. In fact, several studies have reported that financial forms are not always the ones to be most recommended.

To ensure an effective reward system that leads to the desired behavior, it is essential to consider carefully the advantages and strategies used and to ensure that the rewards are based on performance. Encouraging and rewarding performance should be a constant management activity, and not just an annual ritual of remuneration.

Reward systems, when properly set up, have proven to be an important tool for achieving organizational goals. It is essential to keep the plans simple in terms of following, measuring, understanding and managing them so as to increase the performance desired.

However, these programs are not always effectively defined and implemented. One important point emphasized in measurement systems is the psychological and social aspects. When the intention of the measure targeted on motivating people, they tend to change their behavior based on what is being observed and measured. This sees to it that the efforts of teams are directed only to the dimensions measured by the organization. And when these dimensions are not correctly identified, this leads to the problem of dysfunction.

In addition, the cost of measurement needs to be considered. The activities of identification, collection, analysis and dissemination of indicators can represent a high cost to the organization so that relevant indicators are, in fact, considered in the measurement system. There is a great challenge in analyzing the trade-off between: the relevance of the indicator collected, the cost associated with the entire cycle of measurement, the benefits it will bring to the process of organizational decision making and the increase in the performance of teams.

In order to further explore this strategy to improve organizational performance, this chapter provided a set of recommendations in the form of guidelines that can guide managers to define and implement a reward program in a software development organization. It also addressed the negative impacts that these programs can have on the productivity of teams when the programs are badly applied.

The definition of guidelines considered aspects related to the individual, such as, for example, issues related to motivational theories. Some recommendations were also put forward on how to minimize the impact of measurement for the purposes of motivation, i.e., that used to reward people and in relation to the changes in behavior of those involved throughout the measurement process. In addition, the recommendations encompassed factors associated with the correct definition of the teams' contracts of results, the care to be taken when comparing indicators between projects of different natures, the meaning of the

success of the project and the impact of the form of managing teams so as to identify and monitor relevant indicators. In parallel, on top of all these recommendations, the need was seen to set up an independent committee that may act when the reward program is being reevaluated by calibrating various parts of the reward program, since, sometimes, subjective analysis may be necessary, provided that certain precautions are observed.

The adoption of guidelines may be undertaken as whole or in parts. This decision can be taken, for example, in terms of the scope of the organization which it sets out to achieve (organizational process, sales processes, or processes relating to the conduct of a project). The relationships between the guidelines can be used to support this kind of decision.

Finally, like any set of guidelines, if the recommendations presented are adopted only in isolation, this does not guarantee an increase in the productivity of organizations, but the field analysis undertaken provides evidence that this is possible. Nevertheless, it is necessary that other strategies be considered for increasing productivity and that they be combined with this proposal. Moreover, it is essential that these guidelines are adapted to the culture of the organization and that it is possible to receive the support of senior management both when adopting them and to ensure they are used effectively.

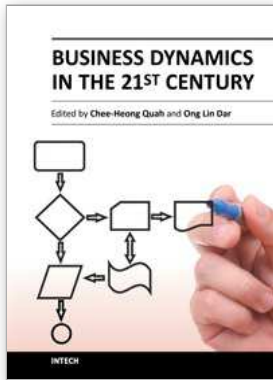
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In this 21st century of opportunity and turbulence, business firms need to equip themselves with new competencies that were never thought of before. For this reason, this book is timely as it introduces new insights into new problems in the aspects of performance and quality improvement, networking and logistics in the interconnected world, as well as developments in monetary and financial environment surrounding private enterprises today. Readers shall find that reading this book is an enlightening and pleasant experience, as the discussions are delivered in a clear, straightforward, and "no-frills" manner - suitable to academics and practitioners. If desired, the book can serve as an additional piece of reference for teaching and research in business and economics.

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