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Nonfinancial performance measures, externalities and target setting: A comparative case study of resolutions through planning

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ABSTRACT

This paper presents an analysis of the resolution of organisational externalities through the use of nonfinancial performance measures for planning. Using a comparative case study, this paper illustrates how centralised controllers' choice of nonfinancial performance measures and target setting in two companies provides critical information to decentralised agents regarding how to balance their performance with the performance of other decentralised agents in their organisation. This work complements current management accounting research in that it focuses on the role of nonfinancial performance measures with respect to the design of performance plans for decentralised agents that can be used to internalise externalities. To date, discussions of externalities in management accounting research have primarily focused on how performance measurements can be used as a price mechanism to provide decentralised agents with incentives to internalise externalities. In addition, this case study illustrates some of the difficulties related to acquiring general knowledge about the externalities of nonfinancial performance measures and, therefore, about whether specific nonfinancial performance measures are appropriate for a particular type of organisation.

1. Introduction

Externalities and their implications have been discussed in management accounting research for decades (Solomons, 1965; Merchant, 1989; Kaplan and Atkinson, 1998). Various methods to resolve externalities, including cost allocations (Zimmerman, 1979; Merchant and Shields, 1993; Zimmerman, 2006), the aggregation of performance measures (Bushman et al., 1995; Keating, 1996), composite performance measures (Dent, 1987; Bouwens and Van Lent, 2007; Baiman and Baldenius, 2008) and subjective performance measures (Gibbs et al., 2004), have been observed in practice and discussed in theory. All are design initiatives used in performance measurement systems to internalise the external effects that one organisational entity may have on another.

Regarding the discussion of nonfinancial performance measures and externalities, the focus in management accounting research has primarily been on how nonfinancial performance measures can be used to measure externalities, make agents responsible for externalities, and provide incentives for the internalisation of externalities (Bouwens and Van Lent, 2007; Baiman and Baldenius, 2008). This paper, in contrast, addresses externalities that nonfinancial performance itself causes and analyses how the value of the measured nonfinancial performance is affected by the externalities that it causes. The paper aims to illustrate the possibility of resolving externalities through centralised performance planning as well as to explain how performance targets provide agents with essential information on how to balance their own performance with the performance of other agents in the organisation.

An externality is a cost or benefit that arises when the actions of one party affect the utility or production possi-

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bilities of another party (Brickley et al., 2004). Regardless of whether the context is a market system or a hierarchy, externalities create inefficiencies in economic systems. This is because the decision maker is not fully accountable for all the costs and benefits associated with his or her choices. With respect to performance measurement design, the notion of an externality is useful because it addresses the effect that performance along one dimension may have on the costs and benefits of another organisational entity (employee, team, department, division and so on). These external costs and benefits have a significant effect on the value of the measured dimension of performance from a firm-wide perspective and thereby also on what an appropriate target would be for the performance measure.

Two general approaches to coordination distinguish between the different ways in which management accounting systems can internalise externalities, namely, the price-based system and the planning of quantities system (Milgrom and Roberts, 1992, p. 94). The former relies on the accounting system to provide the employee with the incentives to make the right decisions (regulation by the 'invisible hand'). The latter specifies and communicates a plan for the employee to make the right decision (regulation by 'the visible hand'). In management accounting research, the internalisation of externalities has been discussed through price-based approaches, according to which aggregated measures, cost allocations, composite measures, and subjective measures account for external effects in the performance evaluation of the individual and hence provide the individual with the incentives to internalise externalities in his or her decision-making. This paper, however, illustrates how nonfinancial performance measures also play a coordinative role simply by providing employees and managers with information about how to perform to internalise externalities when the measures are elements in performance planning systems.

The first part of this paper uses a simple microeconomic model to illustrate the planning problem and to analyse how a firm's optimal level for a given dimension of nonfinancial performance is affected by externalities. In addition, the ways in which economic relationships encourage adjustments in performance targets as a way of internalising positive or negative externalities is considered. Two propositions are derived regarding how externalities resulting from nonfinancial performance measures can be resolved through nonfinancial performance planning. The second part of this paper illustrates the relevance of the propositions using a comparative case study. The case study contains externalities at two different companies with respect to the same three nonfinancial performance measures. Both companies develop, produce, and sell measurement technology and are similar in terms of strategy and a wide range of other context variables. The similarities between the two organisations under analysis offer an opportunity to illustrate the contingent nature of externalities in addition to the relevance of the propositions. In both companies, externalities were resolved by adjusting performance targets set by central planners. Negative externalities also meant that some dimensions of nonfinancial performance were eliminated from the performance measurement system.

This paper contributes to existing research by analysing how performance planning by centralised controllers plays an important role in reducing problems with externalities and myopia. This analysis supplements discussions in the management accounting literature in which the resolutions of externalities have primarily been portrayed as a matter of providing employees and managers with the right incentives. This paper illustrates that sometimes the provision of information (through performance planning) may serve as the sole intervention. In this context, performance targets play an essential role and target setting relies on an analysis of how some dimensions of performance influences other dimensions of performance that subsequently affect firm value.

The reminder of the paper is structured as follows. Section 2 contains a conceptualisation of the economics of nonfinancial performance and externalities, which is the basis for outlining two propositions concerning how the planning of nonfinancial performance can resolve externalities. Section 3 introduces the comparative case study. Section 4 presents an analysis of the externalities associated with three nonfinancial performance measures and their effect on the design of performance measurement systems. Section 5 presents a summary and discussion regarding the case study findings as well as a reflection on the contingent nature of nonfinancial performance externalities and the value of nonfinancial performance measures in organisations. The paper ends with concluding remarks in Section 6.

2. Nonfinancial performance measures, externalities, and value creation

In this section, the problem of nonfinancial performance externalities is conceptualised, and the use of planning and target setting as methods for resolving externalities is explored. The section begins by illustrating how nonfinancial performance externalities are created due to interdependencies among organisational tasks. Second, the different ways in which management accounting systems may resolve externalities are briefly outlined, with planning as one example. Third, the economics of externalities are conceptualised and the ways in which optimal levels of nonfinancial performance can be determined with respect to externalities are discussed. The section ends with an outline of two propositions that suggest how externalities might be resolved through adjustments in nonfinancial performance targets.

2.1. Externalities and interdependencies among tasks

The notion of externalities is generally used to explain market failures in welfare economic theory; that is, "externalities are positive or negative effects that one economic agent's action have on another's welfare that are not regulated" (Milgrom and Roberts, 1992, p. 75). However, the notion of externalities may also be used to identify and characterise inefficiencies within a firm. There has been a long tradition in the management accounting literature of using this concept to specify the effect of one division's performance on another division's performance (Solomons,

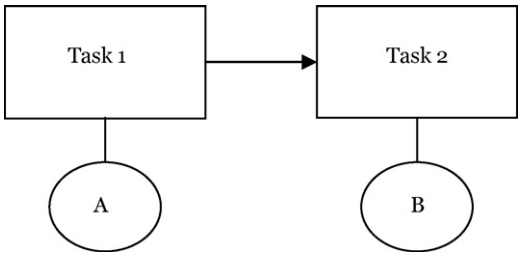

Fig. 1. Interdependence between tasks 1 and 2.

1965; Merchant, 1989; Kaplan and Atkinson, 1998). However, this notion may be used at any level of organisation in firms to specify the costs or benefits that any unregulated decisions made by any organisational entity may have on another entity such as an employee, team, functional department, or division (e.g. Roberts, 2004; Brickley et al., 2004). In this paper, an *externality* is defined as "the effect that the performance of one employee's, group's, or division's organisational task has on the performance of another employee's, group's, or division's task". From an internal control point of view, the challenge is to internalise the externality so that the external effect is taken into account by the affecting party when decisions about performance are made.

2.1.1. Different types of interdependencies

Consider two tasks, task 1 and task 2. Each is performed by a different employee, team, group, or division, that is, A or B. If A's performance of task 1 affects B's production possibilities for task 2 in a way that is not regulated by the internal control system, then an externality exists. In this case, task 1 is the affecting task, and task 2 is the affected task (see Fig. 1).

Externalities are caused by interdependencies between tasks or activities.[1] Scott (1992) defines *interdependence* as "the extent to which items or elements upon which work is performed or the work processes themselves are interrelated so that changes in the state of one element affect the state of the others" (Scott, 1992, p. 230). Interdependencies imply that the production possibilities of the affected task or activity may be influenced in either a positive or negative way. If the improved performance of one task has a positive effect on the performance of the other task, the externality is positive (i.e., a synergy or complement). On the contrary, if the improved performance of one task reduces the performance of another, the externality is negative (i.e., a trade-off or substitution).

The interdependence of the tasks giving rise to an externality may be caused by the fact that the affecting tasks have an effect on the input, process, or output of the affected task, thereby influencing production possibilities. These different connection points can be illustrated through various examples from the literature. For example, Kaplan and Atkinson (1998) describe an input effect in which the output of one department affects the input of another department. Suppose the reduced quality of an intermediate product delivered by department A to department B has a significant effect on the costs in department B due to the rework or scrap that the reduced quality causes. Department A creates negative externalities whenever the quality level of the intermediate product (or input) is too low for department B (Kaplan and Atkinson, 1998). Zimmerman (2006) provides another example of how externalities arise when a task in one department affects the *output* of another task in another department. He describes how the hiring of sales personnel in the sales department affects the output of the Human Resource (HR) department. Whenever an additional sales person is hired, the HR department faces additional administrative work. The HR department's service or output concerning the rest of the organisation temporarily decreases, as the administrative activities related to the new hire have the highest priority (Zimmerman, 2006). Another example illustrating how the affecting task may impact *the process* of the affected task can be seen by studying development engineers. In this case, the design of new products will affect their manufacturability (see for example Ulrich and Eppinger, 2000). For instance, if development engineers design products with an extraordinarily high number of components, then the manufacturing processes of the products are likely to be more complex and have longer durations. Thus, an organisational entity may create an external effect on another entity by affecting *what* the other entity does (output), *how* the other entity does it (process), and *with what* the other entity does it (input). These relationships are illustrated in Fig. 2 below.

Furthermore, externalities can refer to horizontal as well as vertical interdependencies between tasks. Thus, an externality may refer to an interdependency among tasks at different levels in the hierarchy or tasks linked laterally. This paper focuses on externalities that relate to horizontal interdependencies. However, many of the principles discussed here also apply to vertical interdependencies.

2.2. Resolutions of externalities

Externality resolutions have been discussed as long as externalities have been described. In management accounting research, one approach has been to include the external effects in the performance measures used for evaluating and compensating agents (Kaplan and Atkinson, 1998; Zimmerman, 2006). The idea is to design a performance measurement system so that a negative external effect created by an agent affects the performance evaluation and compensation of the agent in a negative direction. Similarly, a positive external effect is designed to have a positive impact. This implies that an agent pays a price for creating a negative external effect or receives a reward for a positive external effect. The agent will internalise the external effect in his or her decision-making if the agent seeks to maximise his or her payoff. How much the agent

[1] Interdependence is a precondition for an externality. However, interdependence among tasks is not necessarily an externality. Thompson, for instance, distinguishes between three different forms of interdependence, namely, pooled, sequential, and reciprocal (Thompson, 1967). Pooled interdependence represents a situation in which the same resource pool performs two tasks. A situation with pooled interdependence cannot cause an externality problem because an externality is caused when two resource pools affect each other.

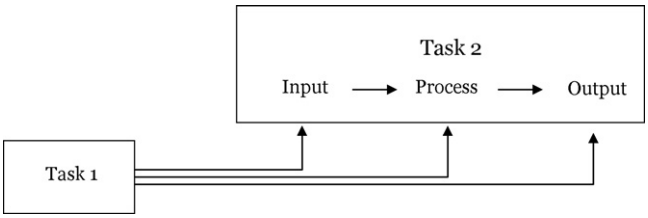

Fig. 2. Different connection points for interrelations between tasks 1 and 2.

will reduce (or increase) the creation of external effects depends on the price the agent pays (or the reward he or she receives) for the external effect and how these costs (or benefits) relate to the payoff the agent receives from performing along the dimension that produces the externalities. Thus, the agent is left to evaluate his or her own actions. Nevertheless, the punishment or reward of the externality is the key to aligning the interests of the agent and owner of the firm and internalising the externality.

Such an indirect way of coordinating actions is often referred to as a price-based coordination system (Milgrom and Roberts, 1992, p. 94). In a price-based system, the firm attempts to guide an agent's decisions via price signals, thereby counting on the agent to respond by picking the appropriate level of performance (coordination by an 'invisible hand'). An alternative to this form of coordination is the system of quantity planning (Milgrom and Roberts, 1992, p. 94), whereby the central coordinator simply specifies the agent's performance level (coordination by a 'visible hand').

Management accounting research has focused on price-based resolutions in which performance measurement system design is used to provide the incentives to internalise externalities. Quantity planning through performance measurement systems has not received much attention in the area of internalising externalities. The following paragraphs contain an outline of these two approaches.

2.2.1. Internalising externalities by adjusting performance evaluation and compensation

Externalities can be internalised in the affecting entity's performance records by the use of a wide range of management accounting techniques (cost allocations, aggregated performance measures, nonfinancial measures and subjective measures). These techniques can be used to punish or reward agents for their externalities, thereby providing incentives. The rationale behind the use of each technique is briefly outlined below.

- Cost allocation is often referred to as a means of taxing negative externalities. For instance, in reference to Cooper and Turney (1988), Kaplan and Atkinson (1998) describe how a single cost driver, such as the number of parts, might be used to tax complex product design and encourage engineers to focus their attention on reducing the number of parts and subsequently prevent negative effects on purchasing and manufacturing. The number of parts then becomes a price signal that an agent can take into account when deciding how many new part numbers to include in a new product design.[2] Another type of cost allocation that can be used for internalising externalities is *non-insulated* cost allocation (e.g. Zimmerman, 2006). In a non-insulated cost allocation scheme for two divisions, the allocation of corporate-sustaining overhead costs to one division depends on the operating performance of the other division and vice versa. This provides incentives to cooperate. Each division takes into account its effects on the other in its decision making, since the affecting division is punished by an increased share of overhead if it reduces the operating performance of the other division.
- Another way to internalise externalities is simply to increase the aggregation level of the agent's performance measure. For example, division manager performance could be measured according to firm accounting metrics rather than division accounting metrics (Bushman et al., 1995; Keating, 1996). Aggregating the agent's performance measure implies that the agent will pay for (or benefit from) his or her negative (or positive) externalities to the extent that the external party's performance is included in the aggregated performance measure.[3]
- Furthermore, a nonfinancial performance measure that captures an externality either by measuring the performance that caused the externality or by measuring the performance of the external party affected is also a way to internalise externalities. An example could be the number of parts that development engineers use in their new product design. In this case, an increase in the number of parts will negatively affect the development engineer's performance evaluation and compensation. This is not because costs are allocated to the financial performance evaluation of the agent as discussed above but rather because the additional nonfinancial measure is weighted in the composite measure of the agent's performance (Ridgway, 1956). Thus, the price the agent pays for the externality is the negative impact on his or her perfor-

[2] It is of course a challenge to set the overhead rate (that is, the price of the externality) correctly. Zimmerman (1979), for example, illustrates some of the conditions for and effects of the overhead rates underestimation or overestimation of externality costs and to what extent the firm will benefit from an overhead allocation in these cases.

[3] However, this incurs other costs: it exposes division managers to additional compensation risk because the agent becomes dependent on the performance of other agents as well. Furthermore, the sensitivity of the performance measure for the agent decreases when the performance measure's aggregation level increases (Banker and Datar, 1989). This is one of the reasons why adding nonfinancial performance measures to the division managers' performance measure to create a composite performance measure has been suggested (Baiman and Baldenius, 2008).

mance evaluation and compensation.[4] When it comes to adding additional measures, another idea is to include non-insulated performance measures that account for the external party's affected performance. For instance, one could include reduced customer satisfaction or sales for the affected party. Recent empirical and analytical research has emphasised the role of nonfinancial performance measures as a means of providing incentives for cooperation between agents and mitigating externalities (Bouwens and Van Lent, 2007; Baiman and Baldenius, 2008).[5]

- Finally, the use of subjective measures is yet another alternative for resolving externality issues; for instance, upper managers may evaluate the abilities of lower managers to internalise externalities subjectively. Research has emphasised the role of subjective measures for making measures more complete and able to account for interdependencies among organisational tasks (Baker et al., 1994; Gibbs et al., 2004; Moers, 2005).

2.2.2. Internalising externalities through planning

Planning is yet another mechanism that can be used for internalising externalities that stands in contrast to the priced-based mechanism described above (Milgrom and Roberts, 1992). In this case, the central planner simply specifies the appropriate performance level when taking externalities into account. The role of nonfinancial performance measures in planning is straightforward because the performance target can be used to communicate the planned level of performance in operational terms. However, in order for the planner to specify the appropriate level of performance for a nonfinancial performance measure that incurs externalities, the marginal costs and benefits of the nonfinancial performance must be known. The microeconomic relationships that lead to the specification of the appropriate level of performance are briefly outlined in the next section.

2.3. Benefits and costs of measured performance and externalities—understanding value creation related to nonfinancial performance measures

In this paper, the value of a nonfinancial performance measure is conceptualised by the benefits received by the firm from the measured performance and the firm's costs of obtaining it.[6] If x is the measured nonfinancial performance, $c(x)$ can be defined as the cost of attaining the measured nonfinancial performance for the firm, and $b(x)$ can be defined as the benefit of achieving the measured nonfinancial performance for the firm. The value created at a particular level of measured nonfinancial performance, x, can then be defined as $v(x) = b(x) - c(x)$.

This paper singles out one factor influencing the value of the measured nonfinancial performance, namely, externalities. The effect that an externality has on the value is considered a cost. This implies that positive externalities that create benefits for the firm will be defined as negative costs and thus serve as receipts for the firm.

The cost of an externality can be categorised as a transaction cost (Milgrom and Roberts, 1992; Roberts, 2004).[7] Other transaction costs caused by other coordination or motivational problems, like multi-tasking (Holmström and Milgrom, 1991), risk (Holmström, 1979), and manipulation (Jensen, 2003) issues, also affect the value of individual measures. However, these are not included in the present discussion. Nevertheless, the principles applied in analysing the costs of externalities are useful in analysing the consequences of other transaction costs as well.

To more clearly illustrate the distinctive meaning of the cost of externalities, another type of costs, namely, production costs, are included in the analysis below. Production costs are often included in discussions of the value of nonfinancial performance measures (Ittner and Larcker, 1998b; Jensen, 2002; Ittner and Larcker, 2003). Thus, the value of the performance measure can be expressed by the following equation: $v(x) = b(x) - c_p(x) - c_e(x)$, where $c_p(x)$ is the production cost, $c_e(x)$ is the cost of externalities caused by the measured performance, and $b(x)$ denotes the benefits of measured nonfinancial performance. $v(x)$ equals the value created for the firm at the level of measured nonfinancial performance, x.

2.3.1. Production costs

Production costs are the costs of the resources consumed to produce the measured nonfinancial performance, which include resources consumed to increase customer satisfaction or reduce throughput time such as man hours, investments in technology, and so on.[8] This paper follows

[4] The challenge is, as in the case with cost allocation, to determine the prices of the externality for the agent and that involves decisions about the weight of the additional measure in the composite performance measure. As in the case of cost allocation, underestimation or overestimation of the price of the externality is also possible in this case.

[5] However, earlier studies illustrate the role of composite measures for cooperation; for instance, Dent (1987) studied a company in which product development managers were held responsible for the sales revenues of the products they developed and sales managers were held responsible for the development costs of the products they sold.

[6] Value for the firm is presumed to be calculated at any specific time by discounting to present value the future cash flows that the firm is expected to generate (Ittner and Larcker, 2001; Merchant, 2006).

[7] Milgrom and Roberts define *transaction costs* as "the costs of running the system: the costs of coordinating and of motivating. Thus, under the hypothesis that organisational structure and design are determined by minimizing transaction costs, both aspects of the organisation problem affect the allocation of activity among organisational forms" (Milgrom and Roberts, 1992). They also outline five kinds of attributes that play important roles in transaction costs analysis, namely, asset specificity, frequency and duration, uncertainty and complexity, difficulty of performance measurement, and connectedness to other transactions (Milgrom and Roberts, 1992, pp. 31–32).

[8] Milgrom and Roberts also distinguish between production costs and transaction costs (Milgrom and Roberts, 1992, pp. 33–34), but they note that it is not generally true that the sum of production costs and transaction costs are the total cost of the economic system, as the former depend only on the technology and the inputs used and the latter depend only on the way transactions are organised. Production and transaction costs generally depend both on the organisation and on the technology, which together sometimes make the conceptual separation between production and transaction costs troublesome. However, for illustrative purposes with respect to the economics of nonfinancial performance, the distinction in this paper is helpful.

earlier work in assuming that the slope of the marginal cost curve for the production costs is positive and constant. This means that the costs of increasing performance at higher levels of performance are presumed to be higher than the cost of increasing performance by the same amount at lower levels. For instance, it is relatively easier to increase the levels of customer satisfaction or quality (e.g., by reducing the number of errors in the product line) at lower levels rather than at higher levels of performance. Furthermore, opportunity costs are likely to increase the more time an individual employee spends on a given task rather than on another task included in his or her job description. Thus, in terms of resource costs as well as opportunity costs, marginal production costs increase due to the increasing costs of achieving a higher level of performance.

2.3.2. Benefits of measured nonfinancial performance

The value added by the measured performance is not only determined by the costs but also by the benefits related to it. Customer loyalty, employee satisfaction, productivity, and throughput time are all examples of dimensions of performance that generate benefits for a firm and benefits in terms of either increased income or reduced costs can be outlined for each of these dimensions. In the following, the marginal benefit function is presumed to be decreasing. This implies that for example, receipts received from increased customer satisfaction are presumed to decrease proportionally with increases in customer satisfaction.

The two functions $b(x)$ and $c_p(x)$ are depicted in Fig. 3a. To lay the foundation for an illustration of the economic effects of externalities, a new preliminary value function, $v(x)$, is defined as $v(x) = b(x) - c_p(x)$. This function expresses the value of measured performance by accounting for both production costs and the benefits of measured performance. The value function is depicted in Fig. 3b and expresses an insight referenced by several scholars that it is possible to "get too much of a good thing" (Jensen, 2002; Ittner and Larcker, 2003). This refers to the fact that the production costs for achieving a particular performance level can be so high that they more than offset the benefits of reaching that level. In fact, if the marginal benefits are decreasing and the marginal costs are increasing, which are the implication of the two functions in Fig. 3a, it is possible to point out an optimal level of performance, x^*, that maximises the value function, as shown in Fig. 3b.

2.3.3. Adding costs of externalities

After defining the value function to illustrate the value created at different levels of performance when production costs and benefits are taken into account, the next step is to outline the economic effects of externalities. As mentioned above, the economic effect of externalities is conceptualised as a cost. Hence, $c_e(x)$ is introduced to express the costs of externalities as a function of measured performance. These costs are positive for negative externalities and negative for positive externalities. The economic consequences of measured nonfinancial performance externalities can be depicted graphically, as shown in Fig. 4a and b. Fig. 4a and b outlines a marginal analysis of the economic effect of externalities. The marginal cost of externalities, $c'_e(x)$, is assumed to be a straight line, where the slope indicates the increasing marginal costs due to the increasing effect of the measured nonfinancial performance on the external task. Two marginal externality cost functions are depicted in Fig. 4b. The function $c'^{neg}_e(x)$ represents a marginal cost curve for a negative externality, and $c'^{pos}_e(x)$ represents a marginal cost curve for a positive externality. The figure also contains the preliminary *marginal* value function, $v'(x)$, which is the derivative of $v(x)$ from Fig. 3b. From Fig. 4a, is it clear that as long as marginal value creation exceeds the marginal costs of externalities of the measured performance, the firm benefits from increased performance. However, if the marginal externality cost exceeds the marginal value created, the firm is better off if performance is reduced. In the case in which the externality of measured performance is negative and represented by $c'^{neg}_e(x)$, the optimal level of performance is x^*_{neg}. In the case in which the externality of measured performance is positive and represented by $c'^{pos}_e(x)$, the optimal level of performance is given by x^*_{pos}.

Fig. 4a illustrates how the existence of externalities changes the optimal level of nonfinancial performance. The intersections between the marginal value curve and the two different marginal externality cost curves indicate different optima. The costs of externalities affect the optimal level of measured nonfinancial performance because they affect the production possibilities of other organisa-

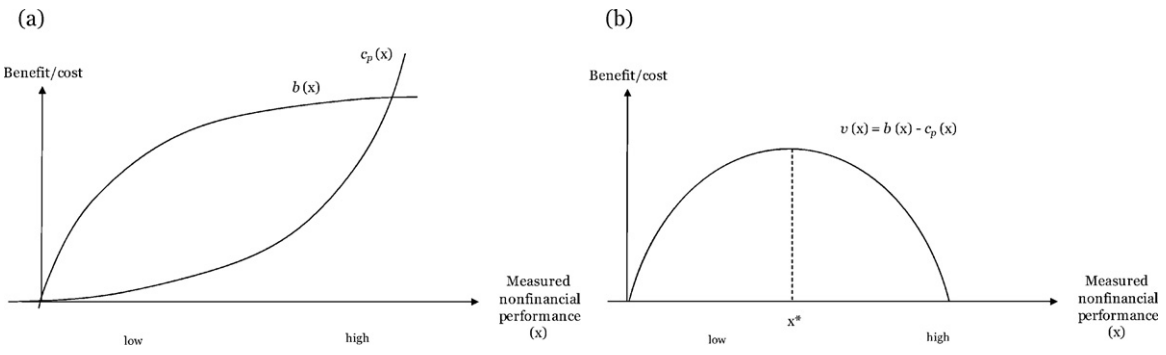

Fig. 3. (a) Cost and benefit functions of measured nonfinancial performance. (b) Value function of measured nonfinancial performance.

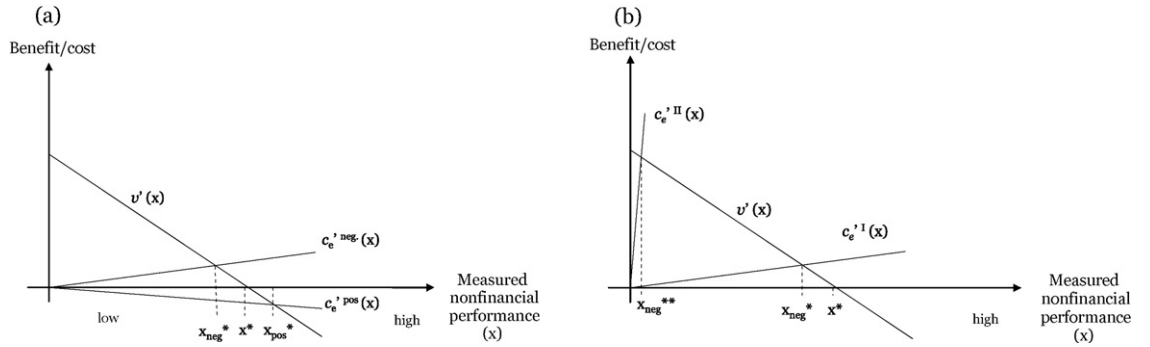

Fig. 4. (a) Two marginal cost functions of externalities (positive and negative) and marginal value functions. (b) Two marginal cost functions of negative externalities with different externality coefficients and the marginal value function.

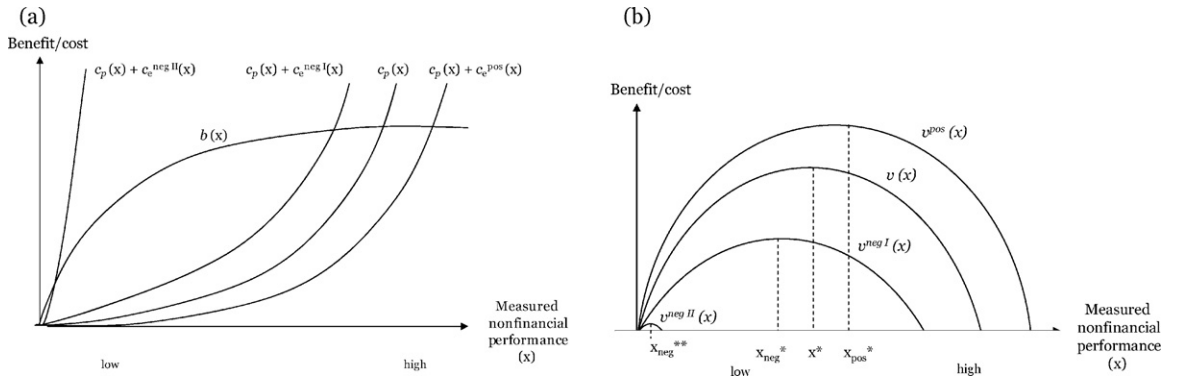

Fig. 5. (a) Benefit and cost functions for measured nonfinancial performance including and excluding costs of negative and positive externalities. (b) Value functions for measured nonfinancial performance including and excluding costs of negative and positive externalities.

tional tasks at an increasing rate. Thus, if there are negative (or positive) externalities, the optimal level for measured nonfinancial performance will be lower (or higher) as compared with a situation with no externalities due to increased (or reduced) marginal costs when performance increases.

Fig. 4b illustrates the consequences of different externality intensities. If the marginal externality cost curve, $c'(x)$, is given by ax and a is the externality coefficient, then higher values of $|a|$ will indicate stronger externalities. If $a = 0$, then no externalities exist. In Fig. 4b, two different marginal externality cost curves are depicted for measured nonfinancial performance. $c_e'^{I}(x)$ indicates a marginal cost curve with a relatively low externality coefficient, while $c_e'^{II}(x)$ indicates a relatively high externality coefficient.

It is clear from the cost curves, in Fig. 4b, that the *relevant range* is reduced for a performance measure with externality costs represented by $c_e'^{II}(x)$ compared with a performance measure with externality costs represented by $c_e'^{I}(x)$ where the relevant range is defined as "the range in which measured performance creates value for the firm".[9]

These ideas are also reflected in Fig. 5a and b, which depict the total benefit, cost, and value functions. Fig. 5a reproduces Fig. 3a but adds negative and positive externalities to the cost curves. The respective total value functions for each of these scenarios are depicted in Fig. 5b. Reviewing the value functions that include the costs of externalities, it is clear that negative externalities reduce the value of performance along the dimension measured. Furthermore, a positive externality may increase the value created along the measured dimension of performance. This affects the optimal performance levels and the range within which performance along the measured dimension is valuable for the firm.

2.4. Externalities and resolutions due to planning and target setting

Based on the discussion above, this section proposes an explanation for how externalities of nonfinancial performance might be resolved by quantity planning. The aim is to suggest how externalities may affect target setting and the value of the performance measure as well as indicate potential adjustments to the performance target if externalities are to be internalised.

By adjusting the performance target that matches the altered optimal performance levels that externalities provide (see Figs. 4a and 5b), central planners can internalise

[9] Zimmerman also uses the notion *relevant range*, but reserves it for indicating the rates of output for which the sum of fixed and variable costs closely approximates total cost (Zimmerman, 2006).

the consequences of externalities. A negative externality implies that the performance target should be adjusted downwards relative to a similar situation with no externality (see Figs. 4a and 5b). The question of how much the performance level should be adjusted to completely internalise the externality and thus maximise the value created depends on the marginal costs of the externality as well as the marginal value of performance measured prior to taking externalities into account. In contrast, a positive externality implies that the performance target should be adjusted upwards relative to a similar situation with no externality. The additional value created along the dimension of performance measured due to the positive effects on the affected party could be exploited by increasing the performance level. Overall, this leads to the following proposition regarding target setting as a means of internalising externalities when performance targets are set by central planners to reflect a firm's optimal performance level:

Proposition 1. Adjusting the performance target downwards (or upwards) from an optimal performance level in which externalities are not taken into account can be used as a means of internalising a negative (or positive) externality of a performance measure. This will increase the value of the measured dimension of performance, *ceteris paribus*.

The inclusion of *ceteris paribus* is important because it specifies that other effects that the adjusted target might have, such as effects on employee motivation, are not included in the present analysis. The only concern here is the role of performance targets with respect to the internalisation of externalities.

Furthermore, there may be situations in which the externality coefficient is so high and so many externality costs are incurred that negative externalities almost totally overwhelm the value of the nonfinancial performance measure (see Fig. 4b). When $v(x)$ tends towards zero, the relevant performance range gradually disappears, and thus, the company is probably better off without the measure. In addition, measurement costs and other types of costs related to the measure would probably not be covered by the residual value of the measure in these cases. Consequently, the following is proposed:

Proposition 2. When the negative externalities that occur are so high that they eliminate the value of performing along the measured dimension of the nonfinancial performance, the firm will be better off without any performance along this dimension, and thus, the performance measure will be eliminated, ceteris paribus.

Again, *ceteris paribus* is included to acknowledge that the performance measure may serve purposes other than coordinating the actions of agents. However, these effects are not included in the present analysis.

One might also imagine a situation in which positive externalities (i.e., negative externality costs) are so strong that the externality coefficient is higher than the preliminary value coefficient of the individual dimension of measured performance. This would imply that the firm always benefits from an increase in that particular dimension of performance. The negative preliminary value faced when performing at a high level will be more than offset by an even higher benefit from the positive externality. Thus, in this case, $v(x)$ tends towards infinity. However, because this is an imaginary situation and that it would never imply that the measure is removed from the performance measurement system, this paper does not further develop this case.

3. Introduction to the case study

The purpose of this section is to introduce the case study. First, the aim of the case study is outlined. Next, the two companies that are included in the study are briefly introduced. Third, the three nonfinancial performance measures under analysis are presented, and the purpose of nonfinancial performance measurements in the two companies is discussed. Finally, the data collection method on which the case study is based is described, and the principles for data analysis are outlined.

3.1. The aim of the case study

The aim of the case study is to explore externalities of nonfinancial performance measures in practice and to illustrate the relevance of the propositions outlined above with respect to resolving externalities through performance planning. The case study was designed as a comparative study, as this provides an opportunity to compare the externalities of the same nonfinancial performance measures across two organisations and thereby more clearly illustrate the factors that cause externalities (and hence the value) of the performance measures within an individual organisational setting.

The two companies included in the study were very similar. Both companies developed, produced, and sold measurement systems used to measure particle movements in terms of both direction and speed, but the two companies were not competitors. The first company's products were used for measurement of turbulence in air and gases, while the second company's products were used for measurements of flows in chemical fluids and powder. Nevertheless, the companies' products consisted of many of the same parts, such as probes, sensor modules, transmission technologies, software modules, and different types of fittings for product set-up. Furthermore, the companies had very similar competitive strategies and markets, and the organisation, size, culture, and supplier relations for the two companies were also alike.

These similarities might lead to the expectation that the same nonfinancial performance measures would fit for both organisations. However, the comparative case study illustrates the difficulties encountered when trying to produce general knowledge about the fit (or lack of fit) of nonfinancial performance measures in similar organisations, an objective that is often pursued in the so-called 'best practice' literature. By focusing on a single element that affects the organisational fit of the individual performance measure (i.e., the performance measure's externalities) this comparative case study revealed how details related to the product technologies and operations determined interdependencies among jobs in the

organisations and thus the externalities and value of the performance measure. Thus, the fact that the externalities of an individual performance measure are hard to generalise implies that the fit of a nonfinancial performance measure may also be hard to generalise.

Within the two companies, the implementation of new nonfinancial performance measures was considered an important element in the execution of their lean manufacturing strategies, which is in line with observations made in contingency theory studies (e.g. Daniel and Reitsperger, 1991; Chenhall, 1997; Fullerton and McWatters, 2002). Both companies made significant changes in their job designs and production planning according to the principles of lean manufacturing (Womack et al., 1991; Womack and Jones, 2003) and the implementation of new nonfinancial performance measures came as a response to those changes.

Several new nonfinancial measures were proposed in the two companies to support the move towards lean manufacturing. Some of these measures were related to production processes, such as quality, process time, and productivity measures. Other measures were oriented towards supplier relations and focused on delivery time and quality. Still others were focused on customer relationships by measuring delivery time and service. Finally, a group of measures related to design-for-manufacturability (DFM) was also considered an important ingredient in realising a lean manufacturing strategy. This paper, however, only focuses on three nonfinancial performance measures, namely, one manufacturing measure and two design-for-manufacturability measures. All three measures were debated in both organisations, and the issue of externalities played a significant role with respect to all measures.

3.2. The two companies

The two companies that were included in this study developed, produced, and sold measurement technology. Both were considered high-tech companies and market leaders. The two companies, hereafter called Company A and Company B for anonymity, matched one another not only in terms of competitive strategy but also in terms of a wider range of other organisational context variables. Table 1 below summarises the similarities between the two organisations. Although the aim of this paper is not to analyse the characteristics of the two organisations with respect to the general variables any further, outlining the similarities with respect to the general variables may be helpful in terms of illustrating the details that create the externalities in the individual organisational settings.

3.2.1. Company A

Company A was a world-class manufacturer of instruments that measure flows in air and gases (e.g., turbulence). The company was relatively small with a turnover of about 62 million Euros, and it operated in a worldwide market in which it sold to R & D departments in different industries, universities, and other research institutions. There were three significant manufacturers in the market, with Company A holding a dominant position.

The company's competitive strategy was based on a unique and innovative technological platform on which the company's products were built. The company was also skilled at customising its products to specific customer needs. This skill is a particular focus of this paper. This company was considered to be a 'supplier of solutions' to individual customers rather than a manufacturer of 'traditional products.' For instance, the company profile states that

> "At [Company A], we believe in providing solutions and solving problems. Since the company was founded in 1948, thousands of organisations and companies worldwide have depended on the quality and reliability of [Company A]'s products and services to solve their problems" (Excerpt from the company profile).

Table 1
Characteristics of the two companies.

Company A	Company B
• Strategy: differentiation by customisation of high-tech products. • Product: measurement systems for analysing flows and turbulence in gases and air. • Customers: R&D departments and universities related to a wide range of industries. • Customisation: adjustments of product parts, programming of software, and adding additional parts from suppliers. • Environment: market leader, two major competitors, specific customer measurement problems are considered to be relatively difficult to predict. Flexibility is considered to be a key to solve customer measurement problems. • Production system: mounting and assembly, pull production principles, and high degree of outsourcing. • Organisation: decentralisation of decision rights to workers and engineers, multi-functional skills among workers in the production system and team organisation, and cross-functional development teams. • Culture: high commitment culture; professional culture, but oriented towards the business and the overall goals of the organisation. • Turnover: €62 mill.	• Strategy: differentiation by customisation of high-tech products. • Product: measurement instruments for analysing flows in chemical fluids and powder. • Customers: R&D departments in companies and research institutions related to the chemical and pharmaceutical industry. • Customisation: adjustments of product parts, programming of software, and adding additional parts from suppliers. • Environment: market leader, three major competitors, specific customer measurement problems are considered to be relatively uncertain and difficult to predict. Flexibility is considered to be key to solve customer measurement problems. • Production system: mounting and assembly, pull production principles, and high degree of outsourcing. • Organisation: high degree of decentralisation for production workers and engineers, team organisation and multi-skilled workers, and cross-functional development teams. • Culture: high commitment culture, professional culture but oriented towards the business and the overall goals of the organisation. • Turnover: € 70 mill.

That sales engineers had opportunities to adjust, supplement, and program the company's products played a major role in customising the company's products to the individual needs of customers, thereby solving individual measurement problems with respect to customers.

The company's considerable focus on supplementing its core products with customised solutions made it necessary to outsource large parts of the company's production processes to subcontractors, as it was not possible to produce all components and elements necessary for an appropriate solution for a customer in-house. However, the company retained its core processes. These comprised the final production phases of manufactured product units, typically including assembly, fitting, and certain highly specialised production processes.

The organisation of the manufacturing system in Company A was heavily influenced by the principles of lean manufacturing and organisation (Womack et al., 1991; Womack and Jones, 2003). The ideas of customer orientation, value-stream mapping, empowerment, and pull production principles were thought to play critical roles in achieving an integrated manufacturing system. Production runs were not planned but rather were initiated by kanbans. Employees were given responsibility for productivity as well as the quality of the product. The plant manager was in charge of several production teams, and each team consisted of multi-functional workers that mounted and assembled the product parts. The plant manager argued that the multi-functionality of employees made the process flow more quickly than if the product part had to pass through several functional teams.

Furthermore, decentralisation was used extensively throughout Company A. Engineers in production, sales, and the new product development department had significant responsibilities for the development of new products in cross-functional development teams, and as mentioned above, production workers were responsible for the day-to-day production scheduling and execution of assembly and mounting.

In general, employees and managers in Company A were considered to be highly committed to the overall strategy of the firm. The integration of customer needs, product development, production, and supplies that is often mobilised under the lean manufacturing philosophy were assumed to be a key to the company's success. The production manager in Company A expressed this presumption as follows:

> "I believe that employees in our company are highly motivated—in production, sales, and development. We have a professional work environment and people have interesting jobs. On the other hand, I also believe that we have been successful in communicating that we are 'all in the same boat,' which means that integration between the customers' needs, development, manufacturing, and our suppliers is decisive."

With respect to the incentive systems in the company, the production workers and the engineers in the company did not have any bonus contracts for individual performance measures. That is, compensation for both workers and engineers was based on a fixed salary; any yearly bonuses were determined by the company's overall performance. The top managers in the company, however, each had individual bonus contracts that included profit, sales, and product development targets.

3.2.2. Company B

Company B was a leading provider of measurement instruments for flows in chemical fluids and powder that were used for highly specialised process analyses. Its customers were typically R&D departments in companies in the chemical and pharmaceutical industries as well as universities. Company B had a yearly turnover of 70 million Euros. It faced intense competition from three other major competitors in its market, although Company B was considered the market leader. The company developed and produced high-quality measurement systems, and its competitive strategy resembled that of Company A, as it was based on an innovative technological platform and extensive use of customisation of products. As with Company A, the study of Company B focused on its concern for customisation and its aspiration to deliver solutions rather than products. Company B's emphasis on customisation was expressed in the company profile as follows:

> "Company B provides and supports dedicated and accurate analytical solutions, specifically, instruments that analyse and control specialised pharmaceutical and chemical processes for the enhancement of our customers' business and knowledge creation." (Excerpt from the company profile)

In Company B, the sales engineers also played a major role in customising individual products. As with Company A, the physical adjustment of software programming to supplement Company B's product parts was critical in customising the company's product so that the individual measurement problem with respect to the customer was solved. As in Company A, customisation was facilitated by the flexible in-house manufacturing system that focused on core production processes and flexible suppliers that could supply sales engineers with components necessary for individual customer solutions. The production manager explained that:

> "I believe that our manufacturing system is extremely important when it comes to being flexible, and here I include our internal as well as external manufacturing system."

Historically, a major part of Company B's products was produced internally. However, now only a limited number of core manufacturing, mounting, and assembly processes remained in-house. The extensive use of suppliers was implemented in part to reduce the cost of production but also to expand flexibility as mentioned above, because the supplier portfolio could supply a wide range of product parts helpful for sales engineers in customising the company's products.

Company B's production system was organised according to lean manufacturing principles (Womack et al., 1991). The production workers were empowered and organised in production teams with responsibilities for productiv-

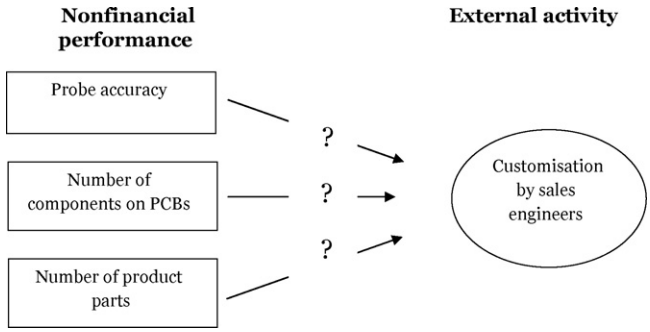

Fig. 6. Exploring interrelations among three dimensions of nonfinancial performance and an external organisational activity.

ity as well as the quality of production. Each worker had multi-functional skills and was able to handle various different types of machinery in the semi-automated work environment, which was thought to create job enrichment as well as make it possible to assign the workers responsibilities for larger parts of the workflow. Furthermore, the development engineers and sales engineers also had a substantial degree of freedom in their jobs, their responsibilities for new product development, and the continuing development of the technological platforms in the company. Similar to the idea of "freedom under responsibility", in the words of one engineer, integrating customer needs with development, production, and supply was considered critical for the company's competitiveness. Introducing cross-functional product development teams, kanban production systems, and value-stream analyses were all steps undertaken to orient workers and engineers towards a more holistic view of the company.

In Company B, the managers also argued that they had a highly motivated workforce. Development and sales engineers, as well as people on the shop floor, were considered to be highly committed. The production manager in Company B stated that:

> "Overall, I would say that job happiness is high. We have been good at developing interesting jobs for engineers as well as for people in production. And people are dedicated to our goal of being a professional organisation that provides high quality and flexible solutions to our customer."

Finally, the bonus system for the production workers and engineers in Company B was, as in Company A, based on an overall company performance measure. No individual performance measures were included in bonus plans. Neither was there any attempt to include new nonfinancial performance measures in employee bonus plans.

3.3. The three nonfinancial performance measures and their use

This paper does not include all nonfinancial performance measures debated within and implemented by the two companies. It focuses on three measures that were considered in both companies. The reason for including the three measures in this study is that externalities were an issue for the use of the three measures in both organisations.[10] Furthermore, the external effects of the three measures were all related to the same type of task in both organisations, namely, the customisation activities of sales engineer, which made the identification of externalities more straightforward. Finally, customisation activities carried out by sales engineers were, as mentioned above, considered a key strategic concern by both companies, which implies that the externality costs incurred when this task was affected were significant and hence appropriate for an analysis of resolution through nonfinancial performance measures.

The three nonfinancial performance measures included in this study include the reduction of components on printed circuit boards (PCBs) and the reduction of product parts, which are both performance measures supporting design-for-manufacturability, as well as probe accuracy, which is a manufacturing quality measure. The external tasks that these measures affected are the customisation activities of sales engineers. Fig. 6 outlines the relationship between the three measures and the organisational task, which is the focus of the paper.

3.4. The customisation activities of sales engineers

The sales engineers played a significant role in both organisations with respect to customisation. The customisation activities in both companies were carried out by adding extra components produced either internally or externally to the major product modules in existence, programming existing software modules, and/or implementing physical adjustments and modifications to extant product parts. The production manager at Company A explained as follows:

> "Our customisation of the products gives us a competitive advantage. We have a sales force that is very good at understanding the specific measurement problem that the customer has and then customising the products

[10] It is worth noting that externalities were not always issues related to the implementation of the other nonfinancial performance measures. Other factors (e.g., multi-tasking, causality, bias, and so on) brought costs and benefits for other performance measures, but with respect to the three measures examined in this paper, externalities were the major issue and hence created a relevant empirical basis for exploring their significance for nonfinancial performance measurement system design.

in ways that match the individual customer's specific needs. . .They do many different things to customise the products: add new components, adjustments of the products, software programming."

Similar customisation activities carried out by sales engineers occurred at Company B. Likewise, Company B's production manager emphasised that these activities played a key role. He explained that:

"The sales engineers put a lot of effort in making our product fit the customer's individual measurement problem. We supplement our own products with additional parts, write new software, and adapt the individual product. These are all important activities related to the process of getting a happy customer. . .. These are critical issues and I think we are better at doing these things than our customers."

Thus, there was clear recognition within both organisations of the importance of the customisation activities of sales engineers.

3.4.1. The choice of performance measures and target setting as coordination mechanisms

Neither of the companies introduced the new nonfinancial performance measures as new elements in employee incentive contracts, nor did management believe that there were problems with employee commitment and/or recognition of the importance of integrating different functional units in the companies. However, managers in both companies experienced issues with respect to the knowledge among employees regarding what it actually meant to integrate individual actions with other individuals in the company. The production manager in Company A had the following to say regarding this topic:

"In general, I think that there is a high commitment in our company—the employees are motivated. The challenge for us is to ensure that the employees get information about what it means to act in the interest of the company. In our company, a lot of responsibility is assigned to engineers and workers, and they are willing to take it, but they do not always know what to do with it."

Thus, a lack of information rather than a lack of incentives potentially created myopic workers or engineers in Company A. While managers in both companies recognised that the lean manufacturing principles that had been implemented had already contributed to integration in many ways, they also emphasised that nonfinancial performance measures played a critical role in informing employees.

Not only the managers but also the employees recognised the potential of the new performance measures with respect to information provisions. A production employee in Company B responded to a question regarding why he thought that nonfinancial performance measurements would be valuable as follows:

"The new performance targets can help us to do things in the right way. We all want to coordinate, but the problem is that we are not always sure about what that means. When performance targets are launched, it becomes much easier."

A development engineer in Company A characterised the relevance of nonfinancial performance targets and emphasised the role of controllers with respect to finding an appropriate level of performance as follows:

"Targets are absolutely essential because they inform us about how to balance our activities with others—for instance, our development activities with the sales engineers' activities. If I should communicate back and forth with people to calculate 'the optimal level of components' myself, I would have no time for developing the new products. It is much better if the controllers do this."

Thus, in the two companies under analysis, controllers were considered to be the personnel who could set the target and balance the costs and benefits of a performance level in one functional unit with the costs and benefits of its effect on another functional unit. These assessments were considered the point of departure for setting performance targets. In other words, there was a call for centralised information produced by controllers that could inform decentralised agents how to balance these issues, as these agents often lacked the time, competences, and/or information available to evaluate the effect of one functional unit's interdependence with another on the overall company. The performance targets were assumed to be equivalent to informing decentralised agents regarding how much performance was appropriate if externalities were taken into account.

An alternative to a centralised resolution for internalising externalities might involve negotiations among the decentralised agents (e.g. Shavell, 2004). However, as emphasised by the engineer quoted above, a controller's analysis of costs and benefits of a given dimension of nonfinancial performance in different functional units from an overall company perspective was considered a much more realistic approach than negotiation among decentralised parties; workers and engineers simply did not have the time and information needed to define optimal performance levels from an overall company point of view.

The controllers in Company A as well as Company B were also cognizant of the coordinating role that the performance measures served. The chief controller in Company A commented on the importance of interdependencies between organisational tasks when setting targets:

"We consider the interdependencies between development, production, and sales when we design the performance measurement system, and we deal with the issue when we set the target for the critical success factors important to us."

Planning was also considered critical in Company B for dealing with interdependencies among tasks and resolving issues involving externalities. The Chief Financial Officer (CFO) made the following argument:

"I believe we have a powerful tool when it comes to controlling these potential conflicts [negative externalities] if we are careful about the level of performance that we set in our performance plans and measures."

Thus, managers, engineers, controllers, and workers in both companies promoted the idea that it was possible to regulate interdependencies among tasks through the performance measurement system. This fact was the rationale behind choosing the two companies for further study of how externalities were internalised through a performance measurement system.

3.5. Data collection and analysis

The data for the comparative case study included in this paper originate from two research projects in the electronics industry in Denmark. The first project involved carrying out in-depth case studies of management control and strategy in manufacturing systems in five electronics manufacturers, and the second project involved studying product development, management control, and strategy in four companies also in the electronics industry. For each project, data collection was undertaken for approximately 6 months on average, and 18–24 interviews were carried out in each company. Furthermore, observations at meetings and document studies were conducted. Although each of the two projects initially focused on their own functional unit, that is, manufacturing and new product development, the interdependencies among suppliers, new product development, manufacturing, and customer relationships in the companies necessitated data collection on a wide range of issues, including management control, organisational design, and strategy issues in different functional units, in order to better understand manufacturing and new product development issues in a wider organisational setting.

The relatively broad scope of the studies implied that field data on performance measurement and strategy implementation issues were available for both companies studied. By chance, two of the companies included in the research projects were in the process of implementing new nonfinancial performance measures to support manufacturing strategy implementation.

Inspired by the data from the two companies, the idea for this paper focussing on externalities and nonfinancial performance measures in the two companies was generated. The interviews from the two research projects provided data relevant to the study of this issue; however, particularly with respect to Company B, which was initially part of the product development research project, some additional information was needed to better explore the research questions in this paper. Thus, it was decided to carry out a second round of interviews in the two companies and focus in particular on externality issues.

In total, 24 interviews were conducted in Company A (18 interviews in the first round and 6 interviews in the second round), and 27 interviews in Company B (19 interviews in the first round and 8 interviews in the second round). The interviews from the first round were conducted at different hierarchical levels and in different functional units, including purchasing, manufacturing, sales/marketing, product design, and production engineering. In Company A, the second round of interviews included the production manager, the sales manager, the chief controller, a production worker, a sales engineer, and a development engineer. The second round of interviews in Company B included the production manager, the sales manager, the CFO, the New Product Development (NPD) manager, a sales engineer, a production employee, a development engineer, and a business controller.

In both rounds, each interview took between one and a half to two and a half hours. Each was recorded and transcribed. The interviews were carried out in Danish; the quotes from the interviews included in this paper have subsequently been translated into English. With respect to the observations of the meetings, written summaries and protocols were produced as documentation.

3.5.1. The role of the propositions

As mentioned above, the interviews from the first round generated the inspiration for exploring issues of externalities and nonfinancial performance measures. It was between the first and second rounds of interviews that the propositions were generated. The second round of interviews then provided an opportunity to explore the propositions in more detail. Thus, the interview guide for the second round was designed with the propositions in mind. This made it possible to carefully collect data on how externalities actually affected the value of the measured nonfinancial performance in the two companies and how target setting was used as a way to inform workers and engineers about how to act to balance their performance with the performance of other units.

The interviews were analysed by exploring respondent interpretations of the role of nonfinancial performance measures with respect to resolving externalities; naturally, the second round of interviews was more informative about externality issues than the first round. Overall, the respondents agreed in their interpretation of how the measures related to externalities in the companies. It was not the case that different respondents had different interpretations of the same episodes and issues. Consequently, it was possible to use the interviews as supplements to the overall data collection. A pivotal factor for complementarity was the fact that respondents were questioned about the same measures, externalities, and coordination issues. The main purpose of the significant number of interviews was therefore to obtain more details about the relationships between the organisational tasks and the performance measures rather than to explore why different respondents had different interpretations of the same experience. With respect to externalities, each of the interviews supplemented one another, and when combined, they created a resource for gaining detailed insights about the relationship between measures and organisational tasks.

In line with other scholars who have promoted case study research methods in management accounting research (Scapens, 1990; Keating, 1995; Ahrens and Chapman, 2006), this paper draws on the idea that case study research provides an opportunity to study a phenomenon in its real-life setting to illustrate how the phenomenon's significance in practice is determined by particularities within the individual organisational practices. The richness of the data on which the case study in

this paper is based provides the opportunity to illustrate how particularities and specificities determine not only the existence of externalities but also the extent to which externalities affect the value of nonfinancial performance and how externalities can be managed through target setting. The case study therefore bridges the rationales produced in both the economic model and the propositions outlined above in Section 2 with the concrete organisational practice through which managers are confronted with issues of externalities.

4. Analysis: three dimensions of nonfinancial performance and their external effects on sales engineer customisation in two organisations

This section reviews the externalities of three dimensions of nonfinancial performance that were discussed in Company A as well as in Company B. The first dimension (i.e., probe accuracy) was a quality issue in the manufacturing system. The two other dimensions (that is, reduction of components on printed circuit boards and reduction of product parts) were related to design-for-manufacturability.

4.1. Probe accuracy as a quality measure

In both companies, quality was a key objective in the manufacturing system. Total Quality Management (TQM) initiatives had been implemented, and several quality performance measures had been discussed to implement lean manufacturing strategies, reduce waste, and increase the value of company products. One of the measures proposed and discussed in both organisations that was particularly interesting for this study was the probe accuracy measure, which was related to the calibration of the measurement probes that were essential components in the products produced by both companies. Company A used the probes for measuring turbulence in fluids and gases, and Company B used the probes for the specialised process analyses in the pharmaceutical and chemical industries. The quality of the probe measurements was quantified by using an accuracy estimate, which was expressed as an estimated value, plus or minus an uncertainty level. Accuracy was important because it had a strong impact on product reliability in Company A as well as in Company B. In both companies, particular jobs were designed as part of the production system to improve probe accuracy. These jobs were manual and carried out by employees from the production teams.

When the accuracy of the probes was improved, the marginal costs related to improving accuracy increased. For instance, a production engineer in Company A explained:

> "We can get it almost as accurate as we want. It is just a matter of how many resources we use. The higher the accuracy we want, the harder it gets. Getting from [0.01][11] to [0.001] takes much more than getting from [0.1] to [0.01]."

This was similar to experiences in Company B, in which increasing marginal costs characterised the improvement processes as well. As a production worker explained:

> "The refinements that are necessary to get from [o.4][12] to [0.5] are only half of those that I need to get from [0.04] to [0.05]".

When it came to customer decisions to buy company products, probe accuracy was presumed to be an important parameter in both companies. Customer experiences with the product and sense of quality were dependent on accuracy. For example, a sales engineer from Company A stated:

> "Going from [0.1] to [0.01] has a remarkable effect on customers' interest in us. If you sell products with a probe accuracy of ±[0.1] you only fulfil the needs of a few customers. Many more customers are interested in your product if you provide accuracy levels at ±[0.01]."

This quote is also representative of the attitude at Company B. Thus, the benefits of accuracy were evident to everyone in both companies. A low level of accuracy would lead to few sales orders, whereas high accuracy would lead to many. However, there was a limit to how accurate the probes needed to be to affect customer utility. If the accuracy was too high, the customers simply did not recognise the improvement. A controller in Company B argued that there was an optimal level of probe accuracy:

> "If we improve accuracy from, for instance, [0.008] to [0.006], I do not believe that the customer would recognise it. In addition, it would cost us much extra time to get there. This is the reason why we have a target for an accuracy of [0.01]. Beyond this point, it costs us too much, and the customers really do not recognise the change. . .It is important that this piece of information gets communicated throughout the system."

Thus, measuring probe accuracy was considered to be critical in Company B, and a performance target was set to ensure that production workers aimed for the optimal level along this dimension of performance in the production system. The performance target was set at 0.01 in Company B. The costs of reaching an accuracy level of ±0.01 were offset by the benefit of customers being willing to buy company products. On the other hand, performance beyond this point would be too costly compared to the benefits for the company.

None of the companies experienced any negative externalities related to probe accuracy performance. However, there was a positive externality related to probe accuracy in Company A. The implication of that externality was that the performance target set for probe accuracy in Company A was higher compared to a similar situation without positive externalities.

[11] In the following explanation, the scale and level of probe accuracy in both companies have been indexed and converted to the same performance level. In practice, the companies use different scales and levels. However, the simplification made here is unproblematic in terms of illustrating the reasoning and principles related to setting targets and internalising positive externalities.

[12] Please see the footnote above.

4.1.1. Positive externalities in Company A

The improvement in the accuracy of the probes in Company A significantly affected the work processes of sales engineers related to the customisation of products. Very high levels of accuracy made customisation easier because the additional necessary adjustments of Company A's products to address the individual customer's measurement problem related to flows in gases or air became more simple and less time-consuming. The adjustments were simply harder to obtain and more complex under lower accuracy levels. As the sales manager of Company A explained:

> "The right performance level with respect to the customer is ±[0.01], but from the sales engineer's point of view, a higher level of performance is desirable. This is because the adjustments the sales engineers need to undertake to measure turbulence, for example, are reduced when the probe's accuracy is increased [i.e., tolerance is lowered]. . .. The customer does not really need accuracy at this level, but we really have an advantage when we adjust the products, and that is something we always do."

Thus, improvement beyond the [0.01] level did not affect the quality of the product from the customer point of view, but the positive externalities present for the customisation activities of sales engineers eased customisation processes and thus reduced the total costs for Company A, because the additional production costs (i.e., additional time in the manual improvement processes) did not exceed the cost savings realised by the sales engineers. Trade-offs were analysed by the controllers in Company A and communicated through the performance targets. The chief controller in Company A commented on the economic rationale for the performance targets as follows:

> "Of course it is a trade-off. On the one hand, we get reduced adjustment activities when we increase accuracy. On the other hand, we have the extra resources needed in production to improve probe accuracy. Probe accuracy close to ±[0.001] is the optimal level, we believe. Beyond that level, it is too costly to improve it from a production point of view, and the effects with respect to customisation activities are relatively lower, which imply that there is no pay-off beyond this level."

Company B did not experience the same positive externalities as in Company A because the adjustments necessary to measure the different types of flow issues in chemical fluids and powder that the company's sales engineers were facing were not affected by higher accuracy levels. In contrast, the adjustments necessary to modify Company A's measurement systems were significantly reduced at higher accuracy levels.

Thus, in Company A, the positive externality was internalised by increasing the target for probe accuracy relative to a situation with no externalities. The performance measure was also implemented in Company B. However, in this case the target was only set by taking customer utility and production costs into account in the manual production processes. No externalities were involved in target setting.

4.2. Reduction of components on the printed circuit boards (PCBs)

Yet another set of nonfinancial performance dimensions and their potential customisation externalities were discussed in the two organisations. These were dimensions related to issues of DFM, which was considered a significant component of the two companies' lean manufacturing strategies. The first is the reduction of components on the PCBs, which is covered in this section, and the second is the reduction of product parts, which is discussed in the next section.

In both companies, the number of components on PCBs in the sensor modules of measurement systems was considered critical for cost and time consumption in manufacturing and purchasing processes. The benefits of reducing the number of components in the manufacturing and purchasing systems were almost the same in the two companies. In addition, it is generally accepted in the electronics industry that reducing the number of components on the PCBs reduces the costs in purchasing, inventory, manufacturing, and so on. A production engineer in Company A stated the following:

> "It is clear that a reduced number of components is a benefit to us. Machine runs are reduced. Activities related to inventories and purchasing are simplified."

Furthermore, the production costs of performing along this dimension (i.e., reducing the number of components) were relatively easy to trace, as they were related to the time that development engineers spent on this activity. As the benefits of reducing the number of components seemed to be relatively higher than the costs, the decision to include the performance measure in both companies' performance measurement systems was obvious, as it represented a dimension of performance that could improve value creation for the firm. However, the costs of reducing the number of components on PCBs were not only related to resources consumed by engineers in the two companies. In addition, a reduction in the number of components also affected the customisation activities of sales engineers. In Company A, the consequences of limiting customisation were so hefty that the controllers decided to drop the measure. In Company B, the negative externalities were addressed by setting a limit for the reductions.

4.2.1. Negative externalities in Company A

Engineers in Company A argued that the number of components on PCBs had serious effects on the customisation processes of development engineers because the number of components affected the possible measurement span of the company's products due to the particular transmission technology applied in Company A's sensor module. A high measurement span was pivotal in terms of customising the products because of the fluctuation in the air and gas flows (especially those caused by turbulence) that Company A's measurement systems should address. Only one particular analogue transmission technology was able to produce a measurement span wide enough to deal with the fluctuations, and the construction of this type of trans-

mission technology required a considerably higher number of components compared with other types of transmission technologies.

The particular type of technology used in Company A's sensor modules meant that the development engineers had a certain view of the number of components on PCBs as a performance criterion for new product development. One development engineer made the following argument:

> "If a machine can only take 150 different components at a time, and we decide to use 250 components, then the machine will just have to run two times.... Perhaps it costs us more, but that doesn't really matter, because it gives us a unique opportunity to increase the measurement span, which is very important in terms of solving a customer's measurement problem...High-scale span costs us in terms of components! And if we start reducing the number of components, it would cost us in terms of customisation."

The concern about the particular transmission technology in Company A was also recognised by the chief controller. According to him, the benefits of the reduced number of components on PCBs, which included reduced costs in purchasing, stock handling, and manufacturing, were not as high as the costs of reducing the number of components, that is, the costs of reducing customisation opportunities due to the reduced measurement span of the transmission technology. In fact, it was argued that reducing the number of components on the PCBs would have quite dramatic consequences on measurement span and hence customisation, even if only a relatively small number of components was removed from the design. The production manager explained:

> "The transmission technology is very sensitive to the number of components on PCBs...Even a relatively limited reduction of components will have a huge impact on the engineers' ability to make products covering the same measurement span, which again will have consequences for our customisation. As soon as we start to reduce the number of components, we reduce customisation possibilities because we reduce the measurement span."

The negative externalities that a reduction of the number of components on PCBs would have on customisation activities were considered so strong that the performance measure was not implemented in Company A. In other words, the negative externality coefficient for the number of components on PCBs was so high in Company A that it totally eliminated the potential value along this dimension. The chief controller in Company A stated the following:

> "This dimension is not valuable to us because as soon as we start to reduce the numbers of components on PCBs, we pay such a high price in terms of lost customisation."

However, Company B was different in this regard. Performance along this dimension did not have the same dramatic consequences.

4.2.2. Negative externalities in Company B

In Company B, a reduction of the number of components did not create the same issues as in Company A, at least with respect to the current numbers of components on the PCBs. The particular type of transmission technology that was used in Company B in the sensor module, which was not applicable for Company A's products due to the considerable turbulence they needed to measure, was not as sensitive with respect to the number of components when it came to measurement span. Furthermore, measurement span did not pose the same issues for measurements in chemical fluids and powder. Thus, the number of components could be reduced without affecting the customisation processes of sales engineers significantly. However, although the measurement span was not affected significantly, the reduction could not go on for too long before the customisation was affected in another way. The availability of other technical features attached to the transmission technology that the sales engineers were using in their customisation activities was dependent on the number of PCBs in the sensor module. As the number of components on the PCBs was reduced, the number of PCBs is also reduced. Initially, an average of eight PCBs were used in the construction of the sensor module, and it was possible to reduce the number of PCBs to five before it affected the availability of the technical features that the sales engineers used to the point that the benefits of the reduction (i.e., manufacturability) were lower than the costs of the reduction (i.e., lack of customisation). Currently, however, eight PCBs were used in the sensor module, which implied that there was room for improvement.

The value creation potential along this dimension of performance in Company B implied that the performance measure should be implemented there. However, due to the critical level of five PCBs, there was a limit to how many components the development engineers should eliminate. A business controller explained this as follows:

> "The concern for our technical features makes it impossible to use less than five PCBs when we talk about the sensor module. If we go below this, the technical features that the sales engineers use will then be reduced so much that it becomes critical. It means that there is room for improvement, but also that there is a limit to how much it is possible to reduce the number of components for customisation."

The controller explained that taking into account the benefits of the reduction of components and PCBs, the costs related to the resources that the development engineers consumed on this particular activity, and the potential affect on the technical features important for customisation, a 15% reduction in the number of components for each new design of the transmission module was considered optimal for Company B. The fact that the production costs of achieving performance are important was emphasised by the product development manager. If the target was set above 15%, too much attention would be directed towards this task relative to the other tasks that development engineers should perform. The development manager stressed

the following:

> "We do not want the engineers to spend too much time on it. Therefore, we set up a target of 15% reduction per new design. I believe that it is a fair target and that it can be reached within a reasonable amount of time. It also means that we will not reach the minimum level of five PCBs before about three generations from now, and by that time, there will probably be another technology available."

Summing up, the transmission technology in Company B was not affected in the same ways as the one used by Company A when it came to the reduction of components on the PCBs. In Company A, the reduction of components had considerable effects on measurement span, which again implied that customisation opportunities were dramatically reduced for the sales engineers. In Company B, the measurement span was not affected by the reduction of components. However, the availability of technical features was affected as the number of PBCs was reduced when the number of components was reduced, and a reduced number of PBCs affected the availability of technical features in the transmission module. Thus, although the externality costs were not as high in Company B as in Company A, when it came to the reduction of the number of components on PCBs, it still had an effect on the target chosen for this particular dimension of nonfinancial performance.

4.3. Reduction of product parts

Another performance dimension related to the design-for-manufacturability debated in the two organisations was 'the reduction of product parts' for each product. The number of parts used had a large impact on the workload in the manufacturing and order–processing systems of both companies. A production engineer in Company A described the issue as follows:

> "When we develop and design a new measurement system, lots of different parts are included in the system: several different cables, suspension options, probes, sensor modules, adaptors, etc. The sales engineers prefer that each different part get its own finished product code that customers can order separately. It gives them flexibility. However, I oppose this idea, because more parts mean a greater chance of defects, problems with stock handling, and larger inventories in the production system. Ideally, we should only have one part per measurement system. But of course, more parts give us more flexibility to solve the customer's particular measurement problem."

In Company A as well as in Company B, a reduction in product parts was considered beneficial because it would decrease costs in the manufacturing and order–processing systems. Furthermore, relatively few resources were considered for consumption to improve performance along this dimension, at least in the beginning. The first reductions could be made by development engineers spending a couple of extra hours on redesign. However, additional reductions would soon require relatively more resource consumption in the development department, because it became relatively more complicated to design part reductions, and additional investments in the product structures were needed to create new reductions. Thus, the first set of part reductions could be achieved with relatively lower resource consumption per part reduction than the next set of part reductions, as was argued in both companies. This provides evidence of an increasing marginal cost curve when it comes to the costs of implementing part reductions. The costs of part reductions, however, were also incurred from another side, namely, from the negative effect that the reduction of parts had on customisation of the product on the part of sales engineers. This had only moderate effects in Company A, but in Company B, the externalities had damaging consequences for the performance dimension's congruence with value creation for the firm.

4.3.1. Negative externalities in Company A

In Company A, the reduction of parts did affect the customisation activities of sales engineers, but the benefits of reducing the numbers of parts (i.e., reduced costs in the manufacturing and order–processing systems) were considered to be much higher than the costs of reducing parts (i.e., increased costs caused by reduced customisation as well as the resources consumed to achieve part reduction) at least for the first parts reduced. This implied that targets for part reduction were implemented in Company A, while the target was considered to be a way to communicate the balance between the costs and the benefits of parts reduction to the decision makers in the new product development department. By communicating the target, controllers informed development engineers about relevant externalities and how to internalise them. The development engineers appreciated the information provided by the performance measurement system. A development engineer commented on the role of the nonfinancial performance target as follows:

> "The number of parts drives manufacturing costs, and I believe we can improve in this area. . .But, on the other hand, there is also a limit with respect to the reduction of parts because of its effect on the sales engineers' job. We can use the target to better understand how to balance the two concerns."

To a large extent, the target for the reduction of product parts was determined by the negative effect on the customisation activities of sales engineers. In general, fewer product parts were considered to imply less customisation. The limit in terms of how low they could go with respect to reductions in product parts in Company A was decided by referring to the main categories of technological features that the customers should be able to choose from and the reasonable number of parts that would make it possible to physically fit the measurement system to a customer's own settings without making it too costly for the customer. The chief controller in Company A explained:

> "What we did was that we reviewed all the product parts and the different types of part categories, e.g., sensor modules, cables, adaptors. We decided on a reasonable

number of parts for each category by taking the different technological situations and physical conditions into account that our customers were facing. . .Furthermore, we of course assessed the potential cost-savings in the manufacturing and order–processing systems from the part reductions and took that into consideration as well."

Thus, with respect to finding a balance between customisation on the one hand and costs savings in the manufacturing systems on the other, the controllers in Company A again became involved in collecting information, analysing it, and communicating the results. The chief controller described it as follows:

"We had an intense dialogue with the sales engineers on these things as well as with the people in manufacturing. The results of our work are the performance targets. The targets express how we should balance these things."

Hence, in Company A, the measure of the reduction of product parts was implemented because it represented a particular dimension of performance that created value for the firm but only up to a certain level. The negative externalities related to performing along this dimension (i.e., reducing product parts) had an impact on the extent to which a certain level of performance paid off for the company. The target was used to communicate the level of performance at which point further reductions would create more costs than benefits for Company A, and this piece of information was useful for development engineers:

"We are very busy and have a lot of things to do. The targets are useful because they help us remember the goal related to each part category. I do not remember these things myself. I have other things to do. I know that it is a complex job to analyse what the right number of parts is. Luckily, we have colleagues to do this."

4.3.2. Negative externalities in Company B

In Company B, the reduction of product parts was more problematic, because the sales engineers experienced a situation in which further reductions would have considerable negative consequences for their opportunities to customise the company's products. One sales engineer commented on the situation:

"We cannot reduce the number of parts any more. If the customers are forced to buy a cable that is too long simply because we have not designed a cable in a length that better fit this customer's needs, we will lose the order to our competitors. I guess we can say that product parts really are valuable to us. There are big differences between the customers' systems, and we need a lot of different parts to deal with the variety."

The controllers agreed on this issue in Company B. Although they recognised that the number of parts was a cost driver manufacturing and order–processing systems, they also acknowledged the point voiced by sales engineers that further reductions of the number of parts would probably be too costly from a customisation point of view because of the significant physical diversity across process systems of customers. A business controller explained the following:

"Well, of course the number of product parts is important in terms of the cost of the manufacturing and ordering processes.[But] we also need to take the sales engineers' opportunities to create customer value into consideration. We believe that further reductions in the number of product parts will have such a negative effect on the sales engineers' customisation that it will erode the gains made from cost-savings in the manufacturing system."

The controllers decided to drop the plan of setting a target for the reduction of product parts for the development engineers, simply because further reductions would have such a negative effect on the customisation opportunities of sales engineers. There was "no room for improvements," as one business controller expressed it, thereby taking the negative effects on customisation into account. The customisation of Company B's products often required more hardware adjustments than in Company A, because the set-up of the products differed more from customer to costumer in Company B due the high physical diversity of the measurement systems. Thus, engineer adjustment to the particular systems relied on a large number of physical components in Company B.

5. Discussion: externalities and nonfinancial performance measurement system design

This section contains a review of the findings from the comparative case study of the externalities of the three dimensions of nonfinancial performance. It also contains a discussion regarding to what extent and under what conditions the propositions outlined in Section 2 were confirmed with respect to the resolution of the externalities. Furthermore, the roles that nonfinancial performance targets played as coordination devices as well as how information about externalities was communicated by central planners and controllers in the two manufacturing settings are discussed. Finally, reflections are presented on how the findings of this study put the role of strategy into perspective when it comes to choosing nonfinancial performance measures.

5.1. Externalities of nonfinancial performance

Table 2 summarises the externalities of the three dimensions of nonfinancial performance in the two organisations and reviews how the measured performance and the external task (i.e., customisation activities by sales engineers) are related. It also recalls to what extent externalities were resolved by target setting or by the elimination of performance measures.

The review in Table 2 illustrates that the externalities of the three dimensions differed from one organisational setting to another. Even though the two organisations were alike, the externalities of the performances differed. The differences were caused by specific technological and operational elements within the individual organisational

Table 2
Externalities of three dimensions of nonfinancial performance in two organisations along with their resolutions.

Nonfinancial performance	Company	Externalities	Resolution
Manufacturing quality (i.e., probe accuracy)	Company A	Positive externalities: extraordinarily high probe accuracy (i.e., higher accuracy level than what the customer requests) reduces sales engineer resource consumption significantly when adjusting products to resolve customers' individual problems with measuring flows in air and gases.	Performance measure implemented and target setting used to internalise positive externalities.
	Company B	No externalities: the customisation activities of sales engineers are not affected by the probe accuracy level in any significant way.	Performance measure implemented. Externalities do not affect target setting.
Reduction of components on PCB	Company A	Negative externalities: a reduction of the number of components on PCBs will reduce the measurement span of the transmission technology appropriate for measurement of turbulence. A reduced measurement span will reduce the ability of sales engineers to set up the company's measurement system to address every customer's flow fluctuations.	Performance measure excluded; the negative externalities were too high.
	Company B	Negative externalities: reducing the number of components does not affect the measurement span because the transmission technology used for chemical fluids is not sensitive to the number of components applied. However, there is a lower limit for the number of PCBs (and thus also the number of components) due to the demand for technical features by customers.	Performance measure included and target setting used to internalise negative externalities.
Reduction of product parts	Company A	No externalities: the number of product parts only affects the customisation processes of sales engineers if the reduction is high. Performance along this dimension will improve productivity in the manufacturing and order–processing systems without significantly reducing customisation up to a certain level.	Performance measure included and target setting used to internalise negative externalities.
	Company B	Negative externalities: reducing the number of product parts will limit customisation. The number of product parts is already low, and the number of physical product parts has considerable impact on the opportunities for sales engineers to adapt to the highly diverse process systems of customers.	Performance measure excluded; the negative externalities were too high.

practices that affected the interdependencies among the three dimensions of nonfinancial performance and the customisation activities of sales engineers (i.e., the external task).

In Company A, probe accuracy had a positive effect on the customisation activities of sales engineers, whereas it had neither a positive or negative effect in Company B. In this case the difference between the two companies was caused by the adjustments Company A's sales engineers needed to carry out to resolve the customers' individual measurement problem of flows in air and gases. These adjustment activities were made significantly easier by higher probe accuracy. Such operational advantages of higher probe accuracy were not present in Company B, because the adjustments of Company B's product to resolve the measurement problem in chemical fluids was not really affected by probe accuracy. Hence, higher probe accuracy did not affect customisation in Company B.

The second nonfinancial performance dimension, that is, the reduction of the number of components on PCBs, caused negative externalities in Company A as well as in Company B but for different reasons. A reduction of the number of components on the PCBs would have very negative effects on sales engineer activities in Company A because the performance of the transmission technology used in the sensor module in Company A was significantly affected by the number of components. Reductions of components was said to reduce the product's measurement span, and a reduced measurement span would seriously affect the ability of sales engineers to measure all fluctuations in air and gas flows (particularly those related to turbulence) that Company A's customers would like to measure. In Company B, in contrast, the number of components did not affect the transmission technology's performance (i.e., measurement span) in the same way because the type of transmission technology applied in chemical fluids was not as sensitive to the number of components. Nevertheless, another issue came up with respect to how far the number of components could be reduced without affecting customisation in Company B. A reduction of components would affect the number of PCBs, and the number of PCBs affected how many extra technical features demanded by customer the sensor module could provide. Consequently, a minimum level of five PCBs was set, which was used as the basis for setting a target for the reduction in components in Company B.

The third type of performance, namely, the reduction of product parts, also illustrates how specific circumstances within the individual organisational setting affect the value of the measured dimension of nonfinancial performance. In Company B, further reductions in the number of product parts would have considerable negative effects on customi-

sation due to the differences across customer chemical process systems, which created many diverse physical measurement system set-ups and thereby a significant demand for a high number of product parts. In Company A, in contrast, the physical set-ups of the measurement solution in gases and air did not differ to the same extent; hence, customisation was not that sensitive to the number of product parts. Furthermore, there was significant room for improvement with respect to the number of product parts in Company A compared to Company B.

A final point to be made with respect to the creation of the externalities and interdependencies among tasks is that the connecting points between the affecting and affected task differ; see Fig. 2. The reduction of components on PCBs and the reduction of product parts both affected *the input* of the customisation activities of sales engineers (i.e., what they have to work with), whereas probe accuracy affected *the processes* of the sales engineers in Company A (i.e., the way that they work). This is because extraordinary accuracy meant that sales engineers could eliminate several steps in their customisation procedures. These different connection points underline the multiple ways that interdependencies between tasks, and thereby externalities, can be created in an individual organisational setting.

5.2. Externalities and design of performance measurement systems

Controllers in both companies adjusted their targets to internalise externalities. They even decided to withdraw performance measures with negative external effects that were too strong. Thus, the case study confirms Propositions 1 and 2 outlined in Section 2 and illustrates how the propositions outline principles for the coordination of interdependencies among organisational tasks through performance measurement and target setting.

5.2.1. Externalities and target setting (Proposition 1)

The comparative case study illustrates how target setting was used in Company A to communicate the synergies between the high accuracy level of the probes and the customisation activities of sales engineers. It was also used to protect the customisation activities of sales engineers against the reduction of product parts in Company B and the reduction of components on PCBs in Company A by setting targets that balanced concerns about customisation with cost-savings in manufacturing and order–processing. Hence, the case study confirms Proposition 1 and illustrates how target setting was used to internalise positive as well as negative externalities of multiple dimensions of nonfinancial performance.

5.2.2. Externalities and exclusion of performance measures (Proposition 2)

Externalities also affected the choice of performance measures in both companies. As suggested in Proposition 2, removing a nonfinancial performance measure for which externality costs are so high that they eliminate the value of performing along the dimension benefits a firm. In one instance in each company, nonfinancial measures were removed from the performance measurement system due to very negative effects on customisation. In Company B, the reduction of product parts had sufficiently strong negative effects on the customisation activities of sales engineers to the point that it was removed. In Company A, a reduction of the number of components on PCBs created such high externality costs that it was withdrawn from the performance measurement system.

5.3. Nonfinancial performance, externalities, and myopic behaviour: performance measures as planning devices

By definition, externalities are created by myopic managers or employees that disregard the external effects of their decision-making and thereby make decisions that create less value for the firm than if they had included this external effect in their decision-making. This paper distinguishes between two types of myopia to further the discussion of myopia. The first is caused by the decision maker's *lack of incentives* to internalise the external effects in his or her decision-making, and the second is caused by the decision maker's *lack of information* regarding how the individual's decisions effect firm value. The myopia of the latter type was the focus of this comparative case study. In fact, no incentive problems were considered to be present with respect to externalities. One employee in Company B expressed it as follows:

> "I guess we are always ready to help each other. It is more a matter of understanding what that actually means."

Thus, the key role of the nonfinancial performance measures in both companies was to provide information that managers and employees could use to coordinate their decisions with others.

The fact that it was a lack of information rather than a lack of incentives that was the issue in the two companies makes the illustration of the internalisation of externalities somehow simpler. As long as the incentive issue is not treated as a problem, the decision maker's personal costs and benefits of performing along an individual dimension of nonfinancial performance are excluded from the analysis. If the nonfinancial performance measures had been used for the provision of incentives and been included in incentive contracts, issues related to performance measurement such as manipulability (Jensen, 2003), risk (Holmström, 1979), and completeness (Holmström and Milgrom, 1991) would have influenced the choice of performance measures and target setting. However, the performance measures were decoupled from the incentive contracts and incentive issues in the two companies. This implies that it is possible to illustrate the consequences of a nonfinancial performance measure's externality directly as an adjustment of targets and that the externality can be internalised by informing the individual agent regarding how much to produce to internalise the externality. Such a direction or plan is an alternative to incentive contract or price-based mechanisms (Milgrom and Roberts, 1992) in which the agent is given an incentive to internalise the externality by either a gain or loss that the agent receives from the contract by internalising or not internalising the externality. The gains and losses related to internalising

or not internalising externalities are price signals that the agent is expected to act upon and thereby indirectly internalise externalities.

The success of nonfinancial performance measures as coordination devices in the two companies might be caused by the fact that the myopia problem was only a problem of lack of information and not a problem of lack of incentive. If the controllers had also needed to resolve an incentive problem through the performance measures and had priced each externality issue not only on the basis of the production of externality costs and benefits but also on costs of manipulability, risk, and completeness, the situation would have been much more complex and not necessarily measurable for the controllers.

Thus, this paper illustrates how centralised planning might also play a role in lean manufacturing, which so often praises the principle of empowerment (Womack et al., 1991). The decentralised agents (i.e., workers and engineers) in the two lean manufacturers included in the case study requested information about how their own performance would affect others. These effects were not something that they had the time or competences to specify themselves. This task was considered to be a centralised job. However, integration in the two lean manufacturers was not only achieved through the performance measurement system but target setting and choices of performance measures played a significant role in terms of providing decision makers with specific information about the trade-offs and synergies between organisational tasks and how they should be dealt with from an overall firm perspective. This was apparently not information that the individual worker or engineer possessed.

5.4. Further reflections on the choice of nonfinancial performance measures in general

The central role of an organisation's strategy has often been emphasised when it comes to explaining the choice of nonfinancial performance measures in organisations (Eccles, 1991; Kaplan and Norton, 1996; Epstein and Manzoni, 1997; Otley, 1999; Ittner and Larcker, 2003). Empirical and field research has illustrated how the choice of performance measures is linked to the organisation's strategy (e.g. Govindarajan and Gupta, 1985; Simons, 1987; Ittner et al., 1997; Malina and Selto, 2001; Malina and Selto, 2004), how nonfinancial performance measures reflect value drivers of organisations (Ittner and Larcker, 1998a; Sedatole, 2003; Kaplan and Norton, 2004; Bryant et al., 2004), and how nonfinancial performance measures play a significant role in terms of strategy implementation as well as strategy development (Langfield-Smith, 1997; Bhimani and Langfield-Smith, 2007).

The results presented in this paper do not contradict such research but rather add to it as well as putting the role of strategy into perspective when it comes to choosing valuable nonfinancial performance measures in organisations. By highlighting how the transaction costs (in this case, the costs of externalities) of performing along a particular dimension of nonfinancial performance affects its value, more issues are added to the analysis of the value of nonfinancial performance measures in the individual organisational setting. Strategy is a factor that affects the value of the individual dimension of nonfinancial performance, not least when it comes to understanding its benefits. However, an analysis of the transaction costs of performing along the particular dimension of performance that the performance measure represents should also be included. This paper demonstrates this by focusing on how task interdependency among the measured nonfinancial performance and other organisational tasks affects firm value creation.

This type of transaction cost-based analysis is of course limited with respect to explaining performance measurement system change in general. Broader frameworks are often necessary to understand choices and changes related to performance measurement systems in practice (Mouritsen, 1999; Vaivio, 1999a,b; Wouters and Wilderom, 2008) in part because interests (Chua, 1995; Briers and Chua, 2001) and institutional concerns (Granlund and Lukka, 1998; Burns and Scapens, 2000) are drivers of accounting change and resistance. Nevertheless, the relatively limited analysis in this paper of the value of three nonfinancial performance measures in the two organisational settings has made it possible to study and illustrate externalities as the determining factor when it comes to performance measurement system design. This is part of the explanation of what drives changes to management accounting practices in organisations.

6. Conclusions

This paper highlights that the problem of externalities is not only caused by myopic decision makers with no incentive to internalise the external effect of their decisions. The problem is also caused by decision makers with the best intensions that nevertheless lack information about how their actions affect others or how to correct them to act in the interest of the organisation. This paper illustrates how controllers' choice of performance measures and target setting plays a central role in terms of providing decentralised agents (i.e., workers and engineers) with information about how to act to internalise their externalities.

Furthermore, by means of a case study, this paper illustrates that despite the coordination mechanisms present in the two lean manufacturers studied, including multi-functional skilled workers, cross-functional teams, value-stream mapping, and pull production, there was still a need for more information about how to balance interdepartmental decisions. The study illustrates how nonfinancial performance measures played a critical role with respect to fulfilling this need. By emphasising the nonfinancial performance measurement system's role as a centralised planning system, the paper supplements the analyses of externality resolutions in management accounting research, which have been primarily focused on the design of incentive systems rather than planning systems.

The planning of nonfinancial performance in the two organisations was based on the principle that if nonfinancial performance created a negative (or positive) externality, the externality could be internalised by adjusting the performance target in a downwards (or upwards)

direction. Furthermore, the choice of performance measures was also used for the provision of information about externalities. When the negative externalities that occurred from a nonfinancial performance measure were so high that they eliminated the value of performing along this dimension of nonfinancial performance, the performance measure was not implemented because the companies were better off without enhanced performance along this dimension.

An additional point derived from the case study is that although the two organisations were very similar, the same measures had different effects in each of the organisations. This illustrates some of the obstacles that are encountered when trying to produce general knowledge about which nonfinancial performance measures fit best into different types of organisations. The case study illustrates how the details related to the operational, organisational, and technological sides that often escape general characterisations of the organisations nevertheless determined the externalities of the performance measures and thereby their value and fit in the individual organisation. The capability to include these details in the analysis illustrates again how case studies supplement and add to other types of research methods. The importance of studying accounting in the context in which it operates (Hopwood, 1983) is emphasised, especially when it comes to producing specific knowledge of how the externalities are created in practice and how the economics of multiple dimensions of nonfinancial performance are determined.

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