THE INTERACTIVE GOAL PANEL: A METHODOLOGY FOR ALIGNING R&D ACTIVITIES WITH CORPORATE STRATEGY

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Abstract

This paper presents a goal-centered, participative approach for the development of R&D metrics that reflect the strategic goals of the company, helping to align the R&D efforts with corporate strategy. The approach combines two popular methods: the Balanced Scorecard from strategic management, and the Goal Question Metric paradigm from software engineering. The approach uses the Balanced Scorecard as a framework for aligning the goals to corporate strategy. GQM is applied to each perspective, defining the goals, and deriving the associated questions and metrics. Benefits of the approach are that we get a balanced set of metrics, which is linked to corporate strategic goals, making strategy visible at multiple organizational levels. The participative nature of the approach increases commitment, and enhances organizational learning. The paper concludes with our first experiences in applying this approach to the product development organizations of several Finnish companies.

I. Background

A. Motivation

Many companies still face serious problems when trying to implement R&D metrics despite the fact that the application of process management and metrics to the R&D process has become quite common (Werner and Souder 1997; Adler et al. 1996; Wheelwright and Clark 1992; Cooper 1993). It is generally accepted that R&D metrics have to be tailored to the needs of the organization; there seems to be less agreement on how to achieve that. Several contingency factors that affect the development of R&D metrics have been identified, and partly validated. Examples include external contingency factors such as market predictability, the nature of the competition, and the number of product markets; and internal factors, such as organizational size and structure (Kerssens-van Drongelen and Cook 1997).

Measurement is a basic building block of process management. It can be used to drive behavior, behavioral change, it can be used to support prioritization, and it enables a company to compare and track progress, i.e., make the process visible.

There are several problems when developing R&D metrics; two of the more fundamental ones include knowing what to measure and getting buy-in from the organization. One solution to the first problem is to use a goal-oriented top-down approach to metrics development (Basili, Caldiera and Rombach 1994). The second one can be solved by having the R&D staff participate in the development of the measurement system.

In addition to the problems above, both R&D efforts and process improvement initiatives are sometimes weakly, if at all, linked to the strategy of the company. In practice this means money and resources put into less than optimal use. In our opinion, a good R&D measurement system should be explicitly linked to corporate strategy, and cover normal R&D efforts as well as improvement initiatives.

We feel that an approach that links R&D activities to corporate strategy, makes strategy visible, increases transparency of the process, and gets buy-in from the R&D department is called for. Creating such an approach is by no means easy, and we do not claim to have solved all problems; however, some basic building blocks that can be used do exist. In this paper we present a goal-centered, participative approach for the development of R&D metrics that combines two popular methods: the Balanced Scorecard from strategic management, and the Goal Question Metric paradigm from software engineering.

The remainder of the paper is structured as follows: the rest of section I presents background on the Balanced Scorecard, the Goal Question Metric
approach and participative management. Section II presents a framework for product development controllability, and the Interactive Goal Panel (IGP). Section III discusses how to apply the IGP, and section IV our first experiences in using it in the product development organizations of five Finnish companies. Section V contains our conclusions and ideas for future research.

B. The Balanced Scorecard

The Balanced Scorecard (Kaplan and Norton 1992; 1993; 1996a; 1996b) is a method for strategic management that makes measurement an essential part of implementing the company strategy. The scorecard balances traditional financial measures with operational ones, and makes the company strategy visible at all organizational levels.

The Balanced Scorecard (BSC) has four perspectives for strategic objectives: the financial perspective, the customer perspective, the internal business process perspective, and the innovation and learning perspective (Fig. 1). The financial objectives represent the long-term strategic theme of the organization. The objectives in other perspectives should be linked to one or more financial objectives. For each objective in the four perspectives, one or more metrics can be chosen.

![Fig 1. The Balanced Scorecard (Kaplan and Norton 1992; 1996a; 1996b).](image)

The ultimate goal of the BSC is to align the activities of all the company’s employees to the strategy. When the strategy can be translated into a measurement system it is easier to execute the strategy because the objectives and targets can be communicated more efficiently. The top-level BSC can be translated into scorecards for the lower levels of the organization by breaking down the strategic objectives into lower-level objectives and measures. The scorecard allows all employees to see how they contribute to organizational success, focuses change efforts and helps create a shared understanding (Kaplan and Norton 1996b).

In the literature, Kaplan and Norton give some principles for selecting and designing the measures, but they do not present any systematic way for developing the right metrics for the different dimensions of the BSC. Core measures for each perspective that are used repeatedly on scorecards are presented, but since every strategy is unique, in addition to the core measures, several company specific measures should be selected. Besides this, no procedures for formulating the metrics for the objectives are presented.

In our opinion the BSC can be suitable as a basic framework for the development of R&D metrics. Other researchers seem to support this view (Kerssens-van Drongelen and Cook 1997).

C. The Goal Question Metric Approach

The Goal Question Metric (GQM) approach (Basili, Caldiera and Rombach 1994), widely used in the software engineering community, defines a framework and steps for deriving metrics that are related to explicitly formulated organizational goals.

According to the GQM, measurement should be focused on specific goals and applied to all products, processes and resources. The metrics should be interpreted based on a characterization and understanding of the organizational context, environment and goals. In order to achieve this, measurement has to be defined in a top-down fashion, since it is hard to choose which observable characteristics to measure, and how to interpret the values gained from measurement when using a bottom-up approach.

The GQM approach helps an organization construct a measurement system that targets a particular set of issues and a set of rules for the interpretation of the measurement data. The GQM model has three levels: the conceptual (goal), the operational (question), and the quantitative (metric) level.

At the conceptual level, goals are defined. For each goal we associate a reason which motivates its existence, an object that it is related to, a point of view and an environment. For each goal, a set of questions is used to characterize the object of measurement with respect to a selected issue. Based on the questions, metrics that answer the questions in a
quantitative way are defined. The data can be either subjective or objective.

The resulting GQM model has a hierarchical structure, with a goal at the top, which is refined into several questions that in turn are refined into metrics. The same metric can be used to answer different questions under the same goal. GQM models can also have questions and metrics in common.

Although GQM is conceptually simple, its application is not. The concepts are at a high level of abstraction, and the approach has been criticized for producing metrics that are unpractical to implement. In order to ease the implementation, practical guidelines for its application have been developed (Briand, Differding and Rombach 1996).

We feel that the GQM approach is a good complement to the BSC, as it gives us a methodology for formulating the goals in the different dimensions, and for deriving metrics that are based on those goals.

D. Participative Management

Two fundamentally different approaches to management are presented in the literature: the control-oriented approach and the involvement-oriented approach.

The control-oriented approach is based on the assumption that control and hierarchy make working manners productive and of high quality. This approach is referred to as the hierarchical, mechanistic and bureaucratic approach to management. The involvement-oriented approach, on the other hand, relies more on self-control and self-management. In this approach, employees on all organization levels are given power to influence decisions. The key assumption is that if individuals are given challenging work, they can and will control their own behavior. (Lawler 1992)

In general, the involvement-oriented approach is said to produce superior results. The exceptions are largely situations in which the organization produces relatively simple products or services and faces a relatively stable competitive environment (Lawler 1992). Sometimes the best outcomes may be achieved by combining the two approaches.

There are several advantages to involvement-oriented or participative management. One of the most important advantages is that a procedurally fair decision process is usually associated with increased commitment to the decisions made. In addition, participation in decision-making increases motivation, comprehension and satisfaction. There is also less resistance against new methods. (Korine 1995; Lawler 1992)

It has to be emphasized that the advantages of participative management mentioned above may not always be obtained. This may occur, for example, if people feel that their opinion has been disregarded in the decision-making process (Greenberg and Folger 1983).

We believe that it is essential to use participative methods when developing R&D metrics in order to get the organization committed to the effort.

II. The Interactive Goal Panel

This section presents the Interactive Goal Panel and its underlying framework. The IGP is a matrix visualization of a framework of controllability developed in cooperation with five Finnish companies during a research project aiming at improving the controllability of product development.

The framework takes a broad view of control: it is defined as “any kind of goal-directed influence” (Kerssens-van Drongelen and Cook 1997) and combines the structural, or measurement, and the behavioral approaches to control (Ansari 1977). The structural approach can be seen through the use of goals and metrics. From the behavioral approach, we have adopted the notion of control mechanisms, i.e. mechanisms that you use in order to make people work towards the goals of the organization. Measurement is a basic and very effective control mechanism that has a double role: on the one hand to tell us where we are, and where we are going, on the other hand to influence people to work towards our common goals.

The framework expresses controllability in terms of four levels and four aspects (Fig 2). The levels are strategic, process, project and individual. At each level, the same aspects are considered: objects of control, goals, metrics and mechanisms. The aspects at different levels should be interrelated: the corporate strategy should be communicated from the strategic level, through the process and project levels, down to the individual level.

The following sections briefly describe the aspects and levels in the framework.

A. Aspects of control

The objects of control identify what should be controlled. The objects should be organizationally identifiable entities that each have an owner, who is responsible for controlling them. Examples of objects of control include “business unit X” at the strategic level, “product development process A” at the proc-
For each object of control, quantitatively or qualitatively measurable goals should be set. Each of the dimensions in the BSC should be considered. The goals are formulated according to the GQM approach.

For each goal, metrics are derived using GQM, resulting in a goal-question-metric network. Related to each goal (or set of goals), one or several control mechanisms should be identified. The mechanisms identify the specific actions that the company intends to take in order to reach the goals. This also implies that there is a cost to control; you can get better control by using more mechanisms, but at an additional cost. Examples of control mechanisms include product roadmaps, process models, metrics, training, schedules and budgets.

B. Levels of control
At the strategic level, the organization-wide aspects of control should be defined. Strategic issues are those that receive senior management’s attention. These issues are typically characterized by their long-term influence on the organization. At this level we are interested in how to control the R&D efforts of the whole company or a strategic business unit.

At the process level we deal with issues that are below the strategic level, and above the level of the individual project. Examples include process management and metrics, management of the multi-project environment, and organizational learning. At this level, each process is an object of control, and the goals should be related to a particular process. The goals at this level are often related to process improvement or the installation of new processes. This level deals with how to control the processes in R&D.

The project level contains the controllability aspects that concern individual product development projects. At this level, each project is an object of control. In an ideal case, each project would be an instance of a process that exists on the process level. This means, e.g. that the project inherits some goals and metrics directly from the process that it follows, and adds goals of its own, such as target requirements, schedule and budget.

The individual level consists of the individuals performing the work. At this level we deal with issues such as individual performance, competence development and motivation. In our opinion, a good control system should support the idea of empowerment and self-control, and not implement control in its strict sense, i.e. we should be more interested in how to help the individual control him or herself than how we can control him or her.

The different levels of the framework should be interrelated: the goals defined at a higher level should be broken down into sub-goals for the lower levels. The metrics between the levels are also often interrelated; metrics at a higher level are aggregated from those at lower ones. Control mechanisms at higher levels often end up in the form of goals at lower levels. The vertical links in Fig. 2 show this.

III. Using the IGP
This section presents the basic steps for implementing and using the IGP in R&D organizations. There are two main phases: the implementation of the framework, and the actual usage of it as one of the company’s control systems.

A. The Implementation Phase
We have identified and used the following eight steps in the implementation phase of the IGP:

Step 1. Management contracting. The support and commitment of senior management are sought for, as this is critical to the success of the effort. The scope of and basic schedule for the effort is decided upon.

Step 2. Informing the organization. Information about the framework and the implementation of the IGP is given, and the schedule of the implementation is fixed.

Step 3. Analysis of the current state. The objects, goals and performance measures already in use in the organization are identified and analyzed. It is also important to know how the strategy has been communicated in the organization.

Step 4. Initial goal-setting. The four levels of the IGP are formulated separately. At each level,
the process begins with the identification of the objects of control. Then, for each object, the goals and mechanisms to achieve those goals, are formulated. All levels can be done in parallel and independently of each other.

The objects, mechanisms and goals for the dimensions of the BSC are defined by interviewing representatives at different levels in the company. At the strategic level, senior management, product development managers, and financial managers are interviewed. At the process and project levels, process owners and R&D project managers are interviewed. At the fourth level, all employees in the R&D organization, e.g. designers, engineers, and technicians, give their contribution and ideas for goals. In small organizations, the same person might represent several levels.

Step 5. Goal harmonization. After all the levels in the IGP have been formulated separately, the strategic control aspects are presented to the rest of the organization and analyzed in workshops. The objective of the workshops is to harmonize and gain consensus on the goals to strive for and the control mechanisms to use. This step is very important; based on our experience from several R&D organizations, the strategic goals are not necessarily clearly communicated to lower levels of the organization. The workshops also support emergent strategy, as lower level goals might be found to be strategically important.

Step 6. Prioritization. In this step, the goals are prioritized. Some goals may be more critical to the success of the company than others, and the critical goals may be weighted more than the less important ones.

Step 7. Metrics development. The metrics are derived from the goals by using the GQM approach at each level of the IGP.

Step 8. Creation of a control plan. A control plan is formulated, documenting all aspects and levels of the framework. It also includes practical issues normally found in measurement plans, such as the definition of data to collect, the identification of persons responsible for the metrics, and information on visualization and distribution of the metrics data.

In practice, the implementation process is seldom as straightforward as described above; iteration is often needed. New ideas for goals and mechanisms may arise during the process, and these have to be considered. Often, in order to gain consensus on the goals (step 5), several meetings are needed.

B. The Usage Phase

After development, the IGP should be taken into daily use, and become one of the normal control systems of the organization. It should be a system that is used to communicate strategy and progress, i.e. an interactive lever of control (Simons 1995).

The IGP should be periodically updated, in the same sense as other control systems. Different levels of the IGP can have different update cycles. E.g. the strategic level could be updated annually, and the project level each time a new project starts. In some industries, the strategic level might be unstable, and change more often than lower levels (Brown and Eisenhardt 1998). The framework does support this, especially if supported by information technology.

IV. Industrial Experiences with the IGP

This section describes our first experiences with taking the IGP into use in five Finnish organizations.

Based on our experiences, we believe that the framework offers a systematic way for developing a control system for R&D that reflects the strategic goals of the company. By using the dimensions of the Balanced Scorecard, the framework gives ideas for perspectives to choose goals from, and GQM provides us with a systematic way for deriving metrics based on the goals.

The IGP is a visual tool with which it is easy to describe how the aspects and levels of control are linked to each other. It is also a good roadmap for the comprehensive implementation of the framework.

If senior management does not have a clear view of the company’s strategy, defining the strategic goals is slow and problematic. Also, the strategy may change during the goal definition process, and the goals have to be reformulated.

We have found the participation and commitment of senior management to be very essential for successful implementation of the IGP. When senior management supervises the progress of the implementation and usage of the IGP, the importance and credibility of the work increases in the eyes of individual R&D workers.

Using a participative approach when setting goals and developing metrics is time consuming; it may take several months to formulate a feasible set of performance metrics. At this stage, it is too early to say how much the participative approach we have taken has increased commitment to the controllabil-
itity improvement efforts in the organizations. The positive effects of participation we have experienced so far are that the negative attitudes towards performance measurement have turned into more positive ones, and that the motivation to improve performance in the R&D functions has increased.

We have also found implementing the IGP as a paper exercise to be cumbersome. We feel that supporting the IGP with modern information technology would greatly enhance its usability. Uses for IT include aiding with the definition of the controllability parameters, helping with data collection, and analyzing as well as visualizing the data. We have developed a visualization tool based on Java-technology that supports on-line visualization of the IGP and metrics over an intra- or internet.

V. Conclusions and Future Research

We have presented a participative approach for defining a measurement system for R&D. The benefit of the approach is that we get a balanced set of metrics, which is linked to corporate strategic goals, making strategy visible at multiple organizational levels. The participative nature of the approach increases commitment, and enhances organizational learning.

We are currently finishing the implementation phase in the companies, and moving into the usage phase. Future work includes building tools supporting the methodology and defining the usage phase in detail. We are also planning to look at the relationship between goals, metrics and mechanisms, and to see if we can find emerging patterns, “control scenarios”, based on industrial experiences. This would make it possible, e.g., to automatically suggest metrics and mechanisms based on the organization’s needs.

References


