The consequences of customization on management accounting system design

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Abstract

The understanding of the antecedent conditions influencing the design of management accounting systems (MASs) is very limited. In recent years, significant research attention has been devoted to understanding how different strategic priorities influence these systems. However, the results of these studies have been, at best, equivocal and numerous calls have been made for further research to "unravel" the conflicts that have emerged in the literature. The purpose of this study is to examine not only the relation between strategy and MAS but also to develop a theoretical model to explain how and why this relation exists. The model draws on Galbraith [Galbraith, J. (1973). *Designing complex organisations*. Reading: Addison-Wesley] to develop a theoretical argument concerning the inter-relations among customization, interdependence and MAS. We are particularly interested in assessing whether the relation between customization and MAS is a direct one or whether the relation operates via interdependence. The results indicate that customization affects MAS via interdependence, rather than directly. The study of 170 production and sales managers further revealed little difference in MAS use between production and sales managers facing similar amounts of customization or interdependence. © 2000 Elsevier Science Ltd. All rights reserved.

1. Introduction

To differentiate products and services from competitors an increasing number of firms, both large and small, are pursuing customer-responsive strategies such as customization or manufacturing flexibility (Gilmore & Pine, 1997; Kotha, 1995). The pursuit of such strategies poses significant challenges for the management of these firms particularly in the design of appropriate structures and information systems (Abernethy & Lillis,

1995; Brickley, Smith & Zimmerman, 1997). The purpose of this study is to examine the implications for the design of management accounting systems when firms pursue customization as a strategic priority. Customization requires the development of an organizational culture where individuals are encouraged to be innovative and responsive to customer requirements. To manage effectively in this setting requires the implementation of a sophisticated information system to ensure that managers have the information necessary to cope with continual changes in product design and processes. The pursuit of customization also changes the nature of the relation between functional subunits within the firm, as the work flows between subunits become highly

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interdependent. These interdependencies create additional information requirements to ensure that these work flows are coordinated.

The challenge for management becomes one of satisfying the information needs of departments as well as co-ordinating the work-flows among functional subunits that have become highly interdependent. Management accounting systems (MASs) can play an important role in this situation. They can be designed to provide more sophisticated information that will not only facilitate decision making within departments but will also facilitate co-ordination between functional departments. While there is considerable normative support for this role of MAS (Atkinson, Banker, Kaplan & Young, 1997; Drury, 1997; Horngren, Foster & Datar, 1997) there is relatively little empirical research examining how or in what circumstances MASs can serve this purpose.[1] This study draws on the theoretical frameworks developed by Galbraith (1973) and others (Earl & Hopwood, 1981) to examine the implications of strategic choice, namely, customization for the design of MASs. It examines not only the relation between customization and use of MASs for decision making, but also explores why this occurs. The theory developed in this study argues that it is the interdependencies flowing from customization that primarily influences the relation between customization and MAS design.

The study contributes to the management accounting literature in several ways. Despite the importance of understanding the conditions that give rise to the design and use of MASs (Chapman, 1997; Kren, 1997), this is the first study, of which the authors are aware, that has examined the linkages between strategic choice, interdependence and MAS. The model pays particular attention to the way in which customization and interdependence are conceptualized. This enables the development of a more coherent theoretical model for specifying the nature of the relations

examined (Chapman, 1997; Otley, 1980; Otley & Pollanen, in press). Several methodological limitations associated with prior research have also been addressed. For example, the way in which the model is operationalized limits the potential for correlated omitted variable bias. This ensures a more distinct attribution of the results to the theoretical model at test. The method used attempts to overcome threats of common-rater bias by using two different respondents for the variables of interest. The study design also pays particular attention to construct validity issues. The remainder of the paper is structured as follows. The next two sections define the constructs and develop the theoretical model ending with testable hypotheses. This is followed by the results and discussion. The final section identifies the limitations of the study and provides some direction for further research.

2. Definition of constructs

2.1. Customization

The pursuit of customization, often referred to as manufacturing flexibility, is considered to be the "new" competitive edge (Kotha, 1995). It is defined here as the extent to which a business unit allows individual customers to affect the product/service attributes the business unit produces. While customization can be pursued by producing output that is customized by combining standardized modules which are pre-specified by the organization (referred to in the literature as "mass customization"), this study focuses on the extent to which a firm is willing or able to make "customer-requested" changes (Abernethy & Lillis, 1995). This form of customization is often referred to as tailored customization (Kotha, 1995; Kotler, 1989; Pine, 1993). Customization is conceptualized in this study as a continuum. One end of the continuum represents relatively low levels of customization, that is, where customers are able to request changes to basic models. The other end of the continuum represents high levels of customization where the product/service is completely customized to suit customer requirements.

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[1] Much of the empirical research in behavioural accounting has focused on the relation between contextual variables and the use of MAS for control purpose. There have been relatively few studies focusing on the decision making role of MAS.

2.2. Interdependence

Interdependence is defined as the extent to which departments depend upon each other to accomplish their tasks (Thompson, 1967). We focus here on inter-departmental interdependencies, that is, the relations that exist between subunits within the firm. Following Thompson, we distinguish between pooled, sequential and reciprocal forms of interdependence. Pooled interdependence occurs when departments accomplish tasks virtually independently. Sequential interdependence involves a serial sequence of intermediate output transfers between functional subunits until the final product is delivered to the customer. The highest form of interdependence is reciprocal. In this situation, intermediate outputs move back and forth between departments several times until the final product is delivered to the client. Departments may face all three kinds of interdependence contemporaneously, however, the level of interdependence will increase as the proportion of work flows that are of a reciprocal/sequential nature increases.

2.3. Management accounting systems (MAS)

This study is concerned with the "decision-facilitating function" of MASs.[2] MASs are conceptualized here as a formal system designed for providing information to managers.[3] Following Gordon and Miller (1976) and others (Chenhall & Morris, 1986; Mia & Goyal, 1991), we examine four dimensions of MAS: scope, integration, aggregation and timeliness. The scope dimension has three sub-dimensions: focus, quantification, and time horizon (Chenhall & Morris, 1986; Gordon & Miller, 1976; Gordon & Narayanan, 1984; Gorry & Scott-Morton, 1971; and Larcker,

1981).[4] It is viewed as a continuum with narrow scope at one end and broad scope at the other. Narrow scope information has been linked with traditional accounting systems in that these systems typically are limited to providing information that is internally focused, financial, and historically-based information. Broad-scope information, on the other hand, is information that is also externally focused, non-financial, and future-orientated.

The integration dimension consists of information about the activities of other departments within the firm as well as information as to how the decisions made in one department may influence the performance of other departments. This information could relate to the inputs, outputs, the operating processes and the technology employed by other departments. For example, integrated information could include reports which provide information on the type and volume of output produced by other departments as well as information about the costs, revenues and prices associated with that output.

The aggregated dimension provides summary information by functional area (i.e. summary reports on activities of other business units, or other functions of the organization), by time period (e.g. month, year) or through decision models (supporting marginal analysis, inventory models, DCF, what-if-analysis, cost-volume-profit analysis) (Chenhall & Morris, 1986). Information aggregated at the functional level provides managers with information about the outcomes or results of decisions made in other departments. The use of decision models requires information to be aggregated.[5] Aggregation by time period enables managers to assess the results of their decisions over time. For instance, the result of a decision to introduce a new input can be evaluated in terms of its effect on the business unit's efficiency and production quality over a period of time.

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[2] While we use the term MAS, others have preferred to use the term management information system (MIS) to study the same construct (see, for example, Abernethy & Guthrie, 1994).

[3] For the purpose of this study we do not distinguish between information provided by the department itself or by an organization-wide system. We focus on the importance of the current system for providing information for operational decisions.

[4] Focus refers to whether the information is collected from within the firm or outside the firm (eg. economic, technological and market factors). The quantification feature pertains to whether the information is financial or non-financial. Time horizon refers to the extent to which the information relates to future events rather than historical events.

[5] The level of aggregation for decision models will vary dependent on the comprehensiveness of the decision model.

Timeliness is conceptualized in this study as having two sub-dimensions: frequency of reporting and speed of reporting. Frequency refers to how often information is provided to managers while speed pertains to the time lag between when a manager requests information and when it is made available. MASs are considered high on the timely dimension when information is provided frequently (i.e. on a daily or weekly basis) and when there is little delay between when an event occurs and when information concerning this event is provided to managers.

2.3.1. Relations between the dimensions

This study treats the four dimensions of MASs as conceptually distinct. However, there is potentially some overlap between the dimensions. For example, broad scope and integrated information can be provided in an aggregated form as well as in a detailed form. Similarly, the dimensions of scope, integration and aggregation can vary along the dimension of timeliness. As a consequence the importance managers attach to one dimension may simultaneously vary with the importance attached to other dimensions. Managers, however, can make distinctions between the dimensions. Variation among the dimensions simply signifies the coherence of the MAS. Designing the study to distinguish between the dimensions enables us to examine how the importance of each dimension differs under a given context. For instance, in a particular context, integrative information may be evaluated as very important, while scope may be considered less important.

3. Theoretical model

3.1. Customization and interdependence

Interdependencies will always exist between departments when an organization is functionally structured as each subunit reflects just one link in the organization's value chain. The pursuit of a customization strategy, however, intensifies interdependencies in functionally differentiated organizations. In a situation where customization is not pursued interdependencies among departments

may be relatively low. For example, take an extreme case where a firm produces a single standardized product. It would be possible for a department's interdependence to be limited to pooled interdependence (i.e. sharing of common resources). However, this would require the production and sales departments[6] to operate virtually independent of each other. This would only occur where production faced a relatively stable demand and could stock pile inventory and where the sales department could obtain its stock from inventory or from external suppliers. This is, however, an unlikely scenario, as stock piling inventory is an expensive option and one that successful firms are unlikely to pursue.

In most cases sales and production departments will experience sequential levels of interdependencies. In this situation, production and sales activities will have to be aligned as the output of the production departments becomes the input of the sales department. Higher levels of sequential interdependence emerge when the organization operates in a market where customers demand more than one product type and when market demand for different products fluctuates. When a firm only manufactures products tailored to customers' requirements, sales and production departments will be totally interdependent. As products are tailored to customer requirements, departments will need to adjust continually their input mix to achieve the desired output. Sales and production departments will have to "work jointly on the same raw material, customer, client or project" (Macintosh, 1995, p.122). This type of workflow represents reciprocal interdependence. Sales can no longer acquire an order that is subsequently filled by production, but rather sales and production must co-operate in acquiring and filling the order. This co-operation makes the input/output relations of production and sales intertwined.

In summary, we expect that as a firm moves from low to high levels of customization, interdependencies between sales and production

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[6] The development of the theoretical model in this study draws on only two departments: "production" and "sales". The model, however, could be applied to other departments as well as to more than two departments.

departments will increase. Our expectation is stated as:

Hypothesis 1. There is a positive relation between customization and interdependence among departments.

3.2. Customization, interdependence and management accounting systems

Much of the literature that has explored the relation between strategy and MASs has been interested in the direct relation. Numerous studies have examined the performance effect of the "match" between strategy and MASs. The model developed here argues that a large proportion of the observed relation between customization and MASs occurs via the interdependencies that result when customization is pursued. The model, however, does not rule out the possibility of a direct relation. It is entirely possible that customization will influence the decision context within a department regardless of the level of interdependencies and, thus, will impact directly on the design and use of MASs. The analysis of the data enables an assessment of both the direct and indirect relation between customization and MASs to be explored.

The relation between customization, interdependence, and MASs is developed in two stages. First, we examine how customization and interdependence influence uncertainty. Drawing on Hopwood (1974) and Earl and Hopwood (1981), we argue here that these two factors change the nature of the decision-making context by increasing the level of uncertainty. Second, we explore how the decision context influences MASs. Management accounting systems are part of an organization's information system and are used by managers to help them cope with uncertainty. We argue that MASs will be used to mitigate the effects of customization and interdependence.

3.2.1. Impact of customization and interdependence on the decision-making context

Decisions are made under different levels of uncertainty. The level of uncertainty is determined by the gap between the information currently available and the information required to make the decision (Galbraith, 1973). The amount of information required depends on the extent to which a decision context exists that allows for programmed decision making. An information gap can arise when the information made available only supports programmable decisions, while the context requires non-programmable decisions. The information gap engenders uncertainty in decision making because managers are unaware of where to look for alternative actions (intelligence), which alternative actions can be developed (design), and finally which of the alternative actions is the best (choice) (Emmanuel, Otley & Merchant, 1990; Macintosh, 1995; Simon, 1960).

The pursuit of customization can directly influence the decision maker's level of uncertainty. This is due to its effect on cause/effect relations. When a firm produces a standardized product, the decision-making process is programmable as the knowledge relating to input/output relations is relatively complete. In contrast, customization does not enable inputs to be pre-selected. Customers can demand product features that involve activities that have never been carried out before. The decision-making process becomes increasingly unprogrammable as decision makers not only have to make choices from a range of alternatives, but they must also investigate and design alternative actions. Interdependencies created as a result of customization further exacerbate the complexities associated with cause and effect relations. As interdependencies between departments increase, the decision-making process becomes more unprogrammable as the decision context in one department is affected by the decisions made in other departments (Earl & Hopwood, 1981; Macintosh, 1995; Milgrom & Roberts, 1990). Managers not only need to consider whether an action is technologically feasible from their perspective, but also from the perspective of the other department.

Increasing the level of interdepartmental interdependencies can also create a decision context where there is uncertainty about objectives. Uncertainty occurs when decisions cross departmental boundaries because managers are faced

with multiple and often conflicting objectives and must make trade-offs in the pursuit of their own departmental objectives. This is unavoidable as each department is established to ensure that specific subunit objectives are achieved efficiently and effectively (Thompson, 1967). For example, the objective of production might be to fill orders efficiently while the sales' objective might be to optimize turnover. This means that production will undertake actions that result in an efficient production process from their point of view. These decisions, however, might be in conflict with the sales department's objective of maximizing revenues. Disagreements are likely to emerge over issues such as delivery times, kinds of products produced, or production run sizes.

Thus, decision-makers must not only consider which alternatives are technologically feasible from the perspective of interdependent departments; they must also select solutions that meet the objectives of both departments. In other words, when there are interdependencies among departments, a solution that is optimal for the individual department may not be optimal for other departments or the firm. Essentially, interdependent departments need to shift their focus to the firm's optimal "combined" outcome rather than attempting to optimize their own goals and objectives. If information is not available concerning other departments' objectives and if departmental objectives conflict, interdependencies between departments may result in significant amounts of uncertainty over how best to achieve their objectives (Earl & Hopwood, 1981; Macintosh, 1995).

3.2.2. Relation between the decision context and management accounting systems

Galbraith (1973) argues that one of the options that an organization has when an information gap emerges is to increase the decision-makers' information processing capacity through the introduction of more sophisticated information systems. Management accounting systems can partly fill this gap by providing information that enables managers to better understand input/output relations and by reducing uncertainty concerning the feasibility of achieving objectives that are optimal for the firm.

In this way these systems facilitate the co-ordination of activities among interdependent departments.

Each of the dimensions of MAS reduce the information gap and facilitates the resolution of conflicting objectives.

Broad scope information provides managers with a wider range of solutions to consider. This enables them to better understand the input/output relation (Abernethy & Guthrie, 1994; Chenhall & Morris, 1986; Gordon & Miller, 1976; Parthasarthy & Sethi, 1993; Simons, 1990). It also increases the probability that one of the alternatives considered will be consistent with the objectives of other interdependent departments.

The integrated dimension of MAS will also become increasingly important as interdependencies grow owing to its role in providing information for co-ordination among interdependent subunits (Anthony, 1965; Baumler, 1971; Galbraith, 1973; Gordon & Miller, 1976; Thompson, 1967). Integrated information reduces uncertainty relating to cause and effect relations within departments as it encourages learning and the generation of ideas. It enables departmental managers to 'learn' how to adjust products and production methods to be compatible with other departments (Atkinson et al., 1997). It also enables managers to better understand the different objectives that exist within separate decision units (Atkinson et al., 1997; Walton & Dutton, 1969) and to make trade-offs among alternative ways to operate within the given set of objectives.

Aggregated information enables managers to process larger quantities of information. It condenses information into a format that can be processed quickly and, thus, increases the overall amount of information that can be processed within a given time. The potential for sub-optimal decision making owing to information overload is thereby reduced (Ackoff, 1967). Aggregation of information enables managers to consider more alternatives and develop a better understanding of input/output relations both at the department and within departments. This increases the probability that solutions will be found that are optimal for the firm overall.

Timely information also has the potential to reduce uncertainty. It enables managers to continually

adjust their activities in response to the changes demanded by customization as well as the changes occurring in other interdependent departments. Decision making in this context is not programmable because exceptions are continually occurring which require more frequent decisions. This situation creates a need for more frequent information updates to solve input/output problems as soon as they occur.

3.2.3. Summary

Both customization and interdependencies have the potential to create an information gap for decision makers. This gap occurs because the information required for decision making is less than that provided. When this occurs, decision makers face uncertainty. While customization is likely to have some direct effect on the information required for decision making, the effect of customization on the information gap is primarily via interdependencies. Interdependencies, which flow from customization, not only exacerbate the uncertainty relating to input/output relations within departments, they also have the potential of increasing uncertainty concerning objectives. This uncertainty can be mitigated if the appropriate information is provided. Management accounting systems can help managers in resolving the uncertainty that would be associated with decision making if the information was not made available.[7] If this is the case, we expect that a large proportion of any observed relation between customization and the dimensions of MASs will be explained via interdependence. In other words, we expect an indirect relation between customization and the MAS. The indirect effect of customization on demand for sophisticated MAS, acting through interdependence is expected because customization covaries with interdependence (H1), and it is the association with interdependence that influences MASs. This expectation can be expressed as follows.

Hypothesis 2. There is a positive indirect relation between customization and the MAS dimensions of (i) scope, (ii) integration, (iii) aggregation and (iv) timeliness, acting through interdependence.

As noted earlier, it is possible that customization will have a direct effect on MASs, although this is expected to be relatively small, after controlling for the effect of interdependence. The analytical model used enables an assessment of this relation. We will test Hypotheses 2 separately for each MAS dimension. The theoretical model is presented in Fig. 1.

4. Research method

4.1. Design

Several methodological limitations associated with research using survey-based data were addressed in the design of this study. First, the study was operationalized to control for differences across managerial levels and type of decisions. To achieve this we carefully selected our sample to include only middle-level managers, namely production and sales managers. We also ensured that the managers focused only on operational-level decisions when responding to questions concerning the kinds of information used for decision making. We expected that this would enable the results to be better attributed to a distinct managerial level and decision. Second, to address the issue of common-rater bias, data were collected from two categories of respondents. Business unit managers were used to capture the customization variable and production and sales managers provided data on the interdependence and MAS variables. Third, we collected additional data to enable attention to be paid to construct validity issues.

The final sample used in the analysis includes data collected from business unit managers, production managers and sales managers in 85 business units.[8] All managers completed the questionnaires in the

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[7] This is not to say that the information could not be made available from other sources. This study assumes that the provision of information via accounting systems assists managerial decision making. However, this does not rule out other means of information collection.

[8] Data were also collected from financial controllers in the business units for the purpose of assessing the reliability/validity of the measurement instrument customization.
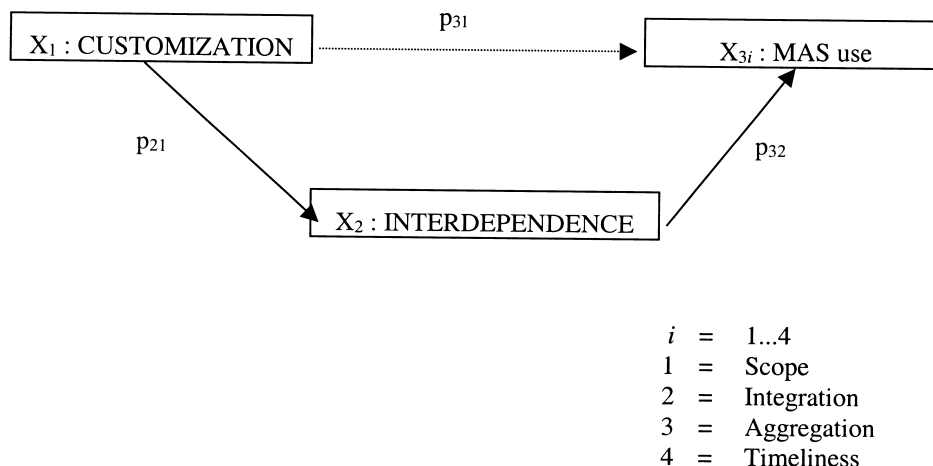
Fig. 1. The research framework.

presence of either the researcher or the student. Three criteria were used in the selection of the sample: (1) production and sales activities were located in two separate departments; (2) each business unit was part of a firm comprised of more than three business units; (3) the business unit employed at least 150 people. The first criterion was set because the study focused on the use of MAS in functionally differentiated organizations. The second criterion and third criterion were invoked to ensure that the organizations included in the study would be sufficiently large to ensure that a formal MAS was in place. In order to obtain sufficient variation on the variables of interest the sample was drawn from both manufacturing and service companies. The data were collected in the Netherlands.

A description of the sample divided by industry and size of business units and departments is provided in Table 1. A chi-square test of the industry means for size indicated that there was no significant relation between industrial sector and the size of the business unit, or type of department.

4.2. The measures

All measures are drawn from existing instruments and are reproduced in Appendix A. Customization was measured using an adapted version of the Pugh, Hickson, Hinings and Turner (1969) instrument. Business unit managers were asked to indicate the percentage of products/services in four categories of customization: (a) completely standardized, (b) basic models that are customized according to

Table 1
Description of the sample by industry and size

Type of industry[a]	N	Size (mean, STD)		
		Total employees	Production employees	Sales employees
Total samples	85	375 (233)	222 (192)	21 (14)
Food/textiles	14	458 (308)	322 (270)	22 (11)
Paper/chemicals/iron metallic	21	371 (176)	219 (144)	23 (13)
Metal/machinery	16	331 (116)	158 (118)	20 (18)
Electronic and other manufacturing	15	418 (261)	230 (176)	24 (14)
Financial services	6	375 (232)	222 (192)	21 (14)
Services and construction	13	381 (282)	242 (256)	18 (13)

[a] Classified according to the North American Industry Classification Schedule (NAICS).

organizational specifications, (c) basic models that are customized according to client's specifications, and (d) completely customized. As this study was interested in the extent to which firms actually add features to the product/service that have not been designed in advance, only categories (c) and (d) were used as part of the customization measure.

Interdependence was measured using the instrument developed by Van de Ven, Delbecq and Koenig (1976). Diagrams representing each type of interdependence were provided and respondents were asked to indicate the amount of work that fitted into each category of interdependence, ranging from "almost none" to "almost all". One question was used to represent pooled interdependence (a) and one question to capture reciprocal (d). To capture sequential work flows between production and sales departments, two questions were used (b and c). Following Macintosh and Daft (1987), the scale used in the analyses was created by collapsing the sequential and reciprocal interdependence items into one interdependence scale expressing the total work flow.

MAS was measured using an adapted version of the Chenhall and Morris (1986) instrument. This instrument was designed to capture the importance of the dimensions of scope, integration, aggregation and timeliness for operational decision making. Several changes were made to the instrument. First, the wording of the items were changed slightly to ensure that the instrument was applicable across a range of industries. Second, an item relating to departmental costs was included to better capture the dimension of integration. The third and most important modification to the original instrument was a change in the wording of the instrument to capture the "importance of the information provided to the manager in making operational decisions" rather than to capture the "usefulness" or "use" of the information.[9] This represents a departure from prior use (Chenhall & Morris, 1986; Chia, 1995; Mia & Chenhall, 1994). Product and sales managers were asked to rank on a five-point scale the importance attached to each item. The scale ranged from "little importance" to

"extremely important". The items relating to each dimension were summed for use in the analysis. This is consistent with prior research using the instrument.

4.2.1. Reliability and validity

The reliability and validity of each measure was assessed. The reliability of the customization instrument was evaluated by comparing mean ratings (and variances) provided by business unit managers and financial controllers on each of the categories of the instrument. This inter-rater reliability test involved a chi-square test to determine whether the mean ratings provided by financial controllers for each item of the measure were significantly different to the mean ratings of the business unit manager. The chi-square test was conducted by calculating the maximum likelihood of the goodness of fit of the parallel dimensions of the instrument (i.e., means on the dimensions of the instrument representing customization rated by controllers compared to business unit managers). A similar test was carried out to test the interdependence instrument's reliability, comparing production and sales managers' ratings. The tests indicated that no differences existed in their opinions at conventional levels of significance.[10] The reliability of each of the four MAS dimensions was assessed by calculating Cronbach (1951) alpha coefficients for each of the multi-item measures. All of the coefficients satisfied recommended levels of reliability (Nunnally, 1967).[11]

Our assessment of validity focuses on construct validity. Construct validity tests for the customization and interdependence measure were conducted with specifically designed instruments to assess discriminant validity (multi-trait) and convergent validity (multi-method) (Brownell, 1995). Strong

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[9] The interviewer reinforced the importance of answering the questions in reference to operational decisions.

[10] The test for reliability of the customization instrument was conducted with 33 controllers and business unit managers. There exists a probability of nine per cent for these means to significantly differ [chi square is 4.80, p value 0.09, 2 df].The reliability test of interdependence amounts to the one per cent level of confidence [chi square is 11.30, $p = 0.01$, 2 df]. A paired-sample t-test was also performed and the results confirmed those provided by the chi-square test, i.e. $t = 3.36$, $p = 0.05$ (customization) and $t = 2.01$, $p = 0.01$ (interdependence).

[11] The Cronbach alpha coefficients are: 0.75, 0.82, 0.68 and 0.78 for scope, integration, aggregation, and timeliness.

support[12] was provided for both the discriminant and convergent validity of the customization instrument. Convergent validity was also high for the interdependence measure but the results did not provide strong support for the instrument's discriminant validity. This is likely to be a result of the measure selected to assess discriminant validity. However, as considerable support has been provided in the literature for the Van de Ven et al. (1976) measure, and in view of the high convergent validity of the measure, it was considered appropriate for use in the analyses.

We used factor analysis to test the validity of the MAS instrument (Bohrnstedt, 1983).[13] To ensure that the dimensions were relevant for both production and sales managers, separate factor models were derived and compared for the two groups of managers. This inter-rater test for reliability was conducted to ensure that the items comprising the instrument have a similar meaning to both sales and production managers. The factor model

was then assessed for the combined sample. The four factors identified by Chenhall and Morris (1986) surfaced only after six items of the 22 had been removed. The final factor model consists of 16 items, four for each dimension. The total percentage of variance explained in the final model amounted to 61%. The final instrument and factor scores are summarized in Table 2.

Descriptive statistics of the customization, interdependence, and MAS instruments are summarized in Table 3. Detailed descriptive statistics for each industry group are provided in Appendix B. Perusal of these descriptives indicates that there is sufficient variation among the variables of interest to test our hypotheses.

The matrix in Table 4 summarizes the correlations among the variables of the model. The correlations among the independent variables remain well under 0.50 allowing for the inclusion of the independent variables in the multiple regression model used to test the hypotheses (Kennedy, 1992).

5. Model and results

5.1. Path model[14]

The relations between customization, interdependence and MAS are explored using a path model of the following form:

$$X_2 = p_{21}X_1 + p_{2u}S_u \tag{1}$$

$$X_{3(i)} = p_{31(i)}X_1 + p_{32(i)}X_2 + p_{3v(i)}S_{v(i)} \tag{2}$$

Where,

X_1	= customization;
X_2	= interdependence;
$X_{3(i)}$	= MAS;
p_{21}, p_{31}, and $p_{32(i)}$	= path coefficients explanatory variables;

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[12] An instrument that captured "product standardization" was used to contrast with the customization instrument and an instrument used to capture "direct communication between departments" was contrasted with the interdependence measure. The customization instrument passed the test in that the correlations between the instrument's items in the subsequent tests (different traits/different raters; different traits/same rater; same traits/different raters) followed the required ascending order (Brownell, 1995). This indicated that managers distinguished between customization and the related construct production standardization, and that the managers agreed on the meaning of customization. The results of the different-trait tests (i.e. discriminant validity) were inconclusive for interdependence, in that production and sales managers made no significant distinction between the workflow and the communication construct. The test for convergent validity of the customization instrument was conducted by computing the correlations between the ratings of business unit managers and financial controllers on the tailored customization measure. The results provided strong support for this multi-method test. The correlation for tailored customization was 0.66. A similar convergent validity test was conducted for the interdependence instrument. Correlations were calculated between sales managers' ratings of pooled interdependence with production managers' ratings of sequential/reciprocal and vice versa. As expected, the results were negative and significant ($p < 0.00$). Further details of these tests are available from the first named author.

[13] Some would argue that factor analysis is a means of providing support for the reliability of a multi-item scale (Bohrnstedt, 1983). However, it is commonly used to demonstrate the validity of a scale. Factors were obtained via a varimax rotation.

[14] Arguably, we could have conducted a SEM analysis to conduct measurement and structural analysis simultaneously. However, the limited number of indicators for two of the constructs reduced the effectiveness of this form of analysis. Hence, we sequentially tested reliability and validity of the measures, and then estimated how the data fit the path model.

Table 2
Factor loading for the MAS instrument[a]

Factor	Question	I Scope	II Integration	III Aggregation	IV Timelinesss
I. Scope					
External information	19	**0.82**	−0.04	0.09	0.08
Noneconomic information	20	**0.79**	0.08	0.12	0.12
Probablistic	18	**0.74**	0.16	0.05	0.01
Future-oriented	1	**0.61**	0.12	0.21	0.07
II. Integration					
Cost/price information	3	0.11	**0.80**	−0.01	0.11
Information other department	13	0.10	**0.78**	0.09	0.36
Summary reports organization	14b	0.06	**0.75**	0.27	−0.02
Organizational effects	17	0.10	**0.73**	−0.10	0.37
III. Aggregation					
Temporal reports	12	0.13	0.01	**0.86**	−0.02
Summary reports department	14a	0.10	0.03	**0.84**	−0.03
Precise targets	7	0.14	0.05	**0.65**	0.15
Decision models	15	0.07	0.24	**0.44**	0.14
IV. Timeliness					
Automatic receipt	8	0.02	0.17	0.10	**0.81**
Frequency of reporting	16	−0.01	0.08	0.01	**0.77**
Speed of reporting	2	0.12	0.11	0.08	**0.72**
Immediate reporting	10	0.22	0.31	0.06	**0.70**
Eigenvalues		1.60	2.30	1.41	4.48
% of variance		10.02	14.36	8.79	28.01

[a] Bold prints refer to the factor items comprising the construct; question numbers refer to questionaire items in Appendix A.

Table 3
Descriptive statistics for variables ($N = 85$ business units)[a]

Variable	Median	Mean	STD. Dev.	Possible range		Observed range	
				Min.	Max.	Min.	Max.
Customization	0.20	0.31	0.32	0.00	1.00	0.00	1.00
Interdependence work production managers	0.80	0.74	0.17	0.00	1.00	0.38	0.94
Interdependence work sales managers	0.71	0.69	0.15	0.00	1.00	0.38	0.92
MAS scope production manager	12.00	11.43	3.33	4	20	4	20
MAS scope sales manager	14.00	13.88	3.21	4	20	4	20
MAS integration production manager	14.00	14.11	3.78	4	20	5	20
MAS integration sales manager	15.00	14.43	3.60	4	20	5	20
MAS aggregation production manager	15.00	16.6	3.06	4	20	4	20
MAS aggregation sales manager	15.00	15.16	2.51	4	20	9	20
MAS timeliness production manager	15.00	14.35	3.17	4	20	6	20
MAS timliness sales manager	15.00	14.65	2.95	4	20	7	20

[a] A breakdown into industry sectors is produced in Appendix B.

Table 4
Pearson correlations [*p*-value (2 tailed)] of the model variables

	Customization ($N=85$)	Interdependence ($N=170$)	Scope ($N=170$)	Integration ($N=170$)	Aggregation ($N=170$)
Interdependence	0.35 (0.01)				
Scope	0.04 (0.61)	0.03 (0.66)			
Integration	0.27 (0.01)	0.47 (0.01)	0.25 (0.01)		
Aggregation	0.18 (0.02)	0.23 (0.01)	0.31 (0.01)	0.23 (0.01)	
Timeliness	0.23 (0.01)	0.39 (0.01)	0.23 (0.01)	0.46 (0.01)	0.19 (0.01)

p_{2u} and $p_{3v(i)}$ = path coefficients unexplained variance;
$i = 1 \ldots 4$ = scope, integration, aggregation, and timeliness;
S_u and S_{vi} = error variables.

R_1^2 = variance explained by Eq. (1);

$R_{2(i)}^2$ = variance explained by Eq. (2).

The path coefficients in the model are denoted as p_{21}, $p_{31(i)}$, and $p_{32(i)}$. Path coefficients of the residuals in the equations are represented by p_{2u} (the relation customization/interdependence) and by $p_{3v(i)}$ (the relation customization/interdependence/MAS use). The path coefficients are computed as follows. The path coefficient of the relation customization/interdependence is determined by regressing X_2 on X_1. This suffices when a variable is dependent on a single independent variable and residual, which is the case for X_2, as it is assumed in the model that only customization (X_1) determines interdependence. Path coefficients of $p_{31(i)}$ and $p_{31(i)}$ are calculated by regressing $X_{3(i)}$ on X_1 and X_2 contemporaneously. If, as assumed here, residuals of the variables X_2 and $X_{3(i)}$ are uncorrelated, and all variables (including S_u $S_{v(i)}$) are standardized, then the path coefficients can be estimated using ordinary least squares (Brownell & McInnes, 1986). The calculated betas (regression coefficients) are in this case equal to the path coefficients.

The variance explained in the dependent variable is calculated for the system of equations, rather than for Eq. (2) only (Bouwens, 1998; Dillon & Goldstein, 1984; Hodap, 1991).

$$R_{m(i)}^2 = \left(R_1^2\right) + \left(R_{2(i)}^2\right) - \left(R_1^2\right)^* \left(R_{2(i)}^2\right) \qquad (3)$$

Where,
$R_{m(i)}^2$ = variance explained by the system of equations;

Prior to testing the path model, we assessed if there are differences in the use of MAS in sales and production departments.[15] From this analysis (not reported here), production and sales managers appear to use MAS in a similar manner, except for the timeliness dimension. We also analyzed whether the size of the business unit affects MAS use.[16] The results of this test revealed a significant effect for sales managers on the timeliness dimension only. Therefore, we analyzed the data separately for production and sales managers for the timeliness dimension.

[15] Some evidence in the literature suggests that the use of MAS may differ between sales and production managers (see for example, Mia & Chenhall, 1994). To test if there were any differences, we conducted an F-test comparing a model that included "type of manager" as a variable with a model which did not. The p values of this test are: 0.99; 0.98; 0.99 and 0.05 for Scope, Integration, Aggregation and Timeliness. No significant results were obtained from this test except for sales managers on the dimension of timeliness. The construction of the tests and the results can be obtained from the first named author.

[16] It has been suggested in the literature that size will be an important variable in explaining the design and implementation of MASs (Bruns & Waterhouse, 1975; Govindarajan & Gupta, 1985). Size could also be used as a proxy to control for other mechanisms (i.e. such as integrative liaison devices) that may be used by management to improve co-ordination between functional units when interdependencies increase. The use of these mechanisms has been found to be directly related to size (Abernethy & Lillis, 1995). The results of including size into the model were not significant except with respect to the timeliness for sales managers (this finding may also be due to chance). Results of this analysis are available from the first-named author.

Table 5
Results of the path analysis[a]

Type of manager	MAS dimension	Path coefficient	Value	STD error	t	p-value
Production + sales ($N = 170$)	Scope	p_{31}	0.03	0.08	0.38	0.71
		p_{32}	0.02	0.08	0.28	0.78
	Integration	p_{31}	0.13	0.07	1.75	0.08
		p_{32}	0.43	0.07	5.95	0.00
	Aggregation	p_{31}	0.11	0.08	1.39	0.17
		p_{32}	0.19	0.08	2.39	0.02
Production ($N = 85$)	Timeliness	p_{31}	0.26	0.10	2.63	0.01
		p_{32}	0.36	0.10	3.66	0.00
Sales ($N = 85$)	Timeliness	p_{31}	−0.06	0.11	−0.56	0.58
		p_{32}	0.36	0.11	3.22	0.00
Scope	$R_m^2 = 0.12$;	$p_{2u} = 0.94$;	$p_{3v} = 0.998$;	$F_{2,167} = 0.17$,	$p = 0.84$	
Integration	$R_m^2 = 0.33$;	$p_{2u} = 0.94$;	$p_{3v} = 0.87$;	$F_{2,167} = 25.90$,	$p = 0.00$	
aggregation	$R_m^2 = 0.18$;	$p_{2u} = 0.94$;	$p_{3v} = 0.97$;	$F_{2,167} = 5.64$,	$p = 0.00$	
Timeliness$_{production}$	$R_m^2 = 0.29$;	$p_{2u} = 0.95$;	$p_{3v} = 0.86$;	$F_{2,82} = 14.80$,	$p = 0.00$	
Timeliness$_{sales}$	$R_m^2 = 0.23$;	$p_{2u} = 0.92$;	$p_{3v} = 0.94$;	$F_{2,82} = 5.45$,	$p = 0.01$	

[a] Calculated with Eq. (2).

6. Results

6.1. Hypothesis 1

The first hypothesis of the model required a test of the expected positive relation between customization and interdependence. A simple correlation test confirmed this hypothesized relation. In the univariate Eq. (1), the correlation coefficient equals the path coefficient between customization and interdependence. Our expectations were supported as the correlation was significant and positive ($r = 0.35$, $p < 0.01$).[17]

6.2. Hypothesis 2

It was expected that any observed relation between customization and MAS use would be primarily via interdependence. To assess the direct and indirect relations we examined both the path coefficients produced from the path analysis

(Table 5) as well as a decomposition of the direct ($X_1 / X_{3(i)}$) and indirect ($X_1 / X_{3(i)}$ via X_2) effects of customization on MAS and the direct ($X_2 / X_{3(i)}$) and spurious effect of interdependence on MAS (Table 6). Table 5 provides little evidence of a direct relation between customization and the MAS dimensions (see the $p_{31(i)}$ coefficients), after controlling for the effects of interdependence. We find a weak direct relation between customization and the integration dimension of MAS ($p < 0.10$), and a significant direct effect of customization on timeliness, but only for production departments. By far the most significant path coefficients are those between interdependence and MAS dimensions (see, the $p_{32(i)}$ coefficients). It is interesting to note that no relation exists between scope and either customization or interdependence. No further analyses were undertaken with respect to the scope dimension

Combined with the results of Hypothesis 1, the results of the path model provide strong support for Hypothesis 2. The decomposition of the results presented in Table 6 also provides evidence to support Hypothesis 2. Thus, it appears that the primary effect of customization on MAS is via interdependence.

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[17] We also assessed if this relation differed between sales and production managers. An F test revealed that there was no significant difference (p value 0.99).

Table 6
Decomposition of the effects of customization and interdependence on MAS use ($n = 170$)

Type of manager	Linkage	Direct	Indirect/spurious[a]	Total[b]	p-value
Sales + production	Customiz./interdepend. (X_1/X_2)	0.35		0.35	0.00
	Customiz./integration (X_1/X_{32})	0.13	**0.14**	0.27	0.00
	Interdepend./integration (X_2/X_{32})	0.43	0.04	0.47	0.00
	Customiz./interdependence (X_1/X_2)	0.35		0.35	0.00
	Customiz./aggregation (X_1/X_{33})	0.11	**0.07**	0.18	0.02
	Interdepend./aggregation (X_2/X_{33})	0.19	0.04[b]	0.23	0.00
Production	Customiz./Interdependence (X_1/X_{2p})	0.32		0.32	0.00
	Customiz./timeliness (X_1/X_{34p})	0.26	**0.12**	0.38	0.00
	Interdepend./timeliness (X_2/X_{34p})	0.37	0.08	0.45	0.00
Sales	Customiz./interdependence (X_1/X_{2s})	0.38		0.38	0.00
	Customiz./timeliness (X_1/X_{34s})	−0.06	**0.13**	0.07	0.00
	Interdepend./timliness (X_2/X_{34s})	0.36	−0.02	0.34	0.00

[a] Bold prints refer to the indirect relations of customization and MAS.
[b] Zero order correlation.

7. Discussion

The results of this study add to our understanding of the relation between strategy and MASs and thus have the potential to contribute theoretically to the literature. The findings indicate that customization, as a strategic priority, does not have a direct relation with MAS but rather operates via the interdependencies created when such a strategic priority is pursued. This supports Thompson's (1967) and Galbraith's (1973) propositions concerning the relation between interdependence and a manager's demand for information. It would appear that managers recognize the importance of receiving more sophisticated information to manage the interdependencies that stem from the pursuit of customization.

A number of findings from the study did not confirm prior research. The evidence presented here revealed that the scope dimension of a firm's MAS is not important for operational decision making, which is contrary to the general expectation (Mia & Chenhall, 1994) and findings of earlier research (e.g., Abernethy & Guthrie, 1994; Chong, 1996). In addition, our analysis revealed only minor differences in MAS use between production and sales managers. It is only on the issue of timeliness where significant differences surfaced.

This is also contrary to the findings of prior research (Mia & Chenhall, 1994).

The study overcomes a number of methodological limitations identified by recent reviews of the behavioural accounting literature (see: Kren, 1997; Otley & Pollanen, 1998). Careful attention was paid to the design of the study to control for correlated omitted variable bias[18] as well as to limit the possibility of common-rater bias. In addition, all of the measurement instruments were subjected to rigorous assessment of their psychometric properties. Careful attention to the way in which the independent constructs were defined and operationalized also allowed for greater attribution of the these constructs to the importance of the different dimensions of the MAS.[19]

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[18] It is, of course, not possible to entirely control for correlated omitted variable bias. However, the study design controlled for variables that a priori were expected to confound the results. In hindsight, there may have been other variables such as the degree of competition and the presence or absence of other co-ordination mechanisms that may have influenced the results.

[19] For example the cogent choice of customization (rather than the broad-based notion of strategy), interdepartmental interdependence (rather than interdependence in general), operational decisions of production and sales managers (rather than any decision taken by any manager).

A number of directions for further research emerge from this study. While the evidence suggests that broad-scope information is not important for operational decisions, this does not imply that it is not important for other kinds of decisions. It is entirely possible that broad-scope MAS may be of particular relevance for planning and strategic decision making. Future research could expand the model developed here to investigate the importance of broad-scope information for different levels or types of decisions. This type of model could also be used to further examine the direct relation between customization and MAS. The model could also be expanded to incorporate other variables identified as important in the relations studied here.[20] The use of a field study in one large organization to study this research question would further enhance our understanding of the complexities associated with the "whys" and "hows" of MAS design.

As with most research, the study is subject to a number of potential limitations. First, co-variation does not necessarily imply causation and thus the internal validity of the study may be potentially threatened. There are two possible concerns here. First, the causal relation among the variables might run the other way, and second, there is a possibility that an "unmeasured" variable, which co-varies with the measured variable, may explain the observed variation in the dependent variable. We are not concerned with the first issue as it is relatively implausible for a more sophisticated MAS to augment interdependence and that this would, in turn, prompt organizations to introduce a customization strategy. If reverse causation is implausible, then there is little threat to internal validity, even in a correlational study (Cook & Campbell, 1979). The second threat is more difficult if not impossible to eliminate, as it requires controlling for all the possible "unmeasured" variables that could correlate with the independent variables of interest. Focussing narrowly on customization and interdependence somewhat overcomes

this concerns but as noted by others, concerns relating to this element of internal validity must rely heavily on the theoretical arguments developed (Cook & Campbell, 1979).[21]

Other limitations relate to the study design. Although the study controls for organizational structure through the inclusion of only functionally differentiated business units, the study does not control for other administrative arrangements that may be present within the business unit. It is possible that business units have implemented other co-ordination mechanisms to manage interdependencies. While no systematic evidence was collected, the observations during the interviews indicated that there were no major differences in the administrative arrangements within business units. The theoretical development of the model also relied heavily on the argument that the pursuit of customization leads to increased uncertainty. While there is considerable support for this assertion, collection of data on the dimensions of uncertainty would have strengthened the validity of this argument.

Notwithstanding these potential limitations, this study does add to our understanding of how the choice of strategy influences the design of MASs. It also sheds light on prior literature studying the strategy-MAS link. The evidence of this study suggests that it does not suffice to simply investigate the strategy-MAS link. It is also necessary to take into account what are the other consequences of strategic choice. The findings of this study provide some understanding as to "why" we might observe a relation between strategy and MAS in that it demonstrates "how" this relation emerges. Thus, the study has the potential not only to contribute to the research literature but also to assist top management and designers of management accounting systems in organizations interested in the effective implementation of customization as a strategic priority.

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[20] For example, this study does not measure uncertainty but rather argues that customization influences the level of uncertainty. Further research could extend the model developed here by explicitly incorporating this construct.

[21] For example, it is possible that the pursuit of product innovation results in greater emphases on customization. However, the theoretical argument of importance here is the relation between customization and interdependence not product innovation per se.

Acknowledgements

Appendix A: Measurement instruments

Customization measurement instrument

Product/services

Below are descriptions, which characterize Products/services firms produce. Depending upon the context, each of these descriptions may represent the situation for all, only a fraction, or none of the products/services a firm supplies. Please indicate below what percentage of current total sales regarding the business you are supervising is accounted for by products represented by each of the product/service descriptions. Your answers should total 100%.

Products/services:
a. are completely standardized   %
b. are basic models which are Customized   %
   according to organizational specifications
c. are basic models which are Customized   %
   according to client's specifications
d. are completely Customized   %
e. None of the above descriptions fits our   %
   situation (please specify).

Total   100%

Interdependence measurement instrument

A change of emphasis is required in this section. Here, I would like you to think of the other department you work with.

The following series of the questions deal with your perceptions of cooperation of your department and the . . . . . . department in joint activities you undertake with them. Please give your judgements on the typical relation that exists.

Please indicate how much of the total work within your department flows in each of the ways, as shown by the figures and as described under (a), (b), (c), and (d).

Scale used for all the interdependence questions:

| Almost | Some | About | A lot | Almost |
| none | | half | | all |
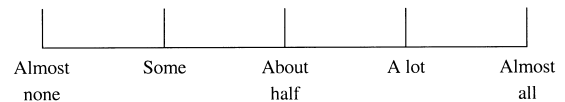
(a) *Independent work flow case*
Where work and activities are performed by your department independently and do not flow between them.
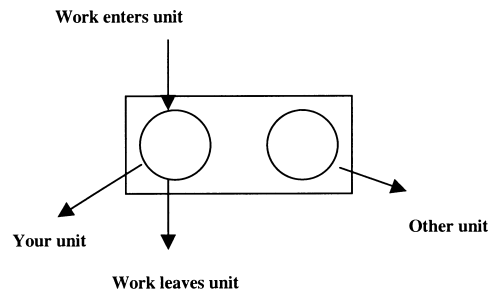
(b) *sequential work flow case from you to them*
Where work and activities flow between your department and the other department, but only from your to the other department.

(c) *Sequential work flow case 2 from them to you*

Where work and activities flow between your department and the other department, but only from their to your department.

Work enters unit

Your unit

Work leaves unit

Other unit

(d) *Reciprocal work flow case*

Where work and activities flow between your department and the other department in a reciprocal "back and forth" manner over a period of time until the work is done.

Work enters

Your unit

Work leaves

Other unit

MAS Measurement instrument

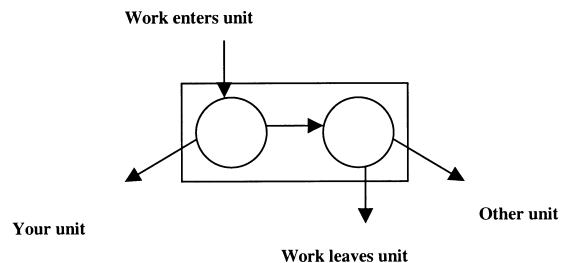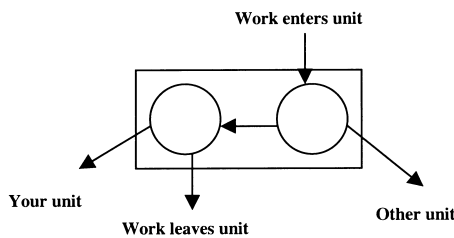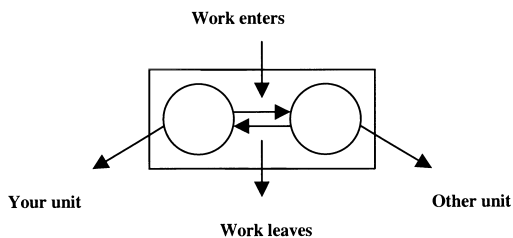If you make operational decisions for your business, some sources of information items are more important than others. Below information characteristics are described with regard to information systems. Information system should include: files, reports, documents, minutes, accounts, and notes, available for decision making and provided within the organization.

I would like you to rate the importance of each characteristic of the current system in place, in making operational decisions within your department. If an item is not part of your information system, please mark the lower end of the scale for that question.

| Of little Importance | Of some importance | Fairly Important | Important | Extremely important |
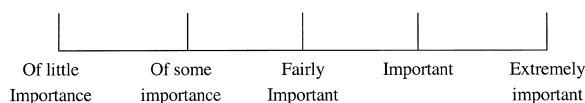
(Letter between brackets refers to the dimension the item covers: (S)cope, (T)imeliness, (I)ntegration and (A)ggregation)

1. (S) Information that relates to possible future events (for example new legislation).
2. (T) Requested information arrives immediately upon request.
3. (I) Cost and price information of the departments of your business unit.
4. (A) Information in forms, which enable you to conduct "what-if analyses."
5. (A) Information, which has been processed to show the influence of events on different functions, such as marketing or production, associated with particular activities or tasks.
6. (S) Non-financial information that relates to the following area:
   (a) Internally-oriented information such as efficiency, output rates, employee absenteeism, etc.
   (b) Market information such as market size, growth share.
7. (I) Presence of precise targets for each activity performed in all sections within your department.
8. (T) Information supplied to you automatically upon its receipt into information systems or as soon as processing is completed.
9. (A) Costs separated into fixed and variable components.
10. (T) There is no delay between an event occurring and relevant information being reported to you.
11. (A) Information provided on the different sections of functional areas in your organization, such as marketing and production, or sales, cost, or profit centers.
12. (A) Information on the effect of events on particular time periods (e.g., month/quarter/annual summaries, trends, comparisons, etc.).
13. (I) Information that relates to the impact that your decisions have on the performance of other departments.
14. (A) Information on the effect of different section's activities on summary reports such as profit, cost, revenue reports for:

(a) Your particular department ......
(b) the overall organization ......

15. (A) Information in formats suitable for input into decision models such as: (discounted cash flow analysis or incremental/marginal analysis).

16. (T) Reports are provided frequently on a systematic, regular basis; e.g. daily reports, weekly reports (for less frequent reporting, mark lower end of a scale).

17. (I) Information on the impact of your decisions throughout your business-unit, and the influence of the other individual's decisions on your area of responsibility.

18. (S) Quantification of the likelihood of future events occurring (e.g., probability estimates).

19. (S) Information on broad factors external to your organization, such as economic conditions, population growth, technological development, labor market, etc.

20. (S) Non-economic information, such as customer preferences, employee attitudes of government and consumer bodies, competitive threats, etc.

Appendix B: Descriptive statistics by sector

Table B1
Descriptive statistics sample variables (sub sample of non-financial services and sub sample of food and textile)

Sector	N	Variable	Median	Mean	Std. Dev	Possible range		Observed range	
						Min.	Max.	Min.	Max.
Services and construction	13	Customization	0.60	0.64	0.29	0.00	1.00	0.00	1.00
		Interdependence work production managers (operations)	0.88	0.83	0.09	0.00	1.00	0.60	0.92
		Interdependence work sales managers (planning and sales)	0.75	0.74	0.10	0.00	1.00	0.56	0.91
[Includes: software (6),		MAS scope production manager	12.00	11.69	3.84	4	20	4	17
technical support (i.e.		MAS scope sales manager	15.00	14.62	3.84	4	20	7	19
maintenance waste) (3)		MAS integration production manager	15.00	15.77	2.62	4	20	13	20
logistics (courier/		MAS integration sales manager	17.00	16.23	2.92	4	20	10	20
transport/warehouse)(2)		MAS aggregation production manager	16.00	15.54	2.79	4	20	11	19
construction (2)]		MAS aggregation sales manager	16.00	16.15	2.38	4	20	13	20
		MAS timeliness production manager	16.00	15.85	2.48	4	20	10	19
		MAS timeliness sales manager	15.00	15.00	2.27	4	20	10	19
		Size business units	240.00	380.77	281.98	NR	NR	135	1,010
		Size production departments	120.00	241.46	255.88			60	800
		Size sales departments	11.00	17.54	12.97			5	50
Food/textile	14	Customization	0.00	0.01	0.04	0.00	1.00	0.00	0.10
		Interdependence work production managers	0.68	0.68	0.18	0.00	1.00	0.43	0.94
		Interdependence work sales managers	0.68	0.68	0.18	0.00	1.00	0.43	0.94
		MAS scope production manager	10.50	10.36	2.62	4	20	4	13
		MAS scope sales manager	14.00	13.64	2.71	4	20	8	18
		MAS integration production manager	13.00	13.14	3.78	4	20	6	20
		MAS integration sales manager	13.50	13.42	4.20	4	20	5	20
		MAS aggregation production manager	12.50	13.14	4.31	4	20	4	20
		MAS aggregation sales manager	14.50	14.71	2.43	4	20	11	19
		MAS timeliness production manager	13.50	12.86	2.98	4	20	6	16
		MAS timeliness sales manager	15.00	14.14	2.96	4	20	8	18
		Size business units	417.50	458.07	308.66	NR	NR	130	1,070
		Size production departments	237.50	322.36	270.39			55	800
		Size sales departments	23.50	22.21	10.74			5	40

Table B2
Descriptive statistics sample variables (sub sample of paper/chemical/nonmetallic, and metal/machinery)

Sector	N	Variable	Median	Mean	Std. Dev	Possible range		Observed range	
						Min.	Max.	Min.	Max.
Paper/chemical/nonmetallic	21	Customization	0.15	0.19	0.19	0.00	1.00	0.00	0.60
[includes: paper produce (4)		Interdependence work production managers	0.60	0.67	0.17	0.00	1.00	0.38	0.92
Basic chemical (5)		Interdependence work sales managers	0.67	0.66	0.15	0.00	1.00	0.43	0.89
Soap, sweetener etc. (5)		MAS scope production manager	11.00	11.86	3.18	4	20	5	20
Pharmaceutical (2)		MAS scope sales manager	14.00	14.38	2.22	4	20	11	20
Plastic produce (3)		MAS integration production manager	15.00	14.33	3.89	4	20	8	19
Glass/plastic packaging (2)]		MAS integration sales manager	16.00	14.95	3.46	4	20	9	20
		MAS aggregation production manager	14.00	14.52	2.73	4	20	10	20
		MAS aggregation sales manager	15.00	14.86	2.67	4	20	11	19
		MAS timeliness production manager	13.00	13.95	3.81	4	20	8	20
		MAS timeliness sales manager	15.00	14.29	3.45	4	20	9	20
		Size business units	350.00	370.95	176.30	NR	NR	178	800
		Size production departments	169.00	219.10	143.98			52	600
		Size sales departments	20.00	22.76	12.94			4	55
Metal/machinery	16	Customization	0.28	0.36	0.35	0.00	1.00	0.00	1.00
[includes: basic steel (1)		Interdependence work production managers	0.88	0.78	0.17	0.00	20	0.38	0.94
Metal packaging (2)		Interdependence work sales managers	0.68	0.66	0.18	0.00	20	0.38	0.90
Metal components (3),		MAS scope production manager	11.00	10.68	3.69	4	20	5	17
Small metal produce (3),		MAS scope sales manager	12.50	12.00	3.35	4	20	5	17
Large metal produce (3),		MAS integration production manager	15.50	14.81	3.94	4	20	8	20
Machinery (4)]		MAS integration sales manager	15.50	14.94	3.75	4	20	8	20
		MAS aggregation production manager	16.00	15.56	2.87	4	20	9	19
		MAS aggregation sales manager	15.00	14.81	2.84	4	20	9	19
		MAS timeliness production manager	14.50	15.56	2.85	4	20	9	20
		MAS timeliness sales manager	15.00	15.50	2.61	4	20	11	20
		Size business units	282.50	330.75	116.19	4	20	160	600
		Size production departments	110.00	157.88	118.47	NR	NR	45	430
		Size sales departments	15.00	20.25	18.12			5	79

Table B3
Descriptive statistics sample variables (sub sample of electronic and other manufacturing and financial services)

Sector	N	Variable	Median	Mean	Std. Dev	Possible range		Observed range	
						Min.	Max.	Min.	Max.
Electronic and other manuf.	15	Customization	0.35	0.44	0.29	0.00	1.00	0.00	1.00
[Includes: conductors (3)		Interdependence work production managers	0.86	0.79	0.13	0.00	1.00	0.50	0.92
Electronic systems (8)		Interdependence work sales managers	0.80	0.74	0.14	0.00	1.00	0.44	0.89
Tape reproduction (1)		MAS scope production manager	11.00	11.07	3.20	4	20	5.00	17.00
Furniture (3)]		MAS scope sales manager	14.00	13.87	3.58	4	20	4.00	18.00
		MAS integration production manager	15.00	13.73	4.14	4	20	5.00	19.00
		MAS integration sales manager	15.00	14.67	2.85	4	20	10.00	20.00
		MAS aggregation production manager	14.00	14.80	2.40	4	20	10.00	18.00
		MAS aggregation sales manager	15.00	15.60	2.16	4	20	12.00	19.00
		MAS timeliness production manager	15.00	14.27	2.99	4	20	9.00	19.00
		MAS timeliness sales manager	14.00	13.80	3.19	4	20	7.00	19.00
		Size business units	345.00	417.67	261.31	NR	NR	120	1,050
		Size production departments	200.00	230.33	176.32			70	790
		Size sales departments	20.00	24.00	4.31			5	50

Table B3 (*continued*)

Sector	N	Variable	Median	Mean	Std. Dev	Possible range		Observed range	
						Min.	Max.	Min.	Max.
Financial services	6	Customization	0.20	0.22	0.23	0.00	1.00	0.00	0.60
[includes:		Interdependence work production managers (back office)	0.69	0.67	0.18	0.00	1.00	0.44	0.91
Investment support Services (1)		Interdependence work sales managers (front office)	0.67	0.68	0.12	0.00	1.00	0.56	0.90
Non-life insurance (3),		MAS scope production manager	14.50	14.50	2.43	4	20	11.00	17.00
Merchant banking (2)]		MAS scope sales manager	16.00	16.17	3.37	4	20	12.00	20.00
		MAS integration production manager	10.00	11.00	2.76	4	20	8.00	16.00
		MAS integration sales manager	10.00	10.50	2.74	4	20	8.00	15.00
		MAS aggregation production manager	12.00	13.17	2.32	4	20	11.00	17.00
		MAS aggregation sales manager	15.50	15.00	2.19	4	20	12.00	18.00
		MAS timeliness production manager	15.50	15.57	2.94	4	20	12.00	19.00
		MAS timeliness sales manager	16.50	16.67	2.48	4	20	13.00	20.00
		Size business units	315	375.16	232.63	NR	NR	150	300
		Size production departments	150	221.64	192.47			50	200
		Size sales departments	20	21.38	13.65			9	40

References

Ackoff, R. L. (1967). Management misinformation systems. *Management Science, 11*, 147–156.

Abernethy, M. A., & Guthrie, C. H. (1994). An empirical assessment of the "fits" between strategy and management information system design. *Accounting and Finance, 34*, 49–66.

Abernethy, M. A., & Lillis, A. M. (1995). The impact of manufacturing flexibility on management control system design. *Accounting, Organizations and Society, 20*, 241–258.

Anthony, R. N. (1965). *Planning and control systems: A framework for analysis*. Boston: Harvard Graduate School of Business.

Atkinson, A. A., Banker, R. D., Kaplan, R. S., & Young, M. (1997). *Management Accounting*. Upper Saddle River: Prentice Hall.

Baumler, J. V. (1971). Defined criterion of performance and organizational control. *Administrative Science Quarterly, 16*, 340–349.

Bohrnstedt, G. W. (1983). Measurement. In P. H. Rossi, J. D. Wright, & A. B. Anderson, *The handbook of survey research* (pp. 69–121). New York: Academic Press London.

Bouwens, J. (1998). The use of management accounting systems in functionally differentiated organizations, Ph.D. thesis, Center for Economic Research, Tilburg University.

Brickley, J. A., Smith, C. W., & Zimmerman, J. L. (1997). *Managerial economics and organizational architecture*. Chicago: Irwin.

Brownell, P., & McInnes, M. (1986). Budgetary participation, motivation and managerial performance. *The Accounting Review, 61*, 502–512.

Brownell, P. (1995). Research methods and management accounting. Melbourne: Coopers and Lybrand Australia and the Accounting Association of Australia and New Zealand.

Bruns Jr, W. J., & Waterhouse, J. H. (Autumn 1975). Budgetary control and organization structure. Journal of Accounting Research, 177–203.

Chapman, C. S. (1997). Reflections on a contingency view of accounting. *Accounting, Organizations and Society, 22*, 189–205.

Chenhall, R. H., & Morris, D. (1986). The impact of structure, environment, and interdependence on the perceived usefulness of management accounting systems. *Accounting Review, 61*, 16–35.

Chia, Y. M. (1995). Decentralization, management accounting systems, MAS information characteristics and their interaction effects on managerial performance: A Singapore study. *Journal of Business Finance and Accounting, 22*, 811–830.

Chong, V. K. (1996). Management accounting systems, task uncertainty and managerial performance: A research note. *Accounting, Organizations and Society, 21*, 415–421.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrica, 16*, 297–334.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: design and analysis issues for field settings*. Chicago: Rand McNally.

Dillon, W., & Goldstein, M. (1984). *Multivariate analysis, methods and applications*. New York: John Wiley and Sons.

Drury, C. (1996). *Management and cost accounting*. Boston: International Thomson Business Press.

Earl, M. J., & Hopwood, A. G. (1981). From management information to information management. In H. C. Lucas Jr, F. F. Land, T. J. Lincoln, & K. Supper, *The information systems environment* (pp. 3–13). Amsterdam: North-Holland.

Emmanuel, C., Otley, D. T., & Merchant, K. A. (1990). *Accounting for management control*. London: Chapman and Hall.

Galbraith, J. (1973). *Designing complex organizations*. Reading: Addison-Wesley.

Gilmore, J. H., & Pine, B. J. (1977). The four faces of mass customization. *Harvard Business Review, 75*, 91–101.

Gordon, L. A., & Miller, D. (1976). A contingency framework for the design of accounting information systems. *Accounting, Organizations and Society, 1*, 59–69.

Gordon, L. A., & Narayanan, V. K. (1984). Management accounting systems, perceived environmental uncertainty and organization structure: an empirical analysis. *Accounting, Organizations and Society, 9*, 33–47.

Gorry, G., & Scott-Morton, M. A. (1971). A framework for management information systems. *Sloan Management Review*, 55–70.

Govindarajan, V., & Gupta, A. K. (1985). Linking control systems to business unit strategy: impact on performance. *Accounting, Organizations and Society, 10*(1), 51–66.

Hodap, V. (1991). *Analyse Linearer Kausalmodelle*. Bern: Verlag Hans Huber.

Hopwood, A. G. (1974). *Accounting and human behaviour*. London: Haymarket Publishing.

Horngren, C. T., Foster, G., & Datar, S. M. (1997). *Cost accounting: A managerial emphasis*. Englewood Cliffs: Prentice Hall.

Kennedy, P. (1992). *A guide to econometrics*. Cambridge, Massachusetts: MIT Press.

Kotler, P. (1989). From mass marketing to mass customization. *Planning Review, 17*, 10–13.

Kotha, S. (1995). Mass customization: implementing the emerging paradigm for competitive advantage. *Strategic Management Journal, 16*, 21–42.

Kren, L. (1997). *The role of accounting information in organizational control: the state of the art* In: behavioral accounting research, foundations and frontiers, V. Arnold, & S. G. Sutton. Sarasota, American Accounting Association.

Larcker, D. F. (1981). The perceived importance of selected information characteristics for strategic capital budgeting. *The Accounting Review*, 519–538.

Macintosh, N. B., & Daft, R. L. (1987). Management control systems and departmental interdependencies: An empirical study. *Accounting, Organizations and Society, 10*, 49–61.

Macintosh, N. B. (1995). *Management accounting and control systems: An organizational and behavioral approach*. Chinchester: John Wiley and Sons.

Mia, L., & Goyal, M. (1991). Span of control, task interdependence and usefulness of MAS information in not-for-profit government organizations. *Financial Accountability and Management, 7*, 249–266.

Mia, L., & Chenhall, R. H. (1994). The usefulness of management accounting systems, functional differentiation and managerial effectiveness. *Accounting, Organizations and Society, 19*, 1–13.

Milgrom, P., & Roberts, J. (1990). The economics of modern manufacturing: technology, strategy and organization. *American Economic Review, 80*, 511–528.

North American Industry Classification Schedule (NAICS: www.census.gov/ftp/pub/epcd/www/naicstab.htm)

Nunnally, J. C. (1967). *Psychometric theory*. New York: McGraw-Hill.

Otley, D. T. (1980). The contingency theory of management accounting: achievements and prognosis. *Accounting, Organizations and Society, 4*, 413–428.

Otley, D. T., & Pollanen, R. (in press). Budgetary criteria in performance evaluation: a critical appraisal using new evidence. *Accounting, Organizations and Society*.

Parthasarthy, R., & Sethi, S. P. (1993). Relating strategy and structure to flexible automation: a test of fit and performance implications. *Strategic Management Journal, 14*, 529–549.

Pine II, B. J. (1993). *Mass customization: The new frontier in business competition*. Boston: Harvard Business School Press.

Pugh, D. S., Hickson, D. J., Hinings, C. R., & Turner, C. (1969). An empirical taxonomy of structures of work organizations. *Administrative Science Quarterly, 14*, 115–126.

Simon, H. A. (1960). *The new science of management decisions*. New York: Harper and Row.

Thompson, J. D. (1967). *Organizations in action*. New York: McGraw-Hill.

Van de Ven, A. H., Delbecq, A. L., & Koenig, R. (1976). Determinants of coordination within organizations. *American Sociological Review, 41*, 322–338.

Walton, R. E., & Dutton, J. M. (1969). The management of interdepartemental conflict: a model and review. *Administrative Science Quarterly, 14*, 73–84.