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STRATEGIC INFORMATION SYSTEMS IN MANUFACTURING INDUSTRIES

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1. INTRODUCTION

An increasing number of case studies of strategic information systems (SIS) have been reported in recent literature. Most of the examples refer to American or British corporations. Research on the level of industry is found only in service industries such as insurance (Harris and Katz 1988) or wholesale business (Cron and Sobol 1983). With the exception of the Kauffman and Weill (1989) study, the adoption of information technologies (IT) for competitive advantage in the manufacturing industry has not been researched at the level of industry. While service industries such as banking and insurance must rely on IT as their major productive asset, this is not the case in most manufacturing businesses.

The competitive advantage from IT investments has stimulated a discussion of new conceptions of information systems (IS) performance to complement efficiency measures such as productivity growth and the conventional measures of the effectiveness of the business: return on assets and return on investments (Buzzell and Gale 1987).

The question of competitive advantage also raises the issue of performance measurement. Wilson (1988) found sixty-six different indicators of IT performance and identified seven different assessment methods. The Kauffman and Weill survey of the IT business value estimation research stated that "it may not be sufficient to track the investment side alone" (p. 385). Continuous theory building was suggested to be more conducive to the development of this field than theory testing at the present level of maturity.

This paper does not presuppose a general solution to the problem of identifying links between information technology and business performance. Competitive advantages of information technology relate to bargaining power, organizational adjustments and industry-wide impacts (Treacy 1986).

In this study, competitive advantages of information systems (CIS) will be discussed at the level of the "systems business unit" (SBU).¹ The identified CIS will be related to IS strategies in the perspective of intended and realized or emergent strategies in order to define SIS (Mintzberg and Waters 1985). The IS strategies are classified according to suggestions made by Methlie (1986). Reported CIS from a study of twenty-seven manufacturing companies representing five industries are also analyzed in terms of competitive forces (Porter 1980) and the activity matrix (Porter 1985).

The study discusses the following questions Can IS expenditure and IT intensity explain observed differences in reported CIS among industries and SBUs? Which IS strategies are pursued by the SBUs and which competitive advantages are ascribed to the CIS? Are all reported CIS also strategic?

2. THE ISSUE

Recently, the attention afforded information technology has been widened from technologies to information systems. In early attempts to define a behavioral theory of information systems, the major thrust was to put the IS into the framework of the organization, not as a technical gadget, but as part of the organization policy (e.g., Mumford 1983). The recommendations offered were that information systems should assist employees to achieve a higher level of efficiency and a high quality working environment; however, the attention to the organizational impact of IS was stressed even more.

Specific examples helped to identify the idea of a strategic impact of IS. Tricker introduced his book with the statement

This book provides a completely new orientation. Information system developments are shown to be organizational developments. Senior managers are not passive patrons of system developments; they must recognize strategic implications and determine strategic directions....There is no panacea for organizational design, no simple techniques waiting to be applied. Much more is at stake. We are concerned with the very *strategy, structure and style of the enterprise*. [Tricker 1982, pp. 2-3, emphasis added]

He goes on to classify the "strategic significance of information systems" according to the impact on marketing strategy, the impact on production and technological strategies, the impact on financial strategy, manpower and management strategies, the effect on acquisition strategies and finally the impact on overall strategy. Tricker sometimes mixes the internal impact of an IS and the impact of an IS upon the competitive advantages of the business, while at other times he is clearly arguing the case of using IS to obtain competitive advantages for the business:

It is not unusual to find that a computer strategy, conceived as an operational support to the activities of the enterprise, proves to have the most significant organizational implication and to *affect the overall, long term strategies of the organization*. [Tricker 1982, p. 17, emphasis added]

He later states:

Information systems can have a major strategic impact....Senior management must think through its information systems strategy in the context of the overall corporate strategy. [Tricker 1982, p. 19]

Parsons (1983) conceptualized the impact of information systems at the industry level, the firm level and the strategy level, clarifying the distinct kinds of impacts. At the level of industry, the impact is found on the products and services of the industry, the markets or the economies of scale or scope in production. At the firm level, the five competitive forces driving industry competition are used to classify the kind of forces at work: substitutes, potential entrants, suppliers, buyers and the industry competitors (Porter 1980). Finally, the strategic level is operationalized as the three generic strategies: overall cost leadership, differentiation and focus (Porter 1980).

Cases of competitive advantage have been reported in the trade journals and have been the subject of numerous academic articles. Strassmann (1985) gives an extensive treatment of the business effects of information technology. Wiseman (1985) presents a number of case studies of SIS. The competitive use of telecommunications has been reported by Keen (1986) and Clemons and McFarlan (1986).

The pervasive *raison d'être* of IT investments in business had been to improve the productivity and the performance of the general ledger, logistics, and the information transaction processing, primarily with examples in procurement (hospital supplies), banking, seat reservations and booking of holidays (Feeny 1988).

Wiseman (1985) identified a new breed of information systems resulting from the strategic planning of competitive advantage by the adoption of information technologies. He named this a *strategic perspective* in contrast to conventional perspectives on information systems. Strategy from the point of view of information systems is not identical to strategy from the corporate management point of view (Earl 1988). The language of the CIO is far from identical to the language of the CEO (Wilson 1988). The gap between them cannot be bridged easily; in most cases, the former cannot argue in terms of ROI or ROA. New conceptions must be devised.

This skeptical attitude has found evidence of a premature solution of the new "mode" of IS by reflecting upon the easy imitation of some CIS, making any advantage a short-lived one. An example of this point of view was the critical appraisal by Benjamin, DeLong and Scott Morton (1990) of electronic data interchange (EDI) as a kind of IS attributed competitive advantage (see also Clemons and Kimbrough 1986). The sustainability of a competitive advantage required something beyond a straightforward implementation of EDI (Scott Morton 1989, p. 40): a redress of the organizational structure and the formation of business partnerships to realize cooperative advantages in logistics, product development and marketing.

Strassmann suggested a method to handle information technology performance in terms of effectiveness relating total value added to management productivity which depends upon the use of information technology. However, Strassmann admitted that

to gain strategic insights about information-technology investments, one must apply the techniques derived from strategic analysis of business units....The strategic aspects of information technology are best explained in terms of their influence on business results, such as changes in market share, improved product quality, increased market penetration, higher profit margins and enhanced customer service. [Strassmann 1985, p. 140]

Clemons and Kimbrough (1986) assumed that competitive advantage of an information system can be identified, if it is sustainable and can thus be related to changes in the industry structure. King, Hufnagel and Grovner (1988, p. 80) stated that "to be a strategic use of information resources, the information resource application must be a significant element of the business strategy - the way in which the firm seeks to gain a sustainable comparative advantage in the marketplace." They conceded that there is no simple way to determine the required significance.

Porter's methodology requires management to map the competitive nature of the industry before setting out to identify the strategic business opportunities of the company. As IT has become a major asset, including in the mapping of an industry the competitors' use of information systems is a prerequisite to obtain competitive advantage.

Research on competitive advantage relying upon the Porter activity matrix is well suited to capturing the business significance of mass transaction processing information systems. However, information systems which serve the objective of coordinating and codifying knowledge by the production of appropriable information services are at odds with the activity matrix. Such activities may be classified as support activities in the value added chain but without methods to specify the business impact in terms of com-

petitive advantage as they have no definite position in the value added chain and can rarely be isolated to one product.

As we move from celebrating the opportunities to investigating the circumstances and conditions for IT to be used strategically, future research must come to grips with four different problems (Earl 1987): how to gain competitive advantage, how to improve productivity and performance, how to enable new ways of managing and organizing, and how to develop new business.

Earl's four categories reflect the revolution in the conception of IS, since by then the scope for changing competitive structures and strategies had been on the agenda of corporate management for some time. Earl remarks

A new research area thus has arrived, potentially combining at least the bodies of knowledge about information systems, business strategy, organizational behavior, technology management and industrial economics....At the same time judicious observers retain a healthy skepticism about some of the strategic outcomes of IT applications and experienced executives are concerned that some of the strategic frameworks entering information systems discourse are superficial, some of the strategy formulation techniques are jejune, some of the prescriptions too generalized and many expectations over-optimistic. Consequently there is a huge scope and need for research in this area. [Earl 1987, pp. 157-158]

Business strategy is an ambiguous concept reflecting the positive management decisions on which business to be in, which critical factors to strengthen, etc., while also reflecting the dialectics of response to changes in industry structure due to invisible, but no less threatening, potential new entrants or new substitute products.

While *competitive* advantage relates IS to the effects upon the market structure, the *strategic* approach relates IS to the strategic management decision process, requiring the competitive advantage to be an implemented outcome of an IS, successful in the marketplace.

The concept of *strategic information systems* (SIS) must refer both to the strategy formulation process (*ex ante*) and the observed competitive advantage of a CIS (*ex post*). SIS must imply an implemented CIS to be realized, i.e. a realized strategy (Mintzberg and Waters 1985). Some CIS have been realized without being a product of a deliberate strategy. Those CIS reflect an emergent strategy if they stimulate the revision of the IS strategy of the SBU. SIS is determined and planned for as a reflection of *strategy conformance* between the business and the IS strategy. If

the intended competitive advantages associated with an SIS actually materialize, it is a realized SIS (*ex ante*) and an emergent SIS (*ex post*), if born out of coincidence, later realized and then exploited as part of the business strategy (see Figure 1).

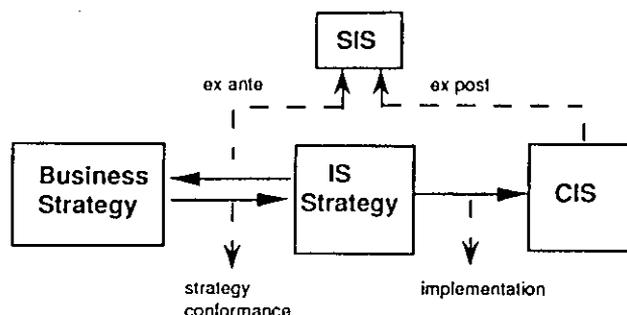


Figure 1. Competitive and Strategic Information Systems

Finally, the point raised by King, Hufnagel and Grover (1988) that "the information resource application must be a significant element of the business strategy" concludes the argument. In order to qualify the IS as an SIS, to what extent should it be a significant element in the business strategy? This criterion may be quantified as the share of IS in the resources devoted to realize the business strategy. However, quantifying strategies may not be an available method in every circumstance.

To identify *strategy conformance*, the Porter scheme of business strategies may be related to the IS strategies. Cost-effectiveness IS strategies may conform to an overall cost leadership business strategy. Management support corresponds to a differentiated or a focused business strategy as do the IS strategies of product and market support, although this interpretation may be challenged in further studies. The interpretation of IS strategies in terms of business strategies should be conducted at a more disaggregated level. For this study, however, these distinctions serve their purpose.

The selection of the *manufacturing industry* as the subject of this study was made for two reasons: systems have recently been developed changing the conception of data processing in manufacturing businesses and the next wave of CIS may find its way into manufacturing businesses (see Gooding 1988).

As examples of the first argument, the Italian case on the Prato district (Rullani and Zanfei 1988a), the European case of the automobile industries adopting advanced IS to realize the strategy of just-in-time production (OSPRI 1986), and the case of merging manufacturing and marketing through networking in the case of Benetton (Rullani and Zanfei 1988b) illustrate the opportunities for the exploitation of telecommunications and data processing as an integrated business activity, and even forming part of an overall business strategy.

The adoption of ISO 9000, which allows production process quality standards to be linked through data processing to CAD/CAM, provides an illustration of the second argument. CALS (computer aided logistics system) in the United States and the Standards for the Exchange of Product Definition Data (STEP) in ISO promise cost savings in research and development, production and distribution (Datamation 1989). This may be seen as the transformation of the business organization from one of sequential processes into one of "electronically linked, cross-functional teams," which will allow "the organization to focus relevant knowledge....without having to put in place special organizational procedures to find the knowledge and make it available to the relevant people" (Scott Morton 1989, p. 41).

3. METHODOLOGY OF THE STUDY

An identified CIS was classified as realized SIS, if it was the outcome of an IS strategy and classified as an emergent SIS, if strategy conformance was established without an explicit intention. The reported CIS has been established as to the competitive effects only so far as the company itself knew of it although these effects may not have been intended originally.

Methlie argues the need for a business economic approach to information systems. Table 1 illustrates four types of IS strategies adopted from Methlie (1986) referring to Drucker, defining cost-effectiveness as doing things right and goal-effectiveness as doing the right things. Methlie applies this distinction - between the effective use of resources and the effective achievement of the objectives of the business - to the primary processes in the business and to the effective use of the information resource as an output being embodied in the product or in product service.

The objective is mainly control in the case of administrative support which can be found in distributed data and word processing systems. These kind of systems are suitable for a firm in price competitive markets for standard products since cost effectiveness is the primary competitive strategy. Further, if the processes in the business are information intensive, there are reasons to strengthen the administrative support, whereas, if the products of the business are information intensive, the market and product support strategy will probably have a stronger impact on the competitiveness of the firm. Goal effectiveness can be achieved through effective use of data. The processes known in this category are decision support systems, expert systems, and communication systems such as electronic mail and electronic data interchange. Looking at resources and products, we find information management contributing to cost-effectiveness by efficient management of data resources. Value-adding can be realized in the product and marketing support systems

offered in inter-organizational systems such as transaction-oriented points-of-sale and electronic payment systems, and home banking or in information services such as business statistics and calculations, marketing, distribution or piggy-backing (information services that are spin-offs of the primary activities and products of the company). This taxonomy has been found useful in the classification of the IS strategies pursued by the companies. In order to explore the issue of strategy conformance, the strategy of a business unit may be related to IS strategies.

The above classification has been used in this study. In cases where a business strategy could not be identified clearly, the issue of strategy conformance has been dropped.

4. THE METHOD

The business unit of each corporation selected was decided upon after consultation with the management in the corporations in order to ensure that the responsibility of the IS organization coincided with the business unit. This may be called "the systems business unit" (SBU) as opposed to a product-based business unit. The questionnaire for the interviews consisted of closed and open questions according to the nature of the information required. Information on CIS was acquired by questioning for details on the kind of competitive advantage and impact associated with an information system. The respondents were asked to assess whether any of their IS could be related to the competitive forces in the Porter taxonomy and how. In most companies, the management of the SBU and the IS department were interviewed one by one, interviews lasting from three hours up to a whole day or taking place over several days. Often specially prepared information was forwarded after the interviews had been conducted.

The head of the research team, the author of this paper, conducted all interviews and coded answers to open questions in order to ensure a consistent interpretation of questions and answers. Only precoded questions were handled by assistants. The database of the study consists of more than 360 fields of data for each company.

5. THE SAMPLE OF COMPANIES

The selected industries represent the most important Danish manufacturing industries as measured by revenues, employees and shares in Danish exports. The five industries - defined as broad groups to safeguard the anonymity of the companies - were food and beverages (6), machinery and electronics (8), chemicals and pharmaceuticals (4), textiles and clothing (5), and the building supplies industry (4). The figures in parentheses are the number of companies interviewed.

Table 1. Taxonomy of IS Strategies

Information Systems for:	Business Effectiveness:	
	Cost-effectiveness	Goal-effectiveness
Processes	Administrative support	Management support
Resources and products	Information management	Markets and product support

Table 2. Conformance of IS Strategy to Business Strategy

Business Strategy	IS Strategy
Overall cost leadership	Administrative support Information management
Differentiation Focus	Management support Markets and product support

Table 3. IS Strategy Ratings in the Twenty-Seven SBUs

	Relative importance of types of IS Strategies to the SBU			
	None	Minor	Some	High
Administrative support	4%	0%	19%	78%
Information management	0%	11%	37%	52%
Management support	19%	19%	44%	19%
Product and marketing support	15%	37%	41%	7%

The companies were selected among the major companies in each industry. All companies had substantial, long term experience with IT. A total of 23,000 tele-terminals and 10,977 work stations were recorded in the SBUs selected for this study. The total number of employees in the twenty-seven SBUs were 57,500, while the twenty-seven corporations had over 100,000 employees. The SBU headquarters were located in the Greater Copenhagen area, in Jutland and on the islands reflecting the regional distribution of major Danish manufacturing companies.

6. RESULTS OF THE STUDY

The companies were asked to use the strategic IS categories to describe their present IS strategy in the SBU. The option to describe the characteristics of their strategy in other terms, if they found the categories unsuitable for the purpose, was not used.

Table 3 shows a consistent pattern in the response to the question about the present IS strategy in the SBUs. The scores show a declining relevance as one moves from administrative support to product and marketing support representing an almost one-dimensional structure in this measurement of IS strategy. Only management support does not solicit a significantly differentiated response. In conclusion, administrative support and information

management, both motivated by cost-effectiveness, have obtained the high scores in over half of the SBUs, while management support and product and marketing support have limited weight in less than half the companies. The strategies of the companies generally reflect a cost-effectiveness approach to IS.

6.1 IS Expenditures and IT Intensity

Looking at the level of IS expenditures in the five industries, there is apparently no clear relationship between expenditures and IT intensity (Table 4), expenditures being defined in this study as the IS personnel wages, maintenance and repairs, leasing and licensees of hardware, applications and systems licensees, data transmission and networks, transmission expenditures, consultants and ancillary expenditures. IT intensity reflects the relative number of terminals available in the SBU, disregarding telecommunications terminals such as hand sets, telefax, mobile telephones, and telex. The measurement of IT intensity relates IT terminals to the number of local telephone lines and to the number of employees. The number of local lines used as a norm for maximum IS access demand is more sensitive to the need for communication and data processing in the SBU than the number of employees. IS expenditures are an average for the industry calculated on the basis of the percentage of IS expenditures in relation to company revenue for each SBU.

Table 4. IS Expenditures and IT Intensity in Five Industries

	IS expenditures in percent of revenues	IT-intensity	
		Workstations/ 100 local lines	Workstations/ 100 employees
Food and beverages	0.97%	69	17
Chemicals and pharmaceuticals	1.84%	32	22
Machinery and electronics	1.84%	55	22
Textile and clothing	1.11%	47	14
Building supplies	0.92%	63	14

Note: Workstations refer to any kind of terminal equipment, be it a terminal, a microcomputer or a technical workstation, but excluding printers, plotters and scanners. The IS expenditures are measured as IS personnel wages, systems maintenance and repairs, applications licenses, communications traffic and access charges, education and training, consultants, and auxiliary expenditures. Investments are not included.

Table 5. Spearman Rank Correlation of Relative IS Expenditures to IT Intensity

IS expenditures in industry groups versus IT intensity:

IT intensity:	Workstations pr 100 local lines N = 5 industries Rho = -.675	Workstations pr 100 employees N = 5 industries Rho = .825
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IS expenditures in SBUs versus IT intensity:

IT intensity:	Workstations pr 100 local lines N = 22 SBUs Rho = -.098	Workstations pr 100 employees N = 22 SBUs Rho = -.073
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Table 6. CIS in Five Industries According to Competitive Forces

	Entrants	Intra-industry	Substitution	Suppliers	Buyers	Sum
Food and beverages	2	5	2	4	4	17
Chemicals and pharmaceuticals	0	0	0	0	0	0
Machinery and electronics	3	6	2	6	6	23
Textile and clothing	0	0	0	1	1	2
Building supplies	<u>2</u>	<u>3</u>	<u>1</u>	<u>2</u>	<u>2</u>	<u>10</u>
	7	14	5	13	13	N=52

Spearman's rank coefficient is negative in the case of work stations per local line, while positive in the case of employees, measured for the industry as a whole.

A large number of work stations per local line is to some degree associated with a low IS expenditure when measured by industry groups. The positive and larger rank correlation (Rho = .825) between IS expenditures and the number of work stations per 100 employees confirms the common sense of a correlation between relative expenditures and IT intensity (Table 5). This correlation evaporates when we look at companies and not at industry groups. The statistics show a remarkably low and negative Spearman rank correlation. No substantial evidence of a relationship between relative IS expenditures and the IT intensity at the company level can be produced in this study (Table 5).

According to these measurements, there is no relationship between relative IS expenditures and IT intensity as measured by work stations relative to the number of local lines or the number of employees, independent of industries. The industry group held constant produced a higher rank correlation, indicating that production technologies or the type of competitiveness in different industries do seem to matter (Table 5).

6.2 Distribution of CIS

Nineteen companies identified fifty-two examples of IS having competitive effects as evaluated by the managers of the IS department and/or the functional business department of the business unit.

Table 6 shows a concentration of IS in the down-stream of competitive forces accounting for 77 percent of the total sample of CIS. The potential competitive forces of substitution and new entrants are less attended to, representing only twelve examples.

The eight companies without examples of CIS were not without means to develop such systems but had been focusing their IS on internal processes and other control systems, to which they did not ascribe any comparative competitive advantage. Their international competitors were no better off. The existence of a CIS thus depends upon the intra-industry competition. Danish chemicals and pharmaceuticals industries are very export-oriented but nonetheless without examples of CIS. Less surprising is the low number of CIS found in the textile and clothing industry. That industry is usually associated with a low level of IT intensity. In recent years more and more Danish textiles and clothing companies have introduced CAD systems for design and calculation of the optimal laser cutting of the garment and information systems for tracking orders. According to management, few of these IS qualify as furnishing a competitive advantage in the industry.

To capture the pattern in the CIS, the results in Table 6 can be transformed into the degree of realization of CIS:

$$\text{deg(CIS)} = \frac{\text{Number of observed CIS} * 100}{5 * \text{Number of companies in industry group}}$$

This measurement neutralizes the effects of different numbers of companies in the industry groups allowing for a direct comparison of industry performance. The *degree of realization of CIS* found is reported in Table 7.

Table 7. Degree of Realization of CIS in SBUs in Five Industries

	Reported CIS in SBUs per industry group
Food and beverages	57%
Chemicals and pharmaceuticals	0%
Machinery and electronics	58%
Textile and clothing	8%
Building supplies	50%

Relating IS expenditures to the degree of CIS realization, we find a low negative rank correlation ($Rho = -.075$), which means that there is no relationship between expenditures and the observation of CIS in the five industries. This is corroborated by other measures in the study. There is no significant relationship between CIS and the relative expenditures on IS in the industries, nor in the companies. The correlation of IT intensity, measured by work stations per employee, with the degree of CIS realization in industry, showed no significant rank correlation either ($Rho = .2$).

The observations of CIS apparently cannot be explained by IS expenditures or by IT intensity as an intermediate variable. Only the industry group matters.

6.3 Information Services in the Value Added Chain

How does the reported CIS relate to the value added chain of the companies? Transforming the contents of the reported CIS into the constituent information services we find mainly activities related to marketing and sales, service, input logistics and the company infrastructure, while output logistics have much less attention paid to them. The classification of CIS has been made after a thorough interpretation of their characteristics. Responses to a number of questions relating the fifty-two CIS to the business activities of the SBU have been processed into forty-four cases of ten types of information service as shown in Table 8.

The information services can be regrouped as to which kind of support or primary activity in the Porter value added chain fits after an inspection of their content and function to the company (see Table 9).

The reason for this result may very well be that the competitors of this sample of companies use IS in output logistics and operations similar to their own, constituting an intra-industry competitive norm, but regrettably no competitive advantage. In the 1990s the logistics IS are expected to be much more important due to adoption of EDI and just-in-time business strategies reflecting a fierce cycle time competition, a trend now observed in Danish manufacturing businesses (Kühn Pedersen 1990).

6.4 IS Strategies, CIS and SIS

Moving from information service categories to the IS strategies demanded an inspection of the characteristics of each information service before classification into the IS strategy taxonomy as a proxy for actual IS strategy.²

Table 10 discloses a low level of CIS in administrative support and a higher level in product and market support than expected from the distribution of IS strategies reported in Table 2. This is not a contradiction since the strategies listed in Table 2 do not necessarily reflect a competitive advantage to the SBU necessary to run the business. Threshold investments in IS may be responsible for the difference observed in IT investments and the difference between IS strategy and reported CIS among the industries (Weill and Olson 1989).

The strategy conformance concept implied that the business strategy should conform to the IS strategy (ex ante) as a precondition for an SIS.

Table 8. Information Services Provided by the CIS

	Number of cases
1. Computational support	7
2. Databases build on transactions with suppliers and customers	7
3. Databases build on research and development	2
4. Data and computations relating to production	7
5. Data relating to customer service	2
6. Data drawn from database services	4
7. Customer or supplier self-service	3
8. Customer or supplier IS "piggy-backing"	10
9. Information service integrated in products	1
10. Information service to authorities, standardization and norms committees	<u>1</u>

N=44

Table 9. Distribution of Information Services in the Value Added Chain

	Support activities
Infrastructure	16%
Human resource management	0%
Technological infrastructure	9%
Procurement	5%

Input logistics	Operations	Output logistics	Marketing and sales	Service
16%	14%	2%	23%	16%

Primary activities

Note. The sample of fifty-two cases of CIS have been decomposed into forty-four examples of information services that have been related to the activity matrix one by one.

Table 10. CIS Grouped According to IS Strategy Taxonomy

	Number of reported CIS	Percentage of all
Administrative support	6	14%
Information management	19	43%
Management support	4	9%
Product and market support	<u>15</u>	<u>34%</u>
Total	N=44	100%

Table 11. Strategic Business Units with Realized SIS

IS Strategy	Business Strategy			Pct. of cum. IT strategy	SBUs with SIS
	Cost leader-ship	Differen-tiation	Focus		
Administrative support	2	3	4	33%	1
Information management	2	5	4	41%	2
Management support	3	0	2	19%	1
Product and market supp.	0	1	1	7%	2
Number of observations	7	9	11	27%	6

Table 11 is generated by adopting a cumulative view of the IS strategies reported in Table 3. In fourteen answers, two or more highest priorities were allocated and in these cases the highest level of IS strategy has been used for the classification. The distribution of IS strategies differs from Table 3 due to the criterion of cumulateness, the rationale of which is You can't reduce the attention paid to the cost-effectiveness of IT, although you must keep your eyes open for new targets, too. The respondents emphasized that you move up on the scale of IS strategies cumulatively.

The definition of SIS presupposes a strategy conformance, found in eight cases in this study, and a fit between the IS strategy implied in the reported CIS conforming to the pursued IS strategy of the company. Table 11 shows the correspondence between IS strategies and reported CIS at the aggregate level except for the product and market support strategy, which apparently is a strategy "non grata" in the IS management of the SBUs. Nonetheless, 34 percent of the CIS reported are located in this category.

To find instances of SIS one must use disaggregated data. Eight SBUs are candidates for the SIS characteristic. Six SBUs each reported two to four instances of CIS fitting the IS strategy they pursue. Out of the forty-four cases of CIS observed, eighteen cases were found in these six SBUs and, among those, three cases of CIS were not classified in conformance to the IS strategy of the SBU. The fifteen cases of CIS were examples of *realized SIS* according to the definition adopted in this study; i.e., 34 percent of all reported cases of CIS in this study were realized SIS. In the twenty-six cases of CIS not found in SBUs with strategy conformance, future changes in business strategy or IS strategy may create *emergent SIS*. Of the six SBUs with cases of SIS, three are found in food and beverages, two in building supplies and one in the machinery and electronics industry, which are the three industry groups reporting 96 percent of the cases of CIS.

Returning to the discussion of strategy, the emergent strategy was described as one which was not intended or planned. Nonetheless, if the exploited opportunities reflect the kinds of CIS asked for by the companies today, this is partly at odds with the declared business objectives of IS strategies for the future by the same companies. The management support strategy is strongly favored by sixteen out of twenty-seven companies as the *future* IS strategy, while product and market strategies come second in a list of options. The management support strategy has proven the dark horse in this study since there is a lot of interest but little action.

Why does IS management refrain from pushing their IS strategy towards those areas in which they have found CIS? The contradiction between the explicit IS strategies of the companies and the imputed strategies of the reported CIS

was presented to the persons interviewed. Some IS managers explained this incongruity as a bias towards fulfilling the irrefutable demands of the business departments for new IS rather than to improve the strategy formulation of the IS department vis-a-vis corporate management (Earl 1987). Another reason might have been that the scale of the impact of CIS is perceived as too low to create substantial business advantages, while the large transaction processing systems must be kept operative non-stop to ensure operations. With few arguments for a major business value from new areas of CIS, an IS strategy formulation process may be a waste of time. On the other hand means not being really scarce in the IS departments the push towards strategy formulation to get shares in the allocation of capital has been weak. And the pull has not materialized at the level of strategy yet, which reflects a general attitude in manufacturing The product comes first, the support activities second. Opportunities for embodied IT are disregarded.

IS managers generally argued the competitive effects of IS by referring to feedback from technical, production or sales departments, admitting that they could not supply any independent estimates of these impacts themselves. As mentioned by Tricker (1982), the strategic impact of IS often seems to develop although not planned for or intended by the IS managers. This dilemma has been more acute with the spread of personal computers to more and more departments, where enthusiastic end users develop applications at the peril of a disintegration of the company information systems and resources. Eventually, these high performance people may introduce new CIS as they bridge the gap between the IS function and the business functions (Strassmann 1985). IS departments exploring ways of cooperation with the high performers may gain valuable insight into the business of their company useful for the development of new CIS.

6.5 Evaluation and developments

The major drawback of the applied method can be identified in the very conceptualization of CIS. In order to strengthen the methodology, one would be well advised to complement the Porter value added chain in order to mediate the relations between the IS expressed in technical terms and the business strategies, adopting the concept of information services. Business strategies are no panacea for the development of CIS. Strategies in Porter's design framework invoke criticism for being too rationalistic and formal to be even close to the reality of business practice in small and medium-sized companies. Transferring this rationalistic framework into IS formulation is easy but may not produce the desired results Business strategy formulation may be counterproductive to the development of CIS by being too abstract to convey the user value of specific information services. While strategies may refer to abstract customers and users, information services have to be as close to the customer or user as any service concept.

To expand the research into CIS, one must find ways of relating IS to what business seeks Information services associated with specific business advantages. The research must focus on the very conception of SIS, since the concept of "a sufficient significance to business strategy" is quite insufficient for a research design.

A suggestion towards this end must start with the acknowledgement of the inadequately specified relationship between information systems and the alleged business impact. Instead of a general suggestion of competitive advantage it might be relevant to identify the impacts of an information system in terms of information services.

Specific analyses of information services with competitive advantages may provide opportunities for comparative studies of the companies within an industry thus contributing to a theory of the contingencies of strategic information systems.

7. CONCLUSIONS

Moving from the technical information systems to the business activity level requires further research into the "missing link" between Porter's value added chain and the nature of information services which support and structure the linkages between the horizontal and vertical activities of the company.

The companies showed a strong variation in the use of CIS between industries and less so within each industry. These variations could not be explained with a reference to the level of IS expenditures or to the IT intensity of the companies. Circumstances to corroborate an ex-ante business strategy realized ex-post in a CIS were found in six companies.

One way of interpreting the results of this study would be that an industry threshold determines the opportunities to exploit IT for competitive advantages. Another may be that high IT investments are insufficient to ensure opportunities to attain CIS, since type of industry matters as shown in the case of the chemicals and pharmaceuticals industry. Both interpretations may be right, but the empirical basis of this study is insufficient to settle this and to determine an industry specific threshold level.

Finally, strategic information systems originating as realized CIS were identified in one third of the cases of the reported CIS, which indicates a strong empirical reason for the distinction between SIS and CIS. This result implies that SIS has been taken into consideration in the strategy process of the IS department as well as in the corporate headquarters in a fifth of the manufacturing companies. Whatever the threshold of an industry, IT has gained a position in the strategies of modern manufacturing business.

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9. ENDNOTES

1. The unit of analysis is here defined by the information systems of the IS department to ensure consistency between cases of CIS and business measurements. This business unit is consequently broader than a business defined by products that are close substitutes for each other. A test was included to measure the diversity which showed for the three major products that in nineteen SBUs they belong to the same business, while in four companies they belong to two different areas of business, and in three companies they belong to three different areas of business.
2. Administrative support: Information service 1; Information management: Information services 2-6; Management support: Information service examples from categories 1, 2, 5, 6; Product and market support: Information services 7-10.