UNDERSTANDING CORPORATE IS SOPHISTICATION: AN EXPLORATORY INVESTIGATION

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ABSTRACT

This paper describes the results of an exploratory study that culminated in the development of a set of theoretical dimensions for "Corporate IS Sophistication". These indicators were developed utilizing grounded theory to analyze archival corporate data and data from in-depth interviews with functional IT executives in two Norwegian and one North American firm.

Keywords: Corporate IS sophistication, grounded theory, empirical study

INTRODUCTION

Until recently, corporations rarely considered information as a critical strategic resource. But, with the advent of the personal computer, office information systems, and networking ("e-everything"), managers and end-users alike have realized the enormous potential of such technologies. The effective use and management of information systems (IS) has allowed companies of all sizes and sectors to gain a competitive edge in their marketplace. In order to remain competitive and defend current market share, many firms have had little choice but to incorporate technology as a key component of their business processes.

Practitioners and researchers alike have argued that effective integration of IS within organizations can improve productivity, customer service quality, and eventually enhance enterprise-level effectiveness and performance. However, there are many issues about the use and management of IS that are still not very well understood. For example: How technologically sophisticated should an organization need to be? (Or, Is there a way to classify or profile a business' standing in terms of their technological sophistication?) How much "sophistication" is necessary to effectively compete in a given sector (or across industrial sectors)? What should be the rate of technological growth in an organization?

MOTIVATION

As the ubiquitous Internet, the WWW, and other advanced communications and information technologies such as office information systems, CAD/CAM, electronic data interchange, electronic commerce applications, expert systems, neural nets, etc. are taking hold in organizations of all sizes, researchers in academe and practice have expressed a need to understand the potential effects of information technology (IT) on organizational variables. In fact, some researchers have lamented "… there exists no recognized characterization of IT in terms of its level of sophistication in organizations, and thus no instrument for use in empirical research and practice. Such an instrument should identify IT's fundamental dimensions and position the organization on each of these dimensions, thus establishing an IT sophistication profile and allowing for comparison between organizations" (22, p. 4).

An informal poll of information systems faculty and some practitioners registered with the ISWORLD-NET (an international, non-profit, academic and research network for IS professionals) taken in early 1998 by the author provided some insight into the paucity of research on organizational IT sophistication. Suggestions of literature in this area elicited from ISWORLD-NET respondents confirmed that only a few authors have tackled this issue and that too only with mixed success. Similarly, Raymond and Paré (22, p. 13) argue that "[g]iven the ultimate aim of IT to improve enterprise-level performance, fruitful insights may be obtained" by using the notion of IS sophistication to "determine the relative impact" and "fit" between the various potential dimensions of sophistication.

The failure of some companies to exploit the full potential of IT may relate to the fact that they do not develop the sophistication needed to purchase, deploy, use and manage IT for achieving enterprise objectives that can be used to provide valuable insight for practitioners into the variables that should be exploited and/or monitored to improve corporation-wide IS sophistication. Many firms use technology because it is an operational or defensive necessity. Consider the example of traditional Electronic Data Interchange (EDI) technology. A firm that has used EDI for order processing only is more technologically sophisticated than those that do manual order processing. Whereas, organizations that seamlessly integrate EDI technology into other business functions such as accounting (Electronic Funds Transfer or EFT) and shipping, are even more sophisticated than those using EDI for only order processing.

RESEARCH OBJECTIVES

Even though, there have been many studies on end-user sophistication and an extensively validated instrument has been developed to measure this construct, only a handful of researchers have attempted to define and measure organizational IS sophistication. This has also been only achieved in a very limited way in very specific contexts. One of the major stumbling blocks for developing an instrument to measure a firm's IS sophistication is the absence of a sound theoretical foundation. Adding to this is the inherent difficulty of identifying common characteristics that are generic across organizations in all industrial sectors and also independent of firm-specific attributes. Thus, the purpose of this research paper is to describe the development of a detailed understanding of the notion of *organizational IS sophistication*.

RESEARCH DESIGN

Research Methodology
The standard grounded theory research protocol with minor modifications was used for this study (7, 13, 19, 25).

Case Selection and Data Sources
In accordance with the theoretical sampling technique used in grounded theory research (7), the organizations chosen for this study are both similar and different. A total of three large firms headquartered in Norway and USA were studied via an analysis of archival documents, web sites, and face-to-face interviews with senior IS executives. The two Norwegian businesses (Firm 2 and Firm 1) are essentially in the manufacturing sector and the American firm (Firm 3) is a major grocery retailer. Table 1 briefly summarizes the key characteristics of the three study firms. The IS executives interviewed for the study were at the CIO/VP and IS Manager/Director

ranks and were also the key source for organizational documents. Their perspective of the IT function within the organization was driven by their closeness to the highest levels (CEO/VP) of each organization.

Table 1: General Characteristics of Study Firms [All financial numbers are based on 1998 information.]

	Firm 1	Firm 2	Firm 3
Key products/services	A leading supplier of metals and materials for the steel, foundry, chemical, and aluminum industries.	A leading manufacturer of drilling equipment for the offshore industry.	A leading north American retailer that is involved in the distribution, merchandising, and retails sales of food, pharmacy, health, and personal care items, household supplies, seasonal merchandise, and related consumable products and services.
Organization	Organized along product lines and geographical regions	Organized along six functional areas: QA, Finance, Personnel, Global, and Business Development	Organized traditional along functional lines; operates nearly 2,000 stores and runs a fully decentralized operation
Total Sales Revenue	NOK 929 million	NOK 1 billion (worldwide)	$ 43.1 billion
IT Budget (estimated)	NOK 14 million	NOK 10 million	$ 200 million (estimated)

Data Analysis

The interview data along with documents obtained from the case study firms were analyzed within each company's context and as well as across the three businesses to detect similarities and compare differences. C*omparative analysis* is an important tool in grounded theory research.

The characteristics of corporate IS sophistication identified in the first firm, guided the interviews in subsequent firms. Data from the first two firms (Firm 1, Firm 2) was sorted into conceptual units and then further extended and validated in the subsequent interview with the third firm. Data from Firm 1 was first sorted into a set of initial concepts and themes. This is done using the techniques of axial coding and open coding. To paraphrase Orlikowski (19), open coding relies on an analytic technique of identifying possible categories and their properties and dimensions. Once all the data are examined, the concepts are organized by recurring theme (16). In axial coding, these themes become the prime candidates for a set of stable and common categories, which link a number of associated concepts (16). Thus the data and associated initial conceptual dimensions from the first two cases (Firm 1, Firm 2) are summarized in Table 2. These initial concepts/categories were used to guide the process of data collection, coding, and analysis and to make it more targeted in subsequent interviews. The analytical conclusions from the data obtained from the first firm was reexamined and refined with the data from each subsequent case. After incorporating data from the first two study firms into the mix and further delineating common and different conceptual areas, a stable version of the analytical dimensions and related indicants was derived and is shown in Table 3. This table shows more detailed conceptual categories and related indicants for each conceptual category. It should be noted that the labels for each category are, of course, an individual choice and will be given closer attention as this analysis is further formalized into an instrument.

Table 2: Describing Corporate IS sophistication--Concepts and Findings

Concepts	Data (from Firm 1)	Data (from Firm 2)
Strategic Sophistication	✓ IT is reorganized and plays a strategic role in planning and budgeting processes ✓ CIO reports to the President/CEO ✓ IT investments are managed by assessing business impact and value ✓ Project-based decisions (cost-benefit analysis; using payoff thresholds)	✓ IT manager reports to the Director of finance ✓ IT has a "support" role in strategic planning and in general to support business processes ✓ IT is not considered a strategic resource at the present time ✓ IT investments are made by assessing business value

	✓ Management handling of follow-up has been important ✓ Focus is on mission critical applications ✓ Senior executives have been responsive to IT investment needs and have been supportive of IT initiatives	✓ Emphasis is on critical systems (such as e-mail, AutoCAD)
Managerial Sophistication	✓ IT planning is given considerable importance within the organization and senior executives clearly perceive IT as a critical strategic resource ✓ Emphasis on integration of organizational and technical systems. ✓ Keep in touch with the marketplace ✓ Planning for "learning" => human resource management is important ✓ Hiring the right people with diverse expertise ✓ Key influences on IS function are: business needs, nature of technology available, and project investigation (cost - benefits, business value)	✓ Business impact of IT (awareness is important) ✓ MH's IT use is "suboptimized" ✓ MH's goal is to be in line with industry. Business need and cost are not the only critical factors ✓ Communication within the organization is important ✓ "We shall not chose 'best in class' systems only the 'best for our needs'. ✓ Awareness of value of IT needs to be increased ✓ How do I forge a closer relationship with our vendors (in choosing new technologies)? ✓ IT is not a business within MH
Operational Sophistication	✓ There is some understanding of the importance keeping up to date with new technologies to improve operational applications. ✓ Linking systems together is very important ✓ Effective Implementation of new applications is crucial ✓ User's efficiency on tools is very important ✓ Expertise of individual end users is very important ✓ Education of users ✓ Emphasis on competence and functionality	✓ Variety of IS applications in use ✓ Gluing applications together is an important goal (not there as yet). ✓ Communication between client and vendors ✓ Develop reliable relationships with Trading Partners ✓ Mutual trust with partners (Implement extranet) ✓ Architectural integration (linking systems and data is a goal at the present time) ✓ Keep end users informed via Intranet ✓ User needs to know the impact of their tasks on other systems (e.g., Salesperson needs to know how does the sales order impact other systems?)

Table 3: Describing Corporate IS sophistication--Concepts and Findings (Next level of analysis)
(Due to space limitation, additional details are not included here.)

Concepts	Indicants		
Strategic Sophistication	Role of IS/T in the organization Position of CIO within Organization Growth in IT investment as percentage of total revenue	Assessing the Business Impact of IT investment Senior Management support of IT Types of projects emphasized or Relationship of projects chosen with strategic decisions	IS function considered as a business (profit center vs. cost center) Level of IS/T Planning Number of business processes enabled by IT innovativeness
Managerial Sophistication	Managers' perception of the role of IS/T Degree of Internal Communication (about IT services) Nature of systems chosen	Human resource strategy Nature of Business needs Nature of relationship with vendors	Management commitment to IT Management attention and championship of IT initiatives
Operational Sophistication	Importance of keeping up with new IT Variety of IS applications (Diversity of tasks being handled) Level of integration of internal systems Effectiveness of implementation	User Efficiency on tools End user expertise User education/ Communication about IT	User education about business impact Level of Communication with Trading partners Trust between trading partners

Table 4 shows the final conceptual dimensions of "corporate IS sophistication." To create this table, data from the third firm (Firm 3) was incorporated and each conceptual category/subcategory was either validated or extended as needed.

Table 4: Describing Corporate IS sophistication--Concepts and Findings (Final level of analysis)
(Due to space limitation, additional details are not included here.)

Concepts	Indicants

| Strategic Sophistication	Role of IS/T in the organization (strategic vs. operational; follower vs. leader)	Senior Management support of IT	Number and diversity of (core) business processes enabled by IT innovativeness
	Position of CIO within Organization	Types of projects emphasized or Relationship of projects chosen with strategic decisions	*Extent of alignment of IT with business*
	Growth in IT investment as percentage of total revenue	IS function considered as a business (profit center vs. cost center)	*Governance process for evaluation, review and maintenance of IT projects*
	Assessing the Business Impact of IT investment (Is IT driving benefits?)	Level of IS/T Planning	*Early/Late adopter of new IT*
Managerial Sophistication	Managers' perception of the role of IS/T	Human resource strategy	Management attention and championship of IT initiatives
	Degree of Internal Communication (about IT services)	Nature of Business needs	*Managerial oversight of IT projects including financial review*
	Nature of systems chosen	Nature of relationship with vendors	*Percentage of projects started as opposed to requested*
		Management commitment to IT	
Operational Sophistication	Importance of keeping up with new IT	Effectiveness of implementation	User education about business impact
	Variety of IS applications (Diversity of tasks being handled)	User Efficiency on tools	Level of Communication with Trading partners
	Level of integration of internal systems	End user expertise	Trust between trading partners
		User education/ Communication about IT	*Simplicity of IT solutions/interface (for novice users)*

CONCLUDING REMARKS AND FUTURE IMPLICATIONS

Study Results

In contrast to the past characterizations of IS Sophistication, the analysis of data collected in this study demonstrates that organizational IS maturity seems to mirror the natural structure of organizations rather than merely emphasizing IT usage support and effective IT management support. Thus in essence, Corporate IS Sophistication can be defined as the extent to which an organization is able to exploit the potential of relevant information and communication technologies by purchasing, developing, deploying, using and managing IT for achieving enterprise objectives while ensuring effective IT integration for all levels and business processes within the organization. *Greater the IS sophistication of a company, more likely that it will have strategic, managerial and operational sophistication*. In fact, interview data indicates that a company's IS sophistication develops in an *evolutionary fashion* to the extent that the firm's operations are the first to become more mature in their deployment of IT for reducing cycle time, improved inventory management, or other improvements in transaction processing activities. Next, the firm's manager's become more capable in acquiring and deploying the IT resources. Finally, a highly mature organization has achieved the first two and is focused on strategic IT applications, effectively managing the portfolio of IT investments and innovating through the use IT.

Based on the dimensions and indicants of corporate IS Sophistication developed in the previous section, the data from the three subject firms in this study are graphically represented in Figure 1 using a radar chart. The radar chart is an excellent visualization technique for mapping multiple

variable data longitudinally or across subject firms. This particular chart shows a comparison of

Figure 1: Corporate IS Sophisitication (Strategic) Radar Chart
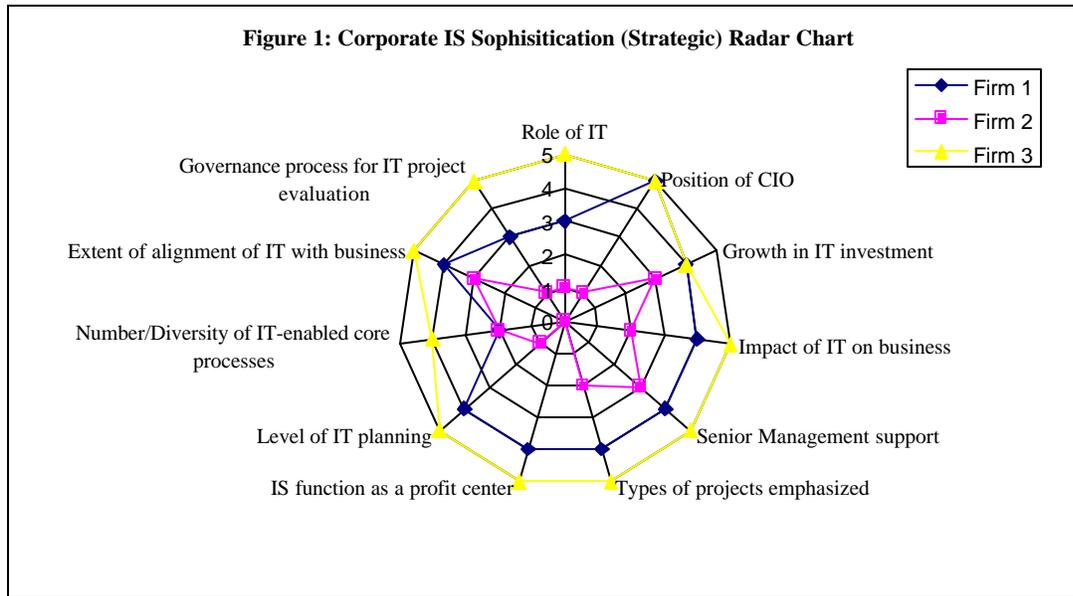
the strategic dimension of corporate IS sophistication of the sample firms along its eleven identified indicants (refer Table 4). The radar chart compares aggregate values of the indicants rated on a scale from 0 to 5 with "0" meaning an indicant is "nonexistent", "1" meaning it is present with low maturity, "3" meaning it is "somewhat mature" or "average", and "5" meaning it is "mature" or "high". The author based these assessments on the information displayed in Tables 1-4 and other interview data not included in this paper. In the chart displayed in Figure 1, the data series that covers the most area, Firm 3, represents the organization with the highest corporate IS sophistication on the strategic dimension. It is important to note the particular corporate IS sophistication radar chart displayed in Figure 1 does not reflect the assessment of one individual, but the assessment (even though subjective) of the indicants of IS sophistication for the whole organization or unit. Thus, this chart could also be drawn for the aggregate values of all the indicants of corporate IS sophistication at the firm level or at a particular unit-level within an organization. This could then be used as a diagnostic tool and/or benchmarking mechanism for a target firm within an industrial sector.

Comparison of Research Results with Extant Literature
In brief, *a priori* research relating to the notion of corporate IS sophistication has followed three different approaches. The first is based on describing this construct in terms of evolutionary stages of IS maturity based on Nolan's work (see e.g. (12), (17)). In Nolan's model, the notion of IS maturity is related to the evolution of the IS function within an organization, and is ultimately realized in the final stage of the computing growth in organizations. Therefore, IS sophistication clearly refers to an organization's state that is characterized by IS resources that are fully developed and effectively utilized. Since the inception of Nolan's model, several researchers (1, 3, 4, 5, 6, 10, 15, 18, 21, 23) have utilized the staged model to characterize an organization's IS sophistication or maturity of a company. Most of these authors have used Nolan's model as a theoretical foundation, and included criteria or "benchmark" variables form the two distinct perspectives of IS usage and management (22). While the empirical validity of this model has been called into question by many authors over the past decade (2, 4, 9, 12, 14), and while it only focuses on the evolution of organizational IS, it is indeed one of the first conceptualizations of an

organization's "IS maturity." Clearly the maturity model is similar to the model developed in the present research to the extent that levels of an organization's maturity are described. However, the notion of corporate IS sophistication obtained by the present study goes much beyond describing this concept as being driven by investment in IT infrastructure alone. The second approach attempts to describe various aspects of an organization's IT maturity such as hardware sophistication, software development process maturity (3, 11, 24, 23), depth and breadth of integration (20), and end user sophistication (16). In fact, the present study demonstrates that all these aspects of IS sophistication are valid and relevant subsets or indicants of a greater conceptualization of this construct. Finally, a third approach taken by Raymond and Paré (22) attempts to describe and profile Corporate IS sophistication as a high-level multidimensional construct that includes various IS usage and IS management support aspects at least in the context of small- to medium-sized manufacturing enterprises. They characterized IT sophistication as "a construct which refers to the nature, complexity and interedepence of IT usage and management in the organization (ibid, p. 7)." Based on their analysis of past research as described in the first two research streams described above, they argued that IS sophistication is a multidimensional construct and includes aspects related to technological support, information content, functional support, and management practices. They developed a list of criteria that could measure these dimensions and incorporated them in a survey instrument. They tested this conceptualization by surveying CEOs of Canadian small- to medium-sized manufacturing firms. Based on 101 responses, they found qualified evidence to support the multidimensional nature of IS sophistication in manufacturing firms. This limited and somewhat simplistic view of Corporate IS sophistication described in terms of *IS Use and IS management of IT* though useful in the context of the Raymond and Paré study, ignores the complexity and depth of the IS sophistication construct. Clearly, as detailed in Table 4, there are many more unique dimensions to the notion of corporate IS sophistication that add granularity to the conceptualization of this construct.

Contributions of the Study
The absence of a validated instrument and a clear understanding of the theoretical underpinnings for organizational IS sophistication has been often touted by researchers as a reason for the absence of critical analysis and profiling of corporate technological maturity and the lack of in-depth study of the relationship of sophistication with organizational structures, strategic choices, corporate culture, and even performance. This study has identified preliminary conceptual dimensions and indicants of "corporate IS sophistication."

As advanced communications and information technologies take hold in the business world, the concept of "corporate IS sophistication" will become more critical. The results of this research study provide the theoretical underpinnings necessary to potentially measure this construct and study its relationship with various organizational variables. The indicants of IS sophistication developed in this paper provide valuable insight for practitioners into the variables that should be exploited and/or monitored to improve corporation-wide IS sophistication. In this regard, the research contributes to practice by providing managers a means of visually representing corporate IS sophistication for potential use as a diagnostic tool, for benchmarking, and/or comparing sophistication levels across firms.

REFERENCES: Due to space limitations, references can be requested from the author.