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Controlling innovative projects with moral hazard and asymmetric information

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ABSTRACT

We study optimal incentive contracts offered to a research and development (R&D) manager, who can propose an innovative project and is in charge of conducting this project. The manager has private information about the project profitability and he exerts unobservable levels of different kinds of effort in order to increase the feasibility of successfully completing the project in terms of meeting product specifications. In particular, we analyze a situation, in which two interrelated performance measures on different hierarchical levels are available for contracting purposes. We show how asymmetric information about the project and further characteristics of the project influence the weights of the performance measures. We also make a number of empirical predictions about the composition of compensation contracts for R&D managers.

1. Introduction

In this paper, we study optimal incentive contracts offered to a research and development (R&D) manager, who can propose an innovative project and is in charge of conducting this project. The manager has private information about the project profitability and she exerts an unobservable level of effort in order to increase the feasibility of successfully completing the project in terms of meeting product specifications. In particular, we analyze a situation, in which two interrelated performance measures on different hierarchical levels are available for contracting purposes. These hierarchically related performance measures are a central element of concepts, such as the balanced scorecard and indicate that each measure's outcome affects the result of lower level measures.[2] Our intention is to examine the influence of both, pre-contractual private information and the sensitivities between the interrelated performance measures on the design of an optimal incentive contract.

Compensating product development managers indicates particular challenges because each project is unique, goals are hard to specify ex ante, and uncertainties get resolved as the project progresses.[3] This has at least three contracting implications. First, the available financial performance measures on the firm level do not completely reflect the project manager's contribution to the firm's total value. As a consequence, contractible performance measures at the project level, such as milestones, serve as an indicator for the company's long-term success. Second, product development performance is multi-dimensional. It includes unique tasks with a high degree of creativity as well as repetitive tasks, such as testing or using knowledge that has already been developed. Using dif-

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[2] See Kaplan and Norton (1992).
[3] See Dosi (1988).

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ferent performance measures in compensation contracts affects these multi-dimensional tasks in different ways and the overall effect is not clear. Third, R&D managers frequently have superior information regarding the profitability of a specific development project; however, their activities are not observable. In this paper, we determine the consequences of these contracting implications in order to design a variable compensation system that focuses on causal links between intermediate performance measures (e.g., time and cost figures) and the overall firm performance.

Managing innovative projects in unusual and unknown environments is a critical function in all technology driven companies. For different types of projects, different tasks must be fulfilled and different performance indicators are used. For example, in the software industry, research and breakthrough innovations (such as the development of a platform technology) are managed in a more output oriented manner by using performance indicators that describe the solution and its functionality for separated parts of the software. The measurement is done with function points[4] and creativity is needed to achieve the objectives. In comparison, the management of innovative projects that are based on existing solutions (such as the development of the next version of an Enterprise Resource Planning system) is more input-oriented, using specific performance indicators that limit resources in time and financial budget. As such, the innovative process is more restrictive as compared to software development projects with unpredictable circumstances and interrelations. In order to define the resources allocated to routine-type projects, each development step is evaluated and assigned to different workplans.

Our analysis provides the optimal incentive contract: when the R&D manager accomplishes two different tasks, a routine job and a creative job. Both tasks are important for the success of an innovative project. While creativity alone frequently leads to overengineered products that are too costly, with routine alone innovative solutions that address the customers' needs cannot be found. We assume that the managerial effort in the routine job immediately contributes to a short-term efficiency objective (e.g., a specific time or cost objective). For example, accomplishing a development project within a defined time-frame usually involves standardized project management activities. The importance of creativity for projects being on time is lower. In contrast, creative effort contributes directly to the project's overall profit. For example, there is no standardized way to meet all product specifications during the development project. Creativity is necessary in order to develop a product that fulfills all specified functions. While creativity is important for improving the project's profit, efficiency objectives also play an important role in the project's profitability. Being on time frequently improves the profitability. Hence, the effort in the routine job also has an impact on the profit. Finally, the project's profit contributes to the firm's market value. While the profit of R&D projects is difficult to measure, listed companies can use the firm's market value as a performance measure. Hence, there are at least two kinds of performance measures, efficiency objectives and the firm's market value, available for contracting purposes. We believe that this three-tier hierarchical structure with the efficiency objective, the project's profit, and the firm's market value as well as our distinction between creative and routine effort is quite descriptive for many R&D projects. Moreover, we make the realistic assumption that the R&D manager is better informed about the profitability of the project than is headquarters. Hence, the manager has an incentive to understate the profitability of the project in order to lower his costly effort. The optimal contract must take into account the managerial private information.

The solution to our optimal contracting model shows that (i) efficiency objectives and the firm's market value should be used for performance evaluation of R&D managers, (ii) incentives on the basis of the firm's market value are stronger for more profitable projects than for less profitable projects, and (iii) incentives on the basis of efficiency objectives are stronger for less profitable projects than for more profitable ones. The reason for the latter counterintuitive result is that strong incentives on the basis of the firm's market value place too much risk on the project manager, in particular, for executing his routine job. These strong incentives are softened by reducing incentives for efficiency objectives that directly affect the effort in the routine job.

Our model makes some new and interesting empirical predictions about the design of incentive contracts for R&D managers. For example, incentives based on the firm's market value should be expected to be stronger in environments, where the information asymmetry tends to be weak. These conditions are more likely in small firms than in large multi-divisional firms. Thus, R&D managers in small firms will receive more performance-based compensation, based on the firm's market value. Simultaneously, these managers in small firms will receive less performance-based compensation based on efficiency objectives than will their counterparts in large firms. A different empirical prediction can be obtained by considering the degree of information asymmetry. R&D projects in highly dynamic markets are likely to exhibit a high degree of information asymmetry. Empirical evidence suggests that using short-term economic measures to motivate product development managers is more likely to succeed for development projects that focus on highly dynamic markets with short product life cycles.[5]

In Section 2, we provide a brief literature review. Section 3 describes the multi-task agency model with interrelated performance measures. In Section 4, we provide two different benchmark solutions. The model is analyzed in Section 5, and comparative statics is provided in Section 6. Section 7 concludes.

[4] Function points measure functionality by objectively measuring functional requirements. Function points quantify and document assumptions in software development.

[5] See Harhoff and Reitzig (2001, p. 520).