The RELATIONSHIP BETWEEN COST SYSTEM DESIGN, PURPOSES OF USE, and COST SYSTEM EFFECTIVENESS

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Abstract:

This paper uses survey data from 133 Dutch, medium-sized manufacturing firms to empirically investigate whether a closer alignment (or 'fit') between the design of cost systems and their purposes of use is associated with a higher level of cost system effectiveness, as proxied by the level of usage of and satisfaction with the cost systems. Concentrating on firms using a full product costing system, the number of cost pools and cost allocation bases used in the cost system are used to operationalize cost system design (or complexity) choices. Two general dimensions are found to underlie cost system usage for nine widely used purposes: usage for strategic purposes and for operational purposes. The results also indicate that cost system complexity and usage for strategic purposes interact negatively in their influence on its effectiveness, whereas cost system complexity and usage for operational purposes interact positively. This implies that when cost system design and the purposes of use are better aligned, the cost system is perceived to be more effective.

Keywords: cost system, design, purposes, effectiveness, fit

Contents:

INTRODUCTION

This paper examines the associations between cost system design, purposes of use, and cost system effectiveness. Almost two decades ago the introduction of activity-based costing (ABC) renewed interest from both practitioners and researchers in the design of cost systems. Since then, a series of studies has empirically examined the determinants of cost system design, in particular those influencing the adoption and use of ABC (e.g., Bjørnenak, 1997; Gosselin, 1997; Krumwiede, 1998). To date, the results of such studies are unstable, however, both between and within studies. One claimed reason for these unstable results is that these studies have focused on a too limited view on cost system design, mostly adoption (or use) versus non-adoption (or non-use) of ABC (Drury and Tayles, 2005). Recent studies by Abernethy et al. (2001) and Drury and Tayles (2005) have started to broaden the scope of cost system design studied, by instead focusing on the distinguishing characteristics of cost systems. This alternative conceptualization has some clear advantages. A consequence of its usage, however, is that whereas ABC adoption choices mainly seem to be driven by environmental, organizational and technological factors, such factors seem to play a less important role for choices on the design (or complexity) of cost systems. Design choices instead mainly seem to be driven by the purposes for which the system is being used. Another series of studies has empirically examined the effectiveness of cost systems design, in particular the effects of using ABC on firms' financial performance (e.g., Cagwin and Bouwman, 2002; Ittner, Lanen and Larcker, 2002; Kennedy and Affleck-Graves, 2001). Overall, these studies show fairly consistent results: when ABC is implemented effectively and in an appropriate environment, its use seems to have positive effects on firms' financial performance. Using a broader conceptualization of cost system design, Pizzini (2006) has recently examined the effects of cost system design on the relevance and usefulness of cost data, and on the financial performance of hospitals. None of these studies has examined the influence of purposes of use[1], which is the focus of this study.

The primary objective of this paper is to investigate whether a closer alignment (or 'fit') between the design of cost systems and their purposes of use is associated with a higher level of cost system effectiveness, as proxied by the level of usage of and satisfaction with the cost systems. Concentrating on firms using a full product costing system, the number of cost pools and cost allocation bases used in the cost system are used to operationalize cost system design (or complexity) choices. For the empirical analyses survey data from 133 Dutch, medium-sized manufacturing firms are used.

This study contributes to the literature in two ways. First, this is the first study in which underlying dimensions of cost system purposes of use are empirically examined. The dimensions identified are related to cost system usage for strategic purposes and for operational purposes, respectively. Second, building on these two dimensions, this study extends the literature on the alignment between the design (or complexity) of cost systems and their purposes of use. Specifically, the (interactive) influence of cost system complexity and usage for strategic and operational purposes on cost system effectiveness (as proxied by the level of usage of and satisfaction with the cost systems) is examined, controlling for the influence of environmental, organizational and technological factors. Overall, the results suggest that cost system complexity and usage for strategic purposes interact negatively in their influence on its effectiveness. In contrast, cost system complexity and usage for operational purposes interact positively. This implies that when cost system design and the purposes of use are better aligned, the cost system is perceived to be more effective.

The remainder of this paper is structured as follows. Section two reviews the literature and develops the research questions. Section three describes the research methods used. Section four presents and discusses the results. Section fives concludes and discusses limitations.

LITERATURE REVIEW AND RESEARCH QUESTIONS

The theoretical foundation of this study is contingency theory, which contends that there is no universally applicable system of management accounting and control. Instead the most appropriate system depends on the specific circumstances confronting an organization. The alignment (or 'fit') between the design of management accounting and control systems and contextual (or 'contingency') factors is therefore what contingency theory focuses attention on. The main focus of this study is on the alignment between the design of cost systems and their purposes of use, and their joint influence on their (perceived) effectiveness.

Contextual factors and cost system design

During the last decade, a series of studies has empirically examined the determinants of cost system design. Mostly, these studies have focused on choices related to the adoption (or use) versus non-adoption (or non-use) of activity-based costing (ABC). Based on their origin, the contextual factors that have been studied so far can broadly be divided into two categories. The first category consists of contextual factors that are logically related to the theory underlying ABC. The rationale behind these factors is that the literature suggests that ABC is more suitable for certain kinds of organizations, and that if these organizations adopt ABC more often than other types of organizations, then we may assume that the adoption decisions have in general been fairly rational (Malmi, 1999). The contextual factors in this category originate from Cooper (1988), who has provided guidelines for the circumstances that are conducive for ABC adoption. These circumstances are related to four factors: cost structure, competition, product diversity and existing cost system. Bjørnenak (1997) and Malmi (1999), among others, have examined the association of these factors with ABC adoption. The second category consists of contextual factors that are argued to influence organizational innovativeness. The argument behind these factors is that certain factors influence the innovativeness of an organization and may facilitate or hinder the adoption of management accounting innovations such as ABC. The contextual factors in this category mostly originate from the innovation diffusion-adoption literature. Typical examples of factors from this category are the strategy, structure and size of organizations. Gosselin (1997) and Malmi (1999), among others, have examined the association of such factors with ABC adoption. Alternatively, the contextual factors that have been studied so far can also be divided into categories based on their nature, as is done in this study, in which a distinction is made between environmental, organizational and technological factors. Environmental factors relate to the external environment of an organization. Organizational factors relate to the strategy and structure of an organization. Finally, technological factors relate to the fundamental work processes in an organization. Overall, the results of empirical studies of the determinants of ABC adoption to date are highly unstable, both between and within studies. Typical explanations offered for these unstable results are that most studies to date have used inconsistent definitions of and measurement instruments for both ABC adoption and its (proposed) determinants, and that some have used rather small sample sizes. Recently, two studies have argued that another (possible) explanation is that studies have a too limited view on cost system design choices (Abernethy et al., 2001; Drury and Tayles, 2005). These studies have started to broaden the scope of choices studied by focusing on the distinguishing characteristics of cost systems.

Cost system design and purposes of use

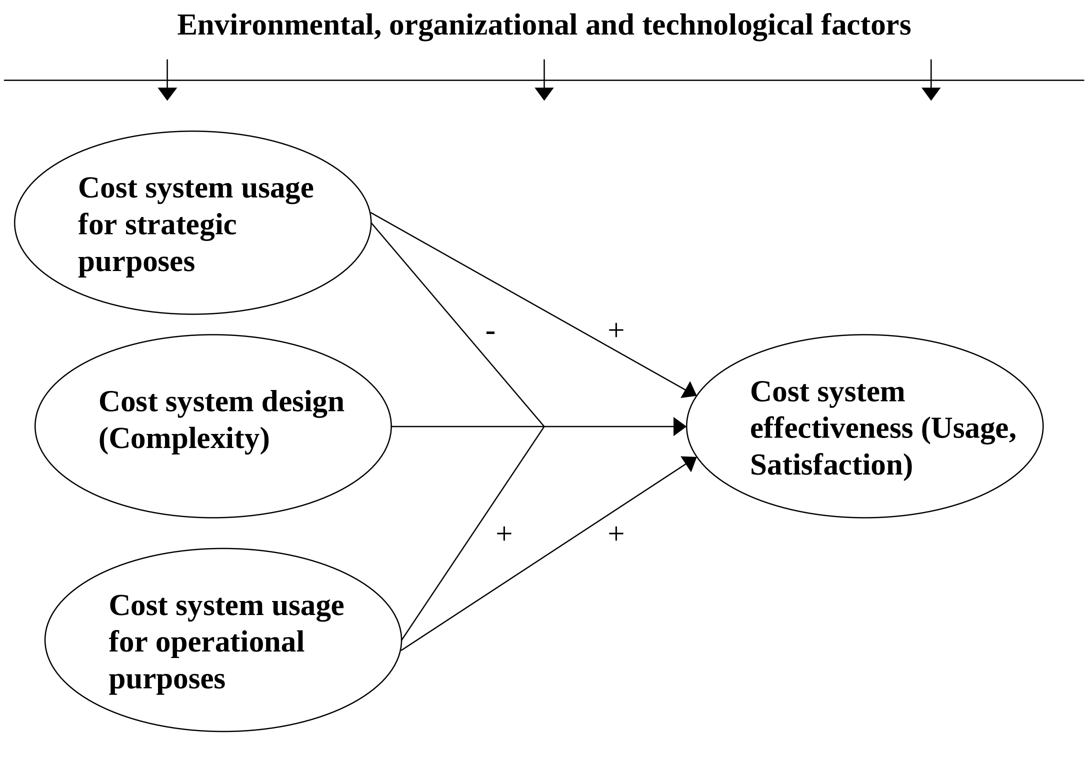
Abernethy et al. (2001) view cost system design choices as varying along three dimensions: number of cost pools (single versus multiple cost pools), nature of cost pools (responsibility-based versus activity-based cost pools), and nature of cost allocation bases (volume-based versus hierarchical cost allocation bases). Together these dimensions form a continuum of (what they refer to as) cost system sophistication, with one end of the continuum representing a simple traditional cost system (with a single responsibility-based cost pool and a volume-based cost allocation base) and the other end representing a sophisticated cost system (with multiple activity-based cost pools and hierarchical cost allocation bases). Similarly, Drury and Tayles (2005) view cost system design choices as varying along a continuum of (what they refer to as) cost system complexity. They suggest that three factors determine the level of complexity of a cost system: the number of cost pools, the number of different types of cost allocation bases and the nature of these bases (transaction, duration, or intensity)[2]. Combining both views, it can be observed that what distinguishes a traditional cost system from an ABC system is not so much the number, but the nature of cost pools and/or cost allocation bases used. Both a traditional and an activity-based cost system may have a small to a large number of cost pools and cost allocation bases, but only an activity-based cost system may have activity-based cost pools (as opposed to responsibility-based) and/or hierarchical (e.g., batch-level, product-level and facility-sustaining) cost allocation bases (as opposed to volume-based only).

This alternative, broader conceptualization of cost system design choices has some clear advantages. A consequence of its usage, however, is that whereas ABC adoption choices mainly seem to be driven by environmental, organizational and technological factors, such factors seem to play a less important role for choices on the design (or complexity) of cost systems, since such choices mainly seem to be driven by the purposes for which the system is being used. The literature generally distinguishes between cost system usage for strategic purposes, such as product pricing and new product design, and for operational purposes, such as performance measurement and budgeting. This distinction is important because it is argued that usage for operational purposes requires a more detailed (i.e., complex) cost system design than usage for strategic purposes (e.g., Kaplan and Cooper, 1998), which applies to both traditional and activity-based cost systems.

Cost system design and effectiveness

In recent years, several studies have empirically examined the effectiveness of cost system design. Most of these studies have focused on the effects of using ABC on firm performance. These studies can broadly be classified into two categories. The first category of studies seeks to identify the determinants of ABC effectiveness for firms that have implemented ABC. These studies mostly use perceptual measures of ABC effectiveness, such as usage of and satisfaction with the cost system, and 'perceived success' of the ABC implementation (e.g., Shields, 1995; Foster and Swenson, 1997). Overall, the results of these studies are fairly consistent: several behavioral and organizational variables, such as top management support and training of employees, are consistently found to be significantly and positively associated with ABC effectiveness. The second category of studies compares the performance of ABC-using firms with a benchmark, usually the performance of non-ABC-using firms. These studies mostly use financial performance measures, such as firms' stock return (e.g., Kennedy and Affleck-Graves, 2001) or their operating performance (e.g., Cagwin and Bouwman, 2002; Ittner, Lanen and Larcker, 2002). Overall, these studies also show fairly consistent results: when ABC is implemented effectively and in an appropriate environment, its use is found to have positive effects on firms' financial performance. Pizzini (2006) has recently examined the effects of four critical attributes of cost system design on the relevance and usefulness of cost data, and on the financial performance of hospitals. These four attributes relate to the level of detail provided, the ability to disaggregate costs according to behavior, the frequency with which information is reported, and the extent to which variances are calculated. One of Pizzini's findings was that the level of detail provided related significantly and positively to both the relevance and usefulness of cost data.[3] More detailed cost information was also significantly and positively associated with three of her four measures of financial performance. These results indicate that more detailed cost systems provide more relevant and useful cost data, which in turn lead to better financial performance; however, these findings do not differentiate between different purposes of use of cost information and systems.

Figure 1: A model of the relationship between cost system design, purposes of use, and cost system effectiveness



Research questions

The key focus of this paper is on the purposes for which cost systems are being used. It aims to extend the current literature on cost system design by answering two questions:

1. What are the underlying dimensions of cost system purposes of use?
2. What is the relationship between the design (complexity) of cost systems, their purposes of use, and their (perceived) effectiveness?

In order to answer the first question, exploratory factor analysis is used to identify underlying dimensions of cost system purposes of use among nine widely used purposes. Based on the literature, two dimensions are expected to be found: usage for strategic purposes and for operational purposes. The second question will be answered by examining the (interactive) influence of cost system complexity and usage for strategic and operational purposes on cost system usage and satisfaction. These analyses control for the influence of environmental, organizational and technological factors, since these factors not only may influence cost system design and purposes of use, but also cost system usage and satisfaction. The literature suggests that usage for operational purposes requires a more detailed (i.e., complex) cost system design than usage for strategic purposes, for which a too detailed design may be harmful (e.g., Kaplan and Cooper, 1998). Therefore, it is expected that cost system complexity and usage for strategic purposes interact negatively in their influence on its effectiveness, whereas cost system complexity and usage for operational purposes interact positively.[4] This would be evidence that if the design of cost systems and their purposes of use are better aligned, cost systems are perceived to be more effective. Figure 1 summarizes these relationships.

RESEARCH METHOD

In the Spring of 2002, I conducted a survey-study on the use of cost systems in medium-sized, Dutch manufacturing firms. Medium-sized firms were targeted because large(r) firms commonly consist of a number of organizational units, which may not all use the same (or even a similar) cost system, whereas small(er) firms may not use (sophisticated) cost allocation systems at all. The data used in this paper are (almost exclusively) taken from this survey-study.

Sample and data collection

I selected the sample for this study from the database REACH. This database contains comprehensive financial and economic information on the largest 5 000 firms in the Netherlands for the last ten years. Firms were included in the sample if they had between 50 and 500 employees, and if their main activity was in a manufacturing industry. These criteria yielded 2 108 firms representing all major manufacturing industries. Next, these firms were categorized into two groups, based on the amount of information available in the database. This division was made because resources were limited, and I wanted to spend most resources on those firms for which the database contained the fullest information. The first group contained all firms providing full information for at least three, non-broken financial years (672 firms). The second group contained all other firms (1 436 firms). Since larger firms have an obligation to publish these data, these mainly populated the first group, and consequently the firms in this group were larger than those in the second group.

Firm-level data on cost systems, and characteristics of the firm unavailable in the database, were collected with a questionnaire mailed to either the general manager or the financial manager in each firm. The questionnaire was pretested with six financial managers, which led to some (small) changes in the questionnaire. The procedure for firms in the first group consisted of, at the most, four moments of contact: contact by phone, and sending a questionnaire, reminder postcard and replacement questionnaire. The procedure for firms in the second group consisted of, at the most, two moments of contact: sending a questionnaire and replacement questionnaire. In all cases, together with the questionnaire and the replacement questionnaire, I sent the respondent an accompanying letter explaining the purpose of the study and guaranteeing confidentiality, as well as a postage-paid return envelope. Also, at the final moment of contact in each procedure, I sent the respondent a postage-paid return card asking the reason(s) for leaving the questionnaire unanswered.[5] In return for their help, I offered respondents the possibility to receive a benchmark report and/or copies of Dutch articles based on the study.

Eventually, 137 firms from the first group and 81 from the second returned a questionnaire. In addition, 14 questionnaires were returned anonymously. Seven questionnaires were unusable because of too many missing values. The overall usable response rate is therefore 10.7%.[6] For the analyses of this paper all returned questionnaires are pooled. Except for the difference by design in organizational size, there are no a priori reasons to assume that the responses from firms in the first group will differ from responses from firms in the second.[7] Consistent with this presumption, Chow tests (e.g., Greene, 2000) for all models show no significant differences between the two groups. The average respondent is 41 years of age (median = 40.5 years), is working at his/her employer for almost 9 years (median = 5 years), and holds his/her position for a little more than 5 years (median = 3 years).

For the analyses reported in this paper, the available number of observations is less than the overall sample, which is caused by two major reasons. First, I concentrate on firms using a full product costing system in this paper. In the questionnaire respondents were asked to answer all questions concerning cost system complexity, purposes of use, usage and satisfaction, for their firm's cost system that (at least) is used for the calculation and processing of its manufacturing costs. Respondents from firms that only used variable costing (15 firms) were asked to skip the questions concerning cost system complexity and purposes of use, as the cost system complexity questions are irrelevant for these firms. Second, as in most survey studies, missing data had to be dealt with. The overall percentage of missing values was slightly below 3%. These values were dealt with in two steps. In the first step, where appropriate, they were handled using EM imputation (e.g., Allison, 2001). In the second step, remaining missing values, among others on the questions concerning cost system complexity and purposes of use, were handled using listwise deletion. The sample left after listwise deletion included 137 cases. Four additional observations were removed from the dataset after an extensive examination of regression diagnostics, however.[8] This left a usable sample of 133 cases for the analyses reported in this paper.

Measures

Table 1 describes all variables examined in this study, and the measurement instruments used to measure them (see also Appendix A). Except for the data on the firms' size, which were collected from the database out of which the firms were selected, all data are from the survey-study. Most measurement instruments are multi-item, use five-point Likert-type scales, and are taken or adapted from earlier studies.[9] Consistent with these earlier studies, for all multi-item measurement instruments (except the Cost system purposes of use measure) composite scales were constructed by averaging the scores on their indicators. As indicated earlier, the level of usage of and satisfaction with the cost systems are used as proxies for their effectiveness. Information system usage and satisfaction are both widely used to measure the effectiveness of information systems (IS) within organizations in the IS literature (e.g., DeLone and McLean, 1992), and have also been used in prior management accounting studies (e.g., Cagwin and Bouwman, 2002; Pizzini, 2006).

Table 1: Description of variables and measurement instruments

Variable	Measurement instrument
- Cost system complexity (CSCOMPL)	- Number of cost pools used, measured on a $\log_2 N$ scale, added to number of cost allocation bases used, also measured on a $\log_2 N$ scale
- Cost system purposes of use (CSPURP)	- A question with respect to whether a firm uses its cost system for each of nine widely used general purposes of cost systems
- Cost system usage (CSUSAGE)	- Single question, measured on a five-point scale, with respect to the extent to which the cost system is used to make decisions
- Cost system satisfaction (CSSATISF)	- Single question, measured on a five-point scale, with respect to the extent to which users of the information of the cost system are satisfied with the system
Environmental factors	
- Competition (COM)	- Average of three items, measured on a five-point scale, with respect to the level of intensity of the competition in the market(s) (instrument adapted from Khandwalla, 1972)
- Perceived environmental uncertainty (PEU)	- Average of eight items, measured on a five-point scale and weighted based on their level of importance, with respect to the level of predictability of the external environment during the last five years (instrument taken from Hoque, 2001)
Organizational factors	
- Competitive strategy (COMS)	- Average of six items, measured on a five-point scale, with respect to the level of product/market innovation (instrument taken from Delery and Doty, 1996)
- Vertical differentiation (VERT)	- Number of hierarchical levels between senior management and team leaders (instrument taken from Gosselin, 1997)
- Formalization (FORM)	- Average of four items, measured on a five-point scale, with respect to the degree to which tasks are standardized (instrument taken from Gosselin, 1997)
- Centralization (CENT)	- Average of twelve items, measured on a five-point scale, with respect to the degree to which power and control in the firm are concentrated in the hands of relatively few individuals (instrument taken from Gosselin, 1997)
- Size (SIZE)	- Ln-transformation of average number of employees in the three years preceding the data collection (Source data: REACH)
Technological factors	
- Product diversity (PD)	- Number of different products (stockkeeping units) produced, measured on a $\log_2 N$ scale, multiplied by the average of three items, measured on a five-point scale, with respect to the extent to which these products (stockkeeping units) differ on average
- Advanced manufacturing technology (AMT)	- Average of nine items, measured on a five-point scale, with respect to the extent to which advanced manufacturing technologies are used in the production process in the firm (instrument taken from Boyer et al., 1997)
- Production lines (PRLIN)	- Number of production lines, measured on a $\log_2 N$ scale
- Production process (PRPRO)	- Dummy variable classifying the structure of the production process in the firm, where 1 = homogeneous mass production (the reference group), 2 = heterogeneous mass production, 3 = serial unit production, and 4 = unit production

Cost system complexity, purposes of use, usage and satisfaction

Cost system complexity (CSCOMPL). Similar to Drury and Tayles (2005), CSCOMPL was measured using two questions. In these questions respondents were asked to indicate the number of cost pools and the number of cost allocation bases used in their firm's cost system. Both were measured using a $\log_2$ N scale, since the influence of both the number of cost pools and the number of cost allocation bases on cost system complexity is posited to be nonlinear.[10] A composite scale was constructed by adding the two $\log_2$ N scores for each firm.

Cost system purposes of use (CSPURP). Respondents were asked to indicate whether their firm uses its cost system for each of nine widely used purposes of cost systems (see Table 2). Appendix B shows the usage rates for the nine purposes, as well as their intercorrelations. The nine purposes were taken from Innes and Mitchell (1995), and have also been used by Innes, Mitchell and Sinclair (2000) and Cotton, Jackman and Brown (2003). In order to identify underlying dimensions of cost system purposes of use among the nine items, exploratory factor analysis was used.[11] Table 2 presents the results of using principle axis factoring and an oblique rotation (Direct Oblimin) to extract two factors with (initial) eigenvalues greater than one that together explain 36.8 percent of the total variance of the nine items.[12] The factor analysis yields a well-behaved solution, with items typically loading on a single factor with a loading greater than .300 and few significant cross-loadings.[13]

*Table 2: Common factor analysis results for cost system purposes of use items (*N = *133)*

Items	Oblique-rotated loadings Factor 1: Cost system usage for operational purposes	 Factor 2: Cost system usage for strategic purposes
Cost reduction	**.553**	-.040
Product pricing	-.143	**.580**
Performance measurement	**.616**	.070
Cost modeling	**.795**	-.134
Budgeting	**.396**	.015
Customer profitability analysis	**.313**	**.513**
Product output decisions	**.482**	**.370**
New product design	.147	**.487**
Stock valuation	-.046	**.586**
Variance explained by each factor	26.3%	10.5%

Notes: Oblique-rotated loadings above .300 in bold.

Inspection of the primary loadings (values greater than .300) is used to interpret each of the two dimensions of cost system purposes of use. The first factor, which loads heavily on such items as cost modeling, performance measurement and cost reduction, is interpreted as "cost system usage for operational purposes". The second factor, which loads heavily on such items as stock valuation[14], product pricing and customer profitability analysis, is interpreted as "cost system usage for strategic purposes". The correlation between the two factors is .390 (see Table 3), indicating that usage of cost systems for strategic and operational purposes is complementary: firms using their cost system for operational purposes also tend to use it for strategic purposes, and vice versa. Factor scores (calculated using Thurstone's least squares regression approach) are used to measure the two dimensions of cost system purposes of use.

Cost system usage (CSUSAGE). CSUSAGE was measured with a single question asking respondents to rate the extent to which the cost system is used to make decisions in their firm.

Cost system satisfaction (CSSATISF). CSSATISF was measured with a single question asking respondents to rate the extent to which users of the information of the cost system are satisfied with the system in their firm.

Environmental factors

Competition (COM) was measured using an (adapted) instrument developed by Khandwalla (1972). Respondents were asked, on a five-point scale ranging from 1 (not at all) to 5 (to a very great extent), to indicate the intensity of their firm's market competition with respect to three elements: price competition, product competition and marketing competition. A composite scale was constructed by averaging the scores on these three items.

Perceived environmental uncertainty (PEU) was measured using an instrument developed by Govindarajan (1984) and Gordon and Narayanan (1984), and adapted by Hoque (2001). Respondents were asked, on a five-point scale ranging from 1 (very unpredictable) to 5 (very predictable), to indicate their perceptions of the predictability of eight elements of the firm's external environment during the last five years. Next, respondents were asked, also on a five-point scale (1=not at all – 5=to a very great extent), to indicate the extent to which these elements are important for the success or failure of their firm. The answers given to the first question were for each item multiplied by the answers given to the second, square roots were taken, and the average of respondents' weighted scores were taken to derive a composite scale.

Organizational factors

Competitive strategy (COMS) was measured using an instrument developed by Segev (1989), and adapted by Delery and Doty (1996). This instrument regards the strategic contingency variable best representing the Miles and Snow (1978) typology to be rate of product/market innovation. Respondents were asked, on a five-point scale (1=not at all – 5=to a very great extent), to indicate the extent to which six product/market innovation characteristics apply to their firm. A composite scale was constructed by averaging the scores on these six items.

Vertical differentiation (VD) was measured as the total number of hierarchical levels between senior management and teamleaders in the respondent's firm (cf. Gosselin, 1997).

Formalization (FORM) was measured using four statements about the extent to which rules, procedures and policies are standardized in the respondent's firm. This instrument was taken from Gosselin (1997), who adapted it from Robbins (1983). A composite scale was constructed by averaging the scores on these four statements pertaining to formalization.

Centralization (CEN) was measured using a series of twelve standard decisions and identifying on a five-point scale, ranging from teamleader to head office manager, the level at which decisions are made. This instrument was taken from Gosselin (1997), who adapted it from Pugh et al. (1968). A composite scale was constructed by averaging the scores on these twelve decision items.

Organizational size (SIZE) was measured as the number of employees. The instrument is transformed into a ln-scale because the distribution of the original values was highly skewed (i.e., nonnormal). For this measure the data were obtained from the REACH database.

Technological factors

Product diversity (PD) was measured by two questions. First, respondents were asked to indicate the number of different products (stockkeeping units) produced in their firm. This was measured using a $\log_2 N$ scale. Second, respondents were asked to indicate to what extent the products (stockkeeping units) produced in their firm differ on average on three dimensions: physical size, complexity and batch size. The $\log_2 N$ scores were multiplied by the average of the three dimensions to obtain the measure of product diversity.

Advanced manufacturing technology (AMT) was measured using the part of an instrument developed by Boyer et al. (1997) concentrating on manufacturing AMT's. Respondents were asked, on a five-point (1=not at all – 5=to a very great extent), to indicate the extent to which nine advanced manufacturing technologies are used in their firm's production process. A composite scale was constructed by averaging the scores on these nine items.

Production lines (PRLIN). To measure PRLIN, respondents were asked to indicate the number of production lines in their firm. This was measured using a $\log_2 N$ scale.

Production process (PRPRO). In order to measure PRPRO, respondents were asked to indicate which of the following classifications best describes the structure of the production process in their firm: homogeneous mass production, heterogeneous mass production, serial unit production, or unit production.

RESULTS AND DISCUSSION

The main statistical methods used in the analyses are correlation coefficients and regression analysis including interaction terms. Following guidelines from the American Psychological Association (e.g., Wilkinson and the APA Task Force on Statistical Inference, 1999), exact *p* values and effect sizes are reported wherever appropriate. Also, as recommended when estimating regression models containing interactions (e.g., Cohen et al., 2003), all continuous independent variables were mean centered before entering them in the models. This procedure has both interpretational advantages (as it yields meaningful interpretations of each first-order regression coefficient of independent variables entered into the regression model), and eliminates nonessential multicollinearity.[15]

Descriptive statistics

On average, the studied firms use their cost system for almost 6.5 of the nine cost system purposes (median = 6), with a range from 1 to 9. Appendix B shows the usage rates for the nine purposes. The purposes with the highest usage rates found are product pricing (95.5%), budgeting (90.2%) and stock valuation (77.4%). The purposes with the lowest usage rates found are performance measurement and new product design (both 64.7%), customer profitability analysis (61.7%) and product output decisions (55.6%). Note that there is no discernible pattern contrasting strategic and operational purposes in these usage rates.
Table 3 presents the descriptive statistics for the main variables used in this study.

*Table 3: Descriptive statistics (*N = *133)*

Variables	Mean	S.D.	CSUSAGE	CSSATISF	STRATPURP	OPERPURP	CSCOMPL
CSUSAGE	3.711	.849	1.000				
CSSATISF	3.372	.802	.432***	1.000			
STRATPURP	.000	.830	.260***	.238***	1.000		
OPERPURP	.000	.884	.240***	.238***	.390***	1.000	
CSCOMPL	7.135	2.325	.181**	.141	.012	.282***	1.000
COM	3.401	.601	.103	.034	.189**	.173**	.129
PEU	3.021	.342	.162*	.130	.115	.061	.009
COMS	2.988	.696	.145*	.128	.016	.160*	.121
VERT	2.193	1.086	.101	.126	.003	.077	.280***
FORM	3.214	.586	.242***	.052	-.083	-.026	.050
CENT	3.630	.557	.156*	.004	.003	.007	.129
SIZE	4.945	.618	.055	.106	-.012	.002	.151*
PD	24.788	13.506	.286***	.012	.084	.092	.191**
AMT	2.174	.713	.175**	.201**	-.055	.174**	.219**
PRLIN	2.770	1.377	.127	.142	.109	-.005	.181**
HomMass	.083	-	.135	.065	.014	.049	.041
HetMass	.263	-	.174**	-.043	.128	.070	.039
SerUnit	.451	-	-.172**	.003	-.085	-.041	-.053
Unit	.203	-	-.070	-.001	-.045	-.060	-.005

Notes: ***, **, * indicates significance at the .01, .05 and .10 level (two-tailed), respectively. See Appendix C for the Pearson product-moment correlations for the independent variables.

As observed in Table 3, the examined aspects of cost system complexity, purposes of use, usage and satisfaction are all significantly and positively interrelated, except for two pairs (CSCOMPL and CSSATISF, and CSCOMPL and STRATPURP). Especially interesting is that CSCOMPL is significantly associated with OPERPURP, but not with STRATPURP. As expected, this finding indicates that when cost systems are used more for operational purposes, their design tends to be more complex, whereas this is not the case for strategic purposes. The correlations with the contextual factors show that STRATPURP is only significantly and positively associated with COM, while OPERPURP is significantly and positively associated with COM, COMS and AMT. Finally, CSCOMPL is significantly and positively associated with VERT, SIZE, PD, AMT and PRLIN. This indicates that a firm's cost system tends to be more complex when it's number of hierarchical levels is higher, it employs more employees, the number of and the differences between the products it produces are larger, it uses more advanced manufacturing technologies, and the number of production lines that it operates is higher. These last findings confirm the results of Drury and Tayles (2005), who also found cost system complexity to be positively associated with firms' size and level of product diversity.

Table 4 provides further detail of the associations between cost system usage for the nine purposes and the contextual factors.

*Table 4: Point-biserial correlations between cost system usage for the nine purposes and the contextual factors (*N *= 133)*

Items	COM	PEU	COMS	VERT	FORM	CENT	SIZE	PD	AMT	PRLIN
Cost reduction	.220**	.041	.104	.088	.069	.089	.042	.150*	.153*	-.076
Product pricing	.085	.030	-.091	.005	.002	.051	-.061	.000	-.122	-.010
Performance measurement	.162*	.045	.152*	.087	-.014	.064	-.017	.146*	.115	-.032
Cost modeling	.063	-.027	.150*	-.019	.003	-.084	-.021	.036	.185**	-.027
Budgeting	.136	.044	.043	.223**	-.042	.242***	.100	.051	.041	-.074
Customer profitability analysis	.184**	.103	.079	.131	.006	.022	-.001	.110	.065	.116
Product output decisions	.084	.164*	.023	.005	-.167*	-.084	-.042	-.064	.039	.103
New product design	.057	.035	.055	-.067	-.047	.043	.076	.029	-.166*	.060
Stock valuation	.211**	.041	.043	-.097	-.081	-.069	-.009	.178**	.054	.080

Notes: ***, **, * indicates significance at the .01, .05 and .10 level (two-tailed), respectively.

Sixteen of the associations shown in Table 4 are significant, of which fourteen are positive and two are negative. Focusing on the strongest effects, with respect to the environmental factors, these results indicate that a higher intensity of market competition is associated with usage of cost systems for cost reduction, customer profitability analysis and stock valuation. With regard to the organizational factors, both a higher level of vertical differentiation and a higher level of centralization are associated with usage for budgeting. Finally, with respect to the technological factors, a higher level of usage of advanced manufacturing technologies is associated with usage for cost modeling, and a higher level of product diversity is associated with usage for stock valuation.

The relationship between cost system complexity, purposes of use, and cost system usage

Table 5 presents the results of a series of nested regression models testing the influence of cost system complexity and purposes of use on cost system usage, controlling for the influence of several environmental, organizational and technological factors.

*Table 5: Regression analysis results for the association between cost system complexity, purposes of use, and cost system usage (*N *= 133)*

Independent variables	Model 1 (control variables only)	Model 2 (control variables & main effects)	Model 3 (control variables, main effects & interaction effects)
Intercept	4.177***	4.142***	4.124***
	(.240)	(.233)	(.230)
	-	-	-
COM	-.046	-.114	-.174
	(.125)	(.123)	(.123)
	-.032	-.081	-.123
PEU	.411*	.375*	.343*
	(.211)	(.207)	(.204)
	.165	.151	.138
COMS	.074	.072	.070
	(.108)	(.105)	(.104)
	.061	.059	.057
VERT	-.036	-.041	-.053
	(.067)	(.067)	(.066)
	-.045	-.053	-.068
FORM	.344***	.365***	.365***
	(.120)	(.116)	(.114)
	.237	.252	.252
CENT	.157	.160	.147
	(.134)	(.131)	(.131)
	.103	.105	.096
SIZE	.066	.066	.060
	(.112)	(.110)	(.108)
	.048	.048	.044
PD	.020***	.019***	.019***
	(.006)	(.005)	(.005)
	.321	.302	.296
AMT	.067	.060	.066
	(.105)	(.105)	(.103)
	.056	.051	.055
PRLIN	.018	.007	.009
	(.053)	(.053)	(.052)
	.029	.011	.015
HetMass	-.263	-.271	-.324
	(.278)	(.271)	(.267)

	-.137	-.141	-.169
SerUnit	-.657**	-.600**	-.633**
	(.258)	(.251)	(.247)
	-.387	-.353	-.373
Unit	-.494	-.440	-.420
	(.301)	(.293)	(.287)
	-.235	-.209	-.200
CSCOMPL		.018	.026
		(.032)	(.032)
		.048	.071
STRATPURP		.198**	.211**
		(.089)	(.090)
		.193	.206
OPERPURP		.099	.137
		(.086)	(.087)
		.103	.143
CSCOMPL*STRATPURP			-.084**
			(.041)
			-.177
CSCOMPL*OPERPURP			.078**
			(.036)
			.177
$R^2 adj$	.188	.238	.268
F	3.358***	3.581***	3.685***
ΔR^2	.268	.062	.037
F for ΔR^2	3.358***	3.597**	3.351**

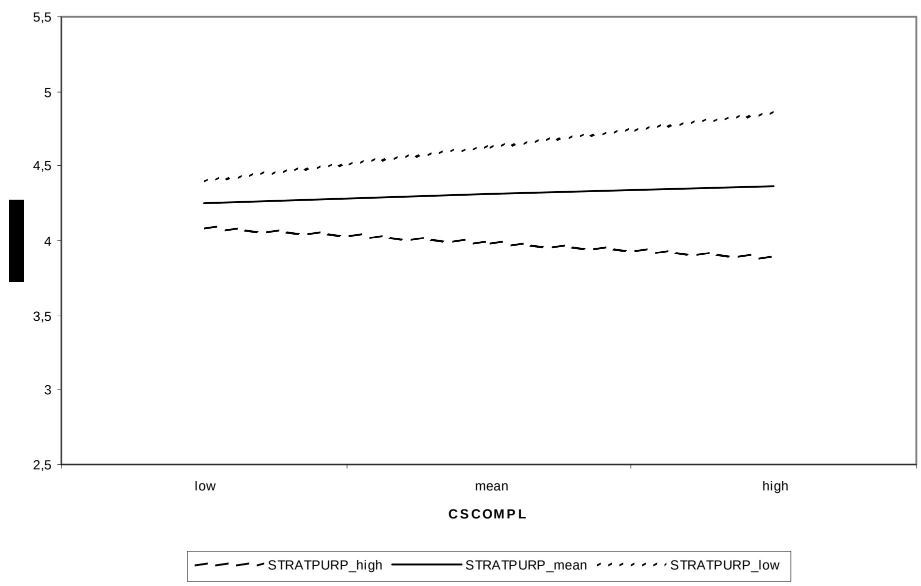
Notes: Cell statistics are unstandardized coefficients, standard errors and standardized coefficients. ***, **, * indicates significance at the .01, .05 and .10 level (two-tailed), respectively. Chow test results for Model 1: $F(14, 105) = 1.129$, $p = .342$, for Model 2: $F(17, 99) = .754$, $p = .740$, and for Model 3: $F(19, 95) = .528$, $p = .943$. All continuous independent variables were mean centered before entering to avoid nonessential multicollinearity. Standardized regression coefficients are estimated using the procedure suggested by Jaccard, Turrisi and Wan (1990).

In Model 1, cost system usage is regressed on the control variables only. This model is significant ($F(13, 119) = 3.358$, $p < .01$, adjusted $R^2 = .188$), and four of the contextual factors are significantly associated with cost system usage. The standardized regression coefficients suggest that SerUnit has the strongest effect, followed by PD, FORM and PEU. The association between cost system usage and SerUnit is negative, suggesting that cost systems tend to be used less for decision making by firms with a serial unit production process than by firms with a homogeneous mass production process. The associations between cost system usage and product diversity, formalization and perceived environmental uncertainty are positive. This indicates that the larger the number of and the more differing the products a firm produces, the more tasks within the firm are standardized and the more uncertain it's environment is perceived to be, the higher the level of cost system usage. Next, in model 2, the main effects are entered. The overall model is significant ($F(16, 116) = 3.581$, $p < .01$, adjusted $R^2 = .238$), as is the change in R^2 ($\Delta R^2 = .062$, $\Delta F = 3.597$, $p < .05$). The main effects of STRATPURP and OPERPURP both have the expected sign, but only the effect of STRATPURP is statistically significant. This suggests that there is a direct effect from cost system usage for strategic purposes on cost system usage: the more a firm's cost system is used for strategic purposes, the higher the level of usage. Finally, in model 3, the interaction effects are entered. The model is significant ($F(18, 114) = 3.685$, $p < .01$, adjusted $R^2 = .268$). The addition of the interaction effects results in another significant improvement in R^2 ($\Delta R^2 = .037$, $\Delta F = 3.351$, $p < .05$). Both interaction effects have the expected sign, and are significant. Cost system usage for strategic purposes and cost system complexity interact *negatively* in their influence on usage of a firm's cost system. On the other hand, cost system usage for operational purposes and cost system complexity interact *positively* in their influence on usage of a firm's cost system. Finally, although the main effect of OPERPURP is close to being significant at the .10 level in this model (p = .117), the significant main effect of STRATPURP on cost system usage clearly is stronger.

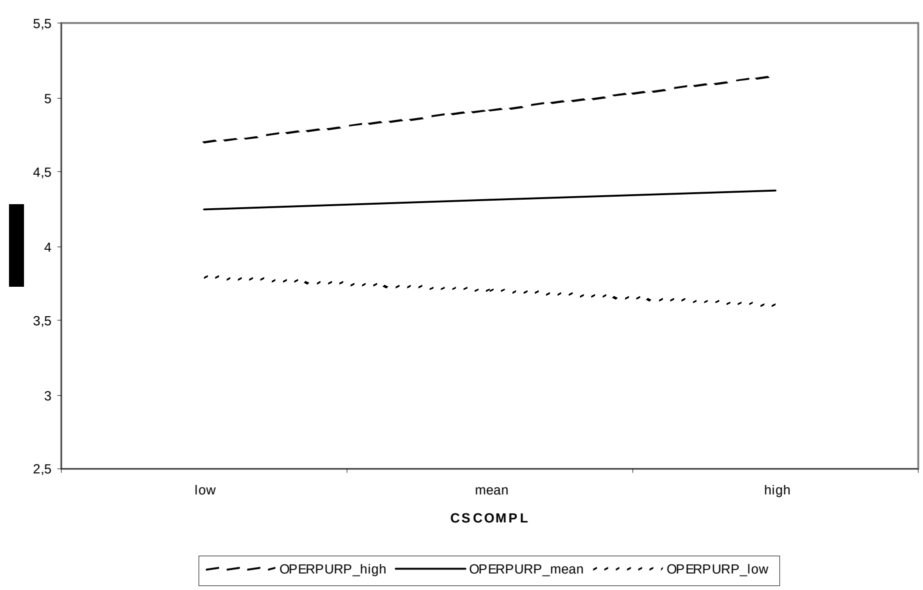
Panel A of Figure 2 shows the interaction effects graphically, by plotting the regression of CSUSAGE on CSCOMPL at three values of STRATPURP: the mean (STRATPURP_mean), one standard deviation below the mean (STRATPURP_low), and one standard deviation above the mean (STRATPURP_high).

Figure 2: Graphical presentations of the interaction effects on cost system usage

Panel A: Interaction effect of CSCOMPL and STRATPURP on CSUSAGE



Panel B: Interaction effect of CSCOMPL and OPERPURP on CSUSAGE



This graph clearly shows that at one *sd* below the mean of STRATPURP, CSCOMPL has a positive influence on CSUSAGE, while at one *sd* above the mean of STRATPURP, the influence of CSCOMPL on CSUSAGE is negative. This indicates that when cost systems are used more for strategic purposes, a higher level of complexity is associated with less usage of the system. On the other hand, when cost systems are used less for strategic purposes, a higher level of complexity is associated with more usage of the system. In a similar way, Panel B of Figure 2 plots the regression of CSUSAGE on CSCOMPL at three values of OPERPURP: the mean (OPERPURP_mean), one standard deviation below the mean (OPERPURP_low), and one standard deviation above the mean (OPERPURP_high). Contrary to the graph for STRATPURP, this graph shows that at one *sd* below the mean of OPERPURP, CSCOMPL has a negative influence on CSUSAGE, while at one *sd* above the mean of OPERPURP, the influence of CSCOMPL on CSUSAGE is positive. In other words, when cost systems are used more for operational purposes, a higher level of complexity is associated with more usage of the system, whereas when cost systems are used less for operational purposes, a higher level of complexity is associated with less usage of the system. Overall, the above results clearly imply that when cost system design and the purposes of use are better aligned, the cost system is perceived to be more effective.

The relationship between cost system complexity, purposes of use, and cost system satisfaction

All regression analyses were re-conducted with an alternative proxy for cost system effectiveness, viz. cost system satisfaction, as presented in Table 6.

*Table 6: Regression analysis results for the association between cost system complexity, purposes of use, and cost system satisfaction (*N *= 133)*

Independent variables	Model 1 (control variables only)	Model 2 (control variables & main effects)	Model 3 (control variables, main effects & interaction effects)
Intercept	3.591***	3.560***	3.509***
	(.251)	(.244)	(.242)
	-	-	-
COM	-.011	-.080	-.115
	(.131)	(.129)	(.129)
	-.009	-.060	-.087
PEU	.221	.176	.184
	(.221)	(.216)	(.215)
	.094	.075	.078
COMS	.114	.109	.097
	(.113)	(.110)	(.109)
	.099	.095	.084
VERT	.072	.071	.052
	(.070)	(.070)	(.069)
	.097	.096	.071
FORM	.047	.071	.064
	(.125)	(.121)	(.120)
	.035	.052	.046
CENT	.014	.025	.046
	(.140)	(.137)	(.138)
	.009	.017	.032
SIZE	.145	.151	.164
	(.117)	(.114)	(.114)
	.112	.117	.127
PD	-.004	-.005	-.004
	(.006)	(.006)	(.006)
	-.062	-.080	-.063
AMT	.141	.138	.132
	(.110)	(.110)	(.109)

	Model 1	Model 2	Model 3
	.126	.123	.117
PRLIN	.076	.068	.072
	(.056)	(.056)	(.055)
	.131	.116	.124
HetMass	-.383	-.403	-.416
	(.290)	(.283)	(.281)
	-.211	-.222	-.229
SerUnit	-.192	-.137	-.133
	(.270)	(.262)	(.260)
	-.119	-.086	-.083
Unit	-.153	-.095	-.082
	(.315)	(.306)	(.302)
	-.077	-.048	-.041
CSCOMPL		.007	.014
		(.034)	(.033)
		.020	.040
STRATPURP		.206**	.189**
		(.093)	(.094)
		.213	.195
OPERPURP		.117	.161*
		(.090)	(.091)
		.130	.178
CSCOMPL*STRATPURP			-.027
			(.043)
			-.061
CSCOMPL*OPERPURP			.087**
			(.038)
			.209
$R^2 adj$	.005	.068	.093
F	1.047	1.605*	1.752**
ΔR^2	.103	.079	.035
F for ΔR^2	1.047	3.713**	2.576*

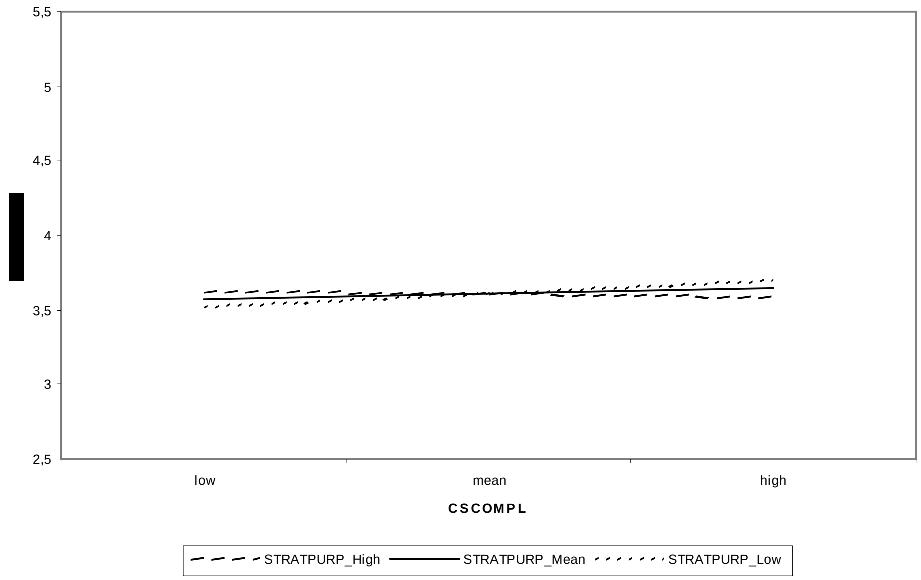
Notes: Cell statistics are unstandardized coefficients, standard errors and standardized coefficients. ***, **, * indicates significance at the .01, .05 and .10 level (two-tailed), respectively. Chow test results for Model 1: $F(14, 105) = .860$, $p = .603$, for Model 2: $F(17, 99) = 1.025$, $p = .439$, and for Model 3: $F(19, 95) = .982$, $p = .489$. All continuous independent variables were mean centered before entering to avoid nonessential multicollinearity. Standardized regression coefficients are estimated using the procedure suggested by Jaccard, Turrisi and Wan (1990).

In Model 1, cost system satisfaction is regressed on the control variables only. This model is not significant ($F(13, 119) = 1.047$, $p > .10$, adjusted $R^2 = .005$). In contrast with the model for cost system usage, none of the contextual factors is significantly associated with cost system satisfaction. In other words, while some of these factors are associated with the extent to which cost systems are used, they are not significantly related to the extent to which users are satisfied with the system. This is somewhat surprising given that, for example, Cagwin and Bouwman (2002) found that ABC system satisfaction was significantly and positively associated with firm size and negatively with the intensity of market competition. Next, in model 2, the main effects are entered. The overall model is significant ($F(16, 116) = 1.605$, $p < .10$, adjusted $R^2 = .068$), as is the change in R^2 ($\Delta R^2 = .079$, $\Delta F = 3.713$, $p < .05$). Similar to the model for cost system usage, the main effects of STRATPURP and OPERPURP both have the expected sign, but only the effect of STRATPURP is significant. This suggests that there is a direct effect from cost system usage for strategic purposes on cost system satisfaction: the more a firm's cost system is used for strategic purposes, the higher the level of satisfaction with the cost system. Finally, in model 3, the interaction effects are entered. The model is significant ($F(18, 114) = 1.752$, $p < .05$, adjusted $R^2 = .093$). The addition of the interaction effects results in another significant improvement in R^2 ($\Delta R^2 = .035$, $\Delta F = 2.576$, $p < .10$). Similar to the model for cost system usage, both interaction effects have the expected sign. Only the effect of CSCOMPL*OPERPURP is significant, however. Cost system usage for operational purposes and cost system complexity interact *positively* in their influence on cost system satisfaction. Also, whereas the main effect of OPERPURP is insignificant in Model 2, it is significant in Model 3. This suggests that there is a direct effect from cost system usage for *both* strategic and operational purposes on cost system satisfaction: the more a firm's cost system is used for strategic and/or operational purposes, the higher the level of satisfaction with the cost system. Similar to the model for cost system usage, the main effect of STRATPURP on cost system satisfaction is stronger than the main effect of OPERPURP.

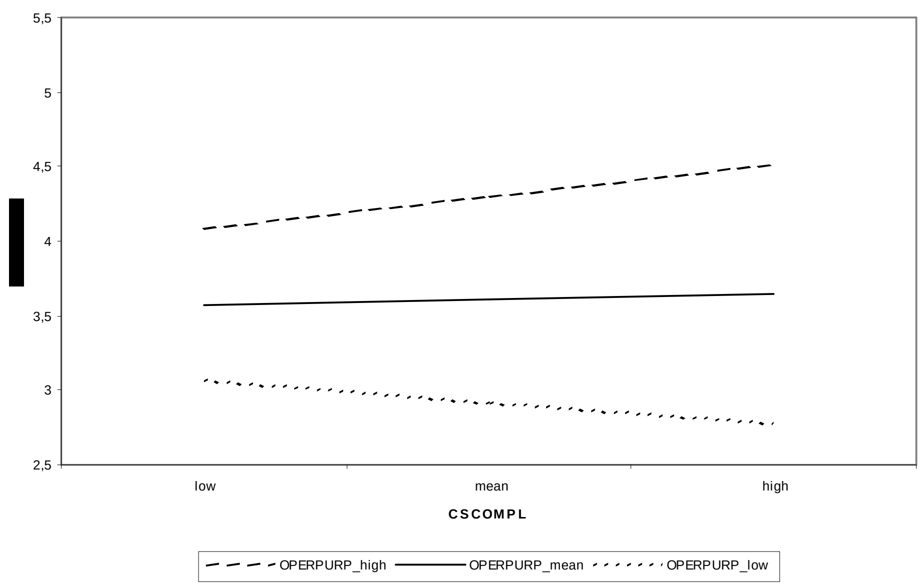
Panel A of Figure 3 plots the regression of CSSATISF on CSCOMPL at three values of STRATPURP: the mean (STRATPURP_mean), one standard deviation below the mean (STRATPURP_low), and one standard deviation above the mean (STRATPURP_high).

Figure 3: Graphical presentations of the interaction effects on cost system satisfaction

Panel A: Interaction effect of CSCOMPL and STRATPURP on CSSATISF



Panel B: Interaction effect of CSCOMPL and OPERPURP on CSSATISF



Consistent with the insignificant interaction effect for STRATPURP, this graph hardly shows any pattern: the three regression lines are almost the same, suggesting the nonexistence of an interaction effect. Panel B of Figure 3 plots the regression of CSSATISF on CSCOMPL at three values of OPERPURP: the mean (OPERPURP_mean), one standard deviation below the mean (OPERPURP_low), and one standard deviation above the mean (OPERPURP_high). Similar to the results for CSUSAGE, this graph shows that at one *sd* below the mean of OPERPURP, CSCOMPL has a negative influence on CSSATISF, while at one *sd* above the mean of OPERPURP, the influence of CSCOMPL on CSSATISF is positive. In other words, when cost systems are used more for operational purposes, a higher level of complexity is associated with more satisfaction with the system, whereas when cost systems are used less for operational purposes, a higher level of complexity is associated with less satisfaction with the system. Overall, the above results again imply that when cost system design and the purposes of use are better aligned, the cost system is perceived to be more effective.

CONCLUSION

This paper examines the associations between cost system design, purposes of use, and cost system effectiveness. Survey data from 133 Dutch, medium-sized firms are used to empirically investigate two research questions. The first question concerns the underlying dimensions of cost system purposes of use. Common factor analysis identified two dimensions underlying cost system usage for nine widely used purposes: cost system usage for strategic purposes and for operational purposes. The second question concerns the relationship between the design (complexity) of cost systems, their usage for strategic and operational purposes, and their (perceived) effectiveness, as proxied by the level of usage of and satisfaction with the systems. The literature suggests that usage for operational purposes requires a more detailed (i.e., complex) cost system design than usage for strategic purposes, for which a too detailed design may be harmful. Consistent with this, the results indicate that cost system complexity and usage for strategic purposes interact negatively in their influence on cost system usage, while cost system complexity and usage for operational purposes interact positively. Similarly, cost system complexity and usage for operational purposes also interact positively in their influence on cost system satisfaction. These results imply that when cost system design and the purposes of use are better aligned, the cost system is perceived to be more effective.

As with any study, the findings of this study are subject to a number of potential limitations. Cross-sectional research can establish associations, but not causality. Consequently, the direction of effects cannot be established with certainty. Also, there may be omitted variables which may bias the results. Another issue that may potentially influence the findings is measurement error. This especially applies to the measurement of cost system usage and satisfaction, as these have both been measured using single-item measures. Finally, there is the issue of generalizability. The response rate in this study is rather low and (as a result) the sample size rather small. Although comparisons with the sampling database show the sample is representative in terms of industry, it may be biased with respect to other (unknown) variables. Despite these potential limitations, this study has important implications for both practice in and research on the design of cost systems. Future research is needed, however, to confirm and extend the results of this study.

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APPENDICES

APPENDIX A: Measurement instruments used

CSCOMPL. **Regarding your firm's cost system, please indicate**

a. **How many cost pools are used** *(log_2 N scale: "0", "1-2", "3-4", "5-8", "9-16", "17-32", "33-64", "65-128" and ">128".)*

b. **How many cost allocation bases are used** *(log_2 N scale: "0", "1-2", "3-4", "5-8", "9-16", "17-32", "33-64", "65-128" and ">128".)*

CSPURP. **For each of the following purposes, please indicate if your firm uses the cost system referred to in the former question for this purpose** *(Scale: "No" or "Yes")*

Cost reduction
Product pricing
Performance measurement
Cost modeling
Budgeting
Customer profitability analysis
Product output decisions
New product design
Stock valuation

CSUSAGE. **Overall, how would you rate the extent to which the cost system referred to in the former questions is used to make decisions in your firm?** *(Scale: 1 = not at all, 2 = to a little extent, 3 = to some extent, 4 = to a considerable extent and 5 = to a very great extent)*

CSSATISF. **Overall, how would you rate the extent to which users of the cost system referred to in the former questions are satisfied with the system in your firm?** *(Scale: 1 = not at all, 2 = to a little extent, 3 = to some extent, 4 = to a considerable extent and 5 = to a very great extent)*

COM. **Please indicate, by circling the appropriate number below, the intensity of your firm's market competition with respect to the following elements** *(Scale: 1 = not at all, 2 = to a little extent, 3 = to some extent, 4 = to a considerable extent and 5 = to a very great extent)*

Price competition
Product competition
Marketing competition

PEU. **For each of the following elements of your firm's external environment, please**

a. **Assess, by circling the appropriate number below, the degree of predictability during the past five years** *(Scale: 1 = very unpredictable, 2 = fairly unpredictable, 3 = neutral, 4 = fairly predictable and 5 = very predictable)* – **REVERSE CODED**

b. **Further indicate, by circling the appropriate number below, to what extent the elements are of importance to the success or failure of your firm** *(Scale: 1 = not at all, 2 = to a little extent, 3 = to some extent, 4 = to a considerable extent and 5 = to a very great extent)*

Suppliers' actions
Customer demands, tastes and preferences
Deregulation and globalization
Market activities of competitors
Production technologies
Government regulations and policies
Economic environment
Industrial (workplace) relations

COMS. **Please indicate, by circling the appropriate number below, to what extent the following characteristics apply to your firm** *(Scale: 1 = not at all, 2 = to a little extent, 3 = to some extent, 4 = to a considerable extent and 5 = to a very great extent)*

<u>"My firm…"</u>
… produces products in innovative ways
… offers a wide variety of products
… has a very diverse customer group
… offers many new products
… offers innovative new products
… allots many resources to marketing

VERT. **How many hierarchical levels exist between senior management and team-leaders in your firm?** *(Please provide a specific number.)*

FORM. **The following questions relate to the degree to which jobs are standardized within your firm.**

a. **Written job descriptions exist for:**

a) operation level employees only
b) operation level employees and teamleaders only
c) operation level employees, teamleaders and production line managers
d) operation level employees, teamleaders, production line and production managers
e) all employees, including senior management

b. **Where written descriptions exist, at what level are employees monitored to ensure compliance with standards set in the job description?** *(Scale: 1 = low, 2 = somewhat low, 3 = moderate, 4 = somewhat high and 5 = high)*

c. **What is the degree of flexibility given to employees to deviate from the standards?** *(Scale: 1 = low, 2 = somewhat low, 3 = moderate, 4 = somewhat high and 5 = high)* – **REVERSE CODED**

d. **To what degree are teamleaders and production line managers free to exercise their judgment when they make decisions?** *(Scale: 1 = low, 2 = somewhat low, 3 = moderate, 4 = somewhat high and 5 = high)* – **REVERSE CODED**

CENT. **What is the lowest level of management in the group below that has the authority to make the following decisions in your firm?** *(Scale: Teamleader, Production line manager, Production manager, Plant manager, and Head office manager.)*

Decide to design a new product
Establish the budget level
Choose the methods of work to be used
Select machinery or equipment to be used for a job
Select suppliers
Determine labor force requirements
Select type or brand for new equipment
Decide what type of costing system will apply
Dismiss direct workers
Determine sale prices
Alter responsibilities or areas of work of a line department
Determine personnel rewards

PD. **How many different products (stockkeeping units) are being produced in your firm?** *(log_2 N scale: "1-2", "3-4", "5-8", "9-16", "17-32", "33-64", "65-128", "129-256", "257-512" and ">512".)*

Please indicate, by circling the appropriate number below, to what extent the products (stockkeeping units) produced in your firm differ on average on the following dimensions *(Scale: 1 = not at all, 2 = to a little extent, 3 = to some extent, 4 = to a considerable extent and 5 = to a very great extent)*

Physical size
Complexity
Batch size

AMT. **Please indicate, by circling the appropriate number below, to what extent the following advanced manufacturing technologies are used in your firm's production process** *(Scale: 1 = not at all, 2 = to a little extent, 3 = to some extent, 4 = to a considerable extent and 5 = to a very great extent)*

Computer-aided manufacturing (CAM)
Robotics
Real-time process control systems
Group technology (GT)
Flexible manufacturing systems (FMS)
Computerized numerical control machines (CNC)
Automated material handling systems
Environmental control systems
Bar coding/automatic identification

PRLIN. **How many production lines does your firm have?** *(log_2 N scale: "1-2", "3-4", "5-8", "9-16", "17-32", "33-64", "65-128" and ">128".)*

PRPRO. **Which classification best describes the structure of the production process in your firm?**

a) homogeneous mass production
b) heterogeneous mass production
c) serial unit production
d) unit production

Appendix B: Usage rates and Pearson product-moment correlations for the nine cost system purposes (N = 133)

Items	Usage rates										
	n	%	1	2	3	4	5	6	7	8	9
1. Cost reduction	92	69.2	1.000								
2. Product pricing	127	95.5	.012	1.000							
3. Performance measurement	86	64.7	.392***	.067	1.000						
4. Cost modeling	88	66.2	.383***	-.079	.469***	1.000					
5. Budgeting	120	90.2	.274***	.050	.233***	.300***	1.000				
6. Customer profitability analysis	82	61.7	.277***	.276***	.355***	.220**	.209**	1.000			
7. Product output decisions	74	55.6	.223***	.171**	.385***	.449***	.216**	.447***	1.000		
8. New product design	86	64.7	.120	.294***	.112	.236***	.074	.323***	.416***	1.000	
9. Stock valuation	103	77.4	.029	.316***	.166*	-.006	.065	.351***	.242***	.278***	1.000

Notes: ***, **, * indicates significance at the .01, .05 and .10 level (two-tailed), respectively.

Appendix C: Pearson product-moment correlations for the independent variables (*N* = 133)

Variables	COM	PEU	COMS	VERT	FORM	CENT	SIZE	PD	AMT	PRLIN	HomMass	HetMass	SerUnit	Unit
COM	1.000													
PEU	.256***	1.000												
COMS	.305***	.085	1.000											
VERT	.036	.172**	.102	1.000										
FORM	-.118	-.071	-.081	.075	1.000									
CENT	.068	.072	-.023	.136	.151*	1.000								
SIZE	-.015	-.043	.046	.074	-.020	-.058	1.000							
PD	.276***	.037	.349***	.174**	-.075	-.013	-.034	1.000						
AMT	.047	.162*	.206**	.136	.172**	-.063	.019	.147*	1.000					
PRLIN	-.012	-.044	.051	.147*	.078	.024	.026	.125	.263***	1.000				
HomMass	.057	.031	-.087	-.154*	.042	.102	-.050	-.165*	.007	-.029	1.000			
HetMass	-.001	-.048	-.047	.225***	.107	.161*	.176**	-.026	.036	.274***	-.179**	1.000		
SerUnit	.024	-.001	.016	-.083	.012	.104	-.214**	.069	.087	-.034	-.272***	-.542***	1.000	
Unit	-.067	.033	.092	-.038	-.161*	-.374***	.105	.057	-.153*	-.238***	-.152*	-.302***	-.458***	1.000

Notes: ***, **, * indicates significance at the .01, .05 and .10 level (two-tailed), respectively.

NOTES

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[1] Some studies did actually measure cost system purposes, but used them to operationalize variables different from this study, such as 'number of primary applications' (Foster and Swenson, 1997) or (as part of) 'ABC use' (Cagwin and Bouwman, 2002).

[2] Transaction drivers are based on the number of times activities are performed; duration drivers are based on the amount of time required to perform an activity; and intensity drivers are based on directly charging for the resources used each time an activity is performed (Kaplan and Cooper, 1998).

[3] Note that the attribute 'level of detail provided' in the study of Pizzini (2006) is closely related to the way cost system design is operationalized in this study. In addition, her measure of 'usefulness' is almost identical to the measurement of 'usage' in this study.

[4] In other words, this study uses an independent-variable interaction model (cf. Luft and Shields, 2003).

[5] The reasons given for leaving the questionnaire unanswered (269 firms) were (more than one answer possible):

- Questionnaire would take too long to fill out (52%);
- General policy against filling out questionnaires (30%);
- Some of the questions not appropriate for business (13%);
- Other (19%).

[6] The composition of the final sample is comparable to the composition of the sample yielded from the database. A one-sample Chi Square test shows no significant difference between the two samples in industry representation ($\chi^2(13, 133) = 17.26$, $p = .188$).

[7] A t-test for two independent samples indeed shows a significant difference between the two groups for organizational size in the final sample ($t(131) = 7.039$, $p < .001$). None of the other variables shows a significant difference at a significance level of .10.

[8] As emphasized by Cohen et al. (2003, p. 411), careful screening for potentially outlying cases is especially important for regression analysis including interaction terms. The four cases were removed after examining the leverage, discrepancy and influence of all cases, using the measures and cutoffs suggested by Cohen et al.

[9] A translation-backtranslation procedure was used for these instruments. The instruments were translated by the author, and back-translated by two colleagues. No meaningful differences between the original and the back-translated instruments appeared.

[10] A one-unit in-/decrease in the number of cost pools is assumed to have a larger influence on cost system complexity when the system has only one or a few cost pools, than when the system already has hundreds of cost pools. A similar argument can be made for the number of cost allocation bases.

[11] A Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of .766 suggests that exploratory factor analysis is a suitable approach and Bartlett's test of sphericity is highly significant ($p < .001$). Inspection of the anti-image correlation matrix also suggests that all items are adequate for use in the analysis; item-level Measures of Sampling Adequacy (MSA's) range from .703 to .835 and the off-diagonal partial correlations are generally low, indicating the existence of one or more factors and little unique item variance. For a few items the communalities are somewhat less than satisfactory. However, this is quite often the case when applying classical factor analysis to binary items (cf. Woods, 2002).

[12] The application of classical linear factor analysis has been argued to potentially distort the underlying structure of binary data (e.g., Woods, 2002). One solution for handling this potential distortion is to use tetrachoric correlations rather than phi coefficients (Woods, 2002). Although using tetrachoric correlations provided some estimation problems (i.e., a nonpositive definite matrix that remained after smoothing the correlation matrix using MicroFACT 2.0; Waller, 2000), the resulting factor structure was very similar to the factor structure as reported in this paper, although the factor loadings were somewhat stronger in magnitude.

[13] Note that two items/purposes have cross-loadings greater than .300. This is probably caused by the ambiguous nature of these two items as far as their strategic or operational nature is concerned.

[14] Given the debatable nature of stock valuation as being a strategic purpose of cost system usage (as in general it mainly serves an external reporting purpose), all analyses have also been conducted with this item excluded. The results of these analyses (not reported) are very similar to the results of the analyses with stock valuation included. The factor structure resulting from the exploratory factor analysis is almost identical to the factor structure as reported in this paper. Also, the correlation between the factor scores calculated for both situations is very high ($r(131) = .998$,

$p < .001$ for factor 1, and $r(131) = .947$, $p < .001$ for factor 2). As a consequence, the regression analysis results are also very similar to the results as reported in this paper.

[15] Variance inflation factors (VIFs) indicate that multicollinearity is not a problem in any of the regression analyses (below 1.5 for the continuous independent variables, and below 4.0 for the dummy independent variables).