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Information Integration And Performance: A Field Study And Structural Equations Analysis

James E. Wyse

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ABSTRACT

The deployment of information systems technology (IST) is often justified on the presumption that improved information delivery and content will positively impact individual performance and, consequently, organizational performance. The integration of information systems undertaken by many organizations as an IST deployment tactic is based on such a presumption. This presumed relationship has not been empirically established nor has it been the subject of significant theoretical development. This investigation sought to address these deficiencies.

To provide a theoretical basis for the research, a model of information integration was constructed. This model is conceptually grounded in the work on critical success factors (CSFs). For each CSF, an information integration component is posited to exist. User information satisfaction (UIS) measures were used to operationalize constructs for information integration. Positive relationships between these constructs and performance constructs were hypothesized. Hypothesis testing and validity assessment were done by treating the model as a latent variable path model and employing Wold's method of Partial Least Squares for analysis.

The study examined information use by individuals whose performance was closely tied to organizational performance. The organization was a major Canadian insurance company and the individuals were the firm's sales representatives. Following identification of CSFs by an executive panel, interviews were held with 102 sales representatives. These interviews involved scale completion to capture manifestations of information integration and to validate CSFs. Measures of individual performance were obtained from archival data.

Research findings include:

1. The UIS measures used as information integration manifests exhibited high levels of validity as did the CSFs used as the basis for information integration constructs.

2. Statistically and managerially significant relationships between information integration and performance were observed, although not all relationships were significant and some of the significant relationships were not positive.

The study makes three contributions:

1. It extends the work on CSFs through its utilization of CSFs as a theoretical basis for information integration.

2. It links the developments in UIS with the work on CSFs by empirically demonstrating a way in which both UIS and CSFs are associated with performance.

3. It provides instrumentation and methodology for observing information integration.

DEDICATION

This is dedicated to my wife, Patricia ("Pats"), to whom I credit all my successes and without whose support this undertaking would not have been possible and to my daughters, Amy and Anna, who tolerated my parental inattention as I pursued it.

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I think of my pursuit of doctoral study as a privileged adventure. Few of us on this planet are given the opportunity to pursue it, fewer still choose to accept its challenges, and no one completes it without the support of many individuals and organizations. Like any real adventure, doctoral study and dissertation research carry considerable risks. While the responsibility for any failing or omission rests entirely with me, those who supported my activities must be acknowledged for their role in helping me cope with these risks and making my years at The University of Western Ontario an adventure that, for me, was an incredible personal success.

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Jim Wyse
February 9, 1992

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CHAPTER 1

INFORMATION SYSTEMS INTEGRATION: EMERGING PERSPECTIVES

Rationalizations for distributing information and deploying information technology throughout an organization are frequently based upon the presumption that information positively impacts individual performance which, in turn, enhances organizational performance. For many information systems practitioners and academicians, this presumption is conventional wisdom. Increasingly, this wisdom is applied with the strategic concerns of the organization in mind. Huge investments, both financial and human, are being made in information resources to attain strategic positions that enhance performance both individually and collectively. Considerable reliance is being placed on the validity of conventional wisdom. For many organizations, industries, and even national economies, much is at stake.

This research investigated the validity of the conventional wisdom underlying the strategic view of information resource management. Fundamentally, the research sought to contribute to our understanding of the impact of information and its means of delivery, information systems, upon organizational performance. Specifically, this study investigated the relationship between information integration and the performance of individuals occupied in organizational work. A research setting was chosen in which the work of individuals is highly information-intensive and in which objective performance measures are available for these individuals. These research conditions allowed conventional wisdom to be tested at an individual level with implications for the organization, particularly with respect to strategic concerns about the deployment of information resources for enhancing organizational performance.

Throughout the past decade much has been said about the use of information systems technology to enhance performance by facilitating higher levels of integration. One recent report in this respect is the *The Arthur D. Little Forecast on Information Technology and Productivity: Making the Integrated Enterprise Work* (Weizer et al. 1991). This book begins with a vignette about the not-so-distant future in which information provision, individual performance, organizational performance, and responsiveness to extra-organizational entities are all supported by an "Integrated Information System (IIS):"

> The time is the mid-1990s. You are crawling down the interstate (traffic hasn't improved over the past five years) after a long business dinner with your field service managers. Your car phone rings and its display shows that one of your company's most important customers in Japan is on the line. Your office communications system has prescreened the call, found it to be one you are willing to accept at any time, and automatically forwarded it to your car phone.
>
> You answer the call--it is the president himself, whom you met on your visit to Tokyo last year when you signed the deal to be their primary supplier. He tells you that a fire has struck his largest plant, knocking it out of commission. He needs all of the parts that were scheduled to be shipped to that facility diverted to another. He also needs an additional emergency shipment sent to the working plant to make up for the parts destroyed in the fire.
>
> Pulling over to the side of the road, you open your brief case and use the computer inside to access your corporate database through a cellular radio link. You identify yourself to the system with your key-card and PIN number. The system then knows exactly what information you may access and what changes you are permitted to make.
>
> You order the system to redirect the scheduled shipments (even the ones already en route) and to send out the needed emergency parts to the customer's plant by the fastest means possible. Within seconds the system replies with the expected shipment and delivery times. It informs you that some of the needed parts are stocked in Europe and asks if you want them shipped by international courier. It quotes the extra cost for this service.
>
> You pass the information on to your customer and ask if he wants to pay the costs for next day delivery. He agrees, and at the same time expresses a great deal of appreciation and admiration for the speed with which you are able to help him. He asks for a fax confirmation of the new delivery quantities, destinations and time, which you immediately transmit from your briefcase-computer.
>
> On the the road again home again, you feel good about the help that you have been able to give a good customer. You feel even better a few weeks later when this customer increases the percentage of parts that he buys from your company by 10 percent because of the excellent service that you are able to provide [pp. xv-xvi].

This is an optimistic scenario indeed, one heavily reliant upon conventional wisdom about the relationship of information use and performance. Yet, it is a scenario likely to be accepted as an example of the vision that many information systems executives might have for the development of Integrated Information Systems (IIS) in their own organizations. An undertaking which is likely to consume significant resources and represent a considerable risk for the organization. This research addresses issues at the heart of the IIS scenario. It examines the interaction of information and the exigencies of the organization's competitive circumstances and strategic concerns in the use of integrated facilities for performance enhancement.

1.1 MANAGEMENT ISSUES

From a less futuristic perspective, investigating the relationship that information systems (IS) integration leads to enhanced performance is motivated by two developments:

(1) the recurrent finding throughout the past decade that the integration of information systems is one of the major issues in IS management (Ball and Harris 1982, Dickson et al. 1984, Hartog and Herbert 1986, Brancheau and Wetherbe 1987, Dixon and John 1989), and

(2) the emergence of systems integration as a high-growth multi-billion dollar niche in markets pursued by the information industry (Radding 1989, Hubbard 1989).

In both developments, the managerial concerns that are raised can be resolved into two distinct, but not unrelated, areas: (1) the interconnection of information systems technologies in the pursuit of efficiencies in transaction handling and data distribution and (2) the alignment of information resource utilization with the strategic interests of the firm. This dichotomous, yet related, set of concerns with IS integration is epitomized in the

EXHIBIT 1.1

Selected Strategic Views on the Integration of Information Systems

Source	Industrial Setting	Strategic View
Stevens, 1989	Banking	Integrated systems are expected to streamline operations and provide the flexibility to quickly produce products that have yet to be conceived, something which is felt to be an important consideration as the financial services industry moves into a deregulated environment.
Pike, 1989	Retail Building Supplies	Systems integration is seen as the means of dealing with a serious competitive threat by getting closer to a newly identified market through a networking scheme between headquarters and the retail stores that would more effectively manage inventories.
Moad, 1989a	Consumer Electronics	Integrating information systems across functional lines is being done in support of getting products out the door quickly and enhancing customer relationships and loyalty.
Rockart and Short, 1989	Petroleum	The integration of on-line crude oil trading with market information from Reuters and other trade data sources is critical to managing risk exposure and developing effective pricing strategies for the volatile crude oil market.
Sivula, 1990	Automotive	Integration of systems across dealers, maintenance services, financial services, and manufacturers is a strategic move to (1) warn of widespread mechanical problems, (2) protect dealer profits by managing sales prospects and interconnecting inventories and (3) provide a "total ownership experience" for customers.

studies on IS management issues by the Hartog and Herbert finding that "the integration of technologies . . . is closely related to the planning/aligning issues" [1986, p. 357]. Reports in the trade literature reflect a similar dichotomy of preoccupation with integration. "Networking" and "connectivity" have received, and continue to receive, extensive coverage. (See, for example, Hodges (1988).) Concurrently, reports on the activities of systems integrators and their clients (see Exhibit 1.1) suggest that these and other forms of interconnectivity are more frequently being viewed from a strategic perspective.

The forecasted high growth and size of the systems integration market is a phenomenon that will probably attract the attention of IS researchers throughout the coming decade. One interesting aspect that appears to emerge from the trade literature thus far is the divergence of views on IS integration between systems integrators and their user organizations. Systems integrators tend to think of themselves as value-added resellers, facilities managers, and alternative developers vis-a-vis in-house IS developers. The user organizations appear to take a more strategic perspective on what they hope to gain from major integration projects. Exhibit 1.1 provides a selection of these perspectives from several user organizations. The divergence between systems integrators and user organizations on how each group views systems integration may not be entirely inappropriate and should be of interest to IS researchers; however, this divergence of view is not the subject matter of this study. Instead it is the strategic perspective on the integration of information systems in user organizations that is the general concern of this research.

Within this general context there are many issues that are worthy of research. Exhibit 1.2 presents a selection of issues that have received varying amounts of attention in the trade literature on systems integration. Some of these may be unique to information systems integration but many seem similar to those that have been raised and researched in the context of information systems development. This may well result from the apparent confusion that exists between information systems integration and information systems development. For purposes of this study, a conceptual distinction is made between these two on the basis that *information systems integration refers to the state of information utilization that exists in an organization* while *information systems development refers to a process by which this state is changed.* An example which readily accords with our intuitive notions of integration is seen in the implementation of a database management system (DBMS) to provide to many organizational members, for the first time (say), cross-

EXHIBIT 1.2

Selected Systems Integration (SI) Issues

Source	Issues Raised
Pike, 1989	Establishing an organizational-specific concept of integration. Using standards as an integrating mechanism.
Gaskill, 1989	Formulating a project charter or mission statement. SI Project originator-implementer communications. Assessing SI capabilities re: architecture development and design. De-politicizing cross-functional disputes. Sharing the risk of SI projects with systems integrators.
Keene, Jessel, and Hagel, 1988	Exposing competitive-sensitive information to external integrators. Deciding when to use outside systems integrators. Relationship between outside integrators and in-house IS personnel. Strategic alliances with systems integrators.
Stevens, 1989	Underestimating the scope of SI projects. Enormity of changes to business functions. SI project task force composition. Skills and orientation of SI project leadership. Rigidity: integrating = freezing.
Radding, 1989	Identifying a capable systems integrator. Selecting and controlling systems integrators. Measuring the pay-off from the integration of information systems. Large expenditures and long term commitments. Dealing with cross-functional systems incursions. Sharing the risk of SI projects with systems integrators.
Moad, 1989b	SI contract provisions. Specifying measures of integrated systems performance. Liability for non-performance of SI contracts. Sharing the risk of SI projects with systems integrators.

functional access to needed data. The change in the state of information utilization in an organization as a result of the developments surrounding the DBMS implementation would correspond to a change in the level of information systems integration.

1.2 THE NEED FOR RESEARCH

The presumption discussed at the beginning of the chapter can be reformulated in terms of the changes in the state of information utilization in an organization, in other words, the organization's level of IS integration. Thus, it is presumed that by increasing the level of IS integration we can positively influence the performance of individuals and, consequently, the overall performance of the organization. Establishing the validity of this presumption is critical for any organization in which information utilization is an antecedent to gaining and sustaining strategic advantage. As we move toward an information economy (Naisbitt 1982, Marchand and Horton 1986, Drucker 1988), it becomes more and more difficult to imagine organizations in which information utilization will not be a significant antecedent to strategic advantage. Consequently, the validity of the presumption is critical to not just a few firms that have explicitly chosen an information-intensive competitive strategy but also to the vast majority of organizations who must compete in some way for the resources needed for their continued existence.

Testing the validity of this presumption is where research is needed. Two critical research tasks are suggested:

(1) developing measures of IS integration that are valid, reliable, and managerially meaningful, and

(2) establishing the existence of a relationship between IS integration and the performance of individuals with respect to organizational work.

While there have been studies (to be reviewed in the following chapters) that can be considered contributions to the above, there has been no research which has directly addressed them. This study seeks to address this lack of research and holds these two tasks central to its purpose.

1.3 THE RESEARCH QUESTION

Some kinds of organizational work are more information-intensive than others. This variation in information-intensity occurs across different occupations within the same organization as well as across different organizations and industrial settings (Keen and Bronsema 1981, Porter and Millar 1984, Weber 1988). The relationship between IS integration and performance is suspected to be stronger in occupational, organizational, and industrial situations which are more highly information-intensive. It was felt that, by focussing this research on such situations, the best prospect would be realized for observing the existence of the hypothesized relationship. Consequently, this investigation focussed on information-intensive occupations in industrial settings in which the performance of individuals in these occupations is closely tied to organizational performance. This focus lets us approach an investigation of information systems integration and strategic advantage by posing the question: *Is there a relationship between the level of information integration for information workers and the performance of these workers?*

Several points should be noted. The word 'systems' is missing from the research question statement. This reflects the notion that 'information integration' corresponds to the extent of information utilization and not with how the information is delivered. The means of information delivery, the system, is undoubtedly an antecedent or moderator of information integration; however, the impact of alternative 'systems' is not the subject of this investigation. Instead, what is of primary interest is the concomitant variation between information integration and performance for a group of information workers.

The use of information-intensive organizational and industrial settings is consistent with a recommendation made by Bakos (1987) to those undertaking empirical research on the impacts of information systems utilization. He recommends that "we should study organizations in which information technology is closely related to their core technology, and thus is more likely to result in impacts [that are] easier to observe." In addition to this anticipated observational convenience, formulation of the research question in terms of information workers allows this investigation to contribute to our understanding of the antecedents of the productivity of information-intensive occupations: an area considered critical to organizations that are, or soon will be, required to compete in the information economy (Marchand and Horton 1986, Drucker 1988).

1.4 RESEARCH CONTRIBUTIONS

As will be seen in the chapters that follow, information integration is a special way of viewing information use. Consequently, this research essentially investigated the relationship between information use and performance, a relationship that stands at the very core of both information systems practice and information systems research. Yet, in spite of its centrality, this relationship has been the subject of surprising little research. Dealing with a relatively unexamined relationship at the core of the information systems discipline makes this investigation an important one; pursuing it without the benefit of extensive previous research makes it a risky one, particularly for doctoral research. Considerable effort had to be expended in several respects. Extensive conceptual development was required to develop a research model that would guide a high quality empirical investigation; major time commitments and considerable openness were required of the participating organization and the individuals who agreed to be subjects; and, significant innovation in instrumentation was required in order to feasibly capture the data needed for research model evaluation and hypothesis testing. These all represented areas of considerable risk: the research model linked two disparate areas of information systems research for the first time; the requirement to examine detailed performance data could unnerve even the most open of organizations; and, the data collection instrumentation had not been previously utilized.

The extensive effort associated with this investigation, motivated in no small way by the risks that faced it, resulted in research with considerable strength in the following respects:

- Objective Measures of Performance. These measures are maintained by the participating organization and are actively used for individual performance evaluation. They were made available to the researcher for the individuals on whom an detailed examination of information use was done. The availability of such measures avoided the problems often associated with self-reports of performance and with other subjective performance measures. The use of objective measures in an actual organizational setting provides both a rigorous test of theory as well as results with strong relevance for practitioners.

- Scope of the Research Model. In forming its concept of information integration, the research model directly linked developments from two major information systems research streams: user information satisfaction (UIS) and critical success factors (CSFs). Various findings from this investigation indicate that the linkage is a highly valid one. Consequently, this study advances both these research streams and responds strongly to the demand for a "cumulative tradition" in information systems research (Keen 1980).

- Application of Causal Modelling. Formulation of the research model as a latent variable path model allowed the model to be evaluated using a second generation multivariate analysis technique. Second generation techniques support confirmatory testing on unobservable theoretical variables in a model with multiple dependent variables. The application of these techniques in this research provided a more comprehensive evaluation of the research model than would have been the case with the application of techniques associated with the previous generation.

- Instrumentation. Capturing valid manifestations of information integration in an actual organizational setting presented one of this study's greatest challenges. From a careful analysis of activities in the study's pre-test, a 'protocol booklet' was developed for use in the final test. The booklet represented a considerable departure from 'traditional' data collection instrumentation. Its ability to capture several hundred responses from an individual during the course of a one-to-two hour interview indicated that it was highly efficient. Subsequent analysis of the validity of these responses as manifestations of information integration indicated that it was also highly effective. Construction and testing of the protocol booklet represents a significant contribution to future research in this area and there is considerable potential for its application in information systems practice.

In sum, this research delivered a tested causal model of a relationship at the centre of both information systems research and information systems practice. The model's conceptual development occurred at the confluence of two research streams of interest to both practitioners and academicians. Its use of objective performance measures considerably enhances the relevance of the model to practitioners and the rigor demanded by academicians. The development of instrumentation for use in actual organizational settings will be of considerable value to academicians conducting future research and is readily applicable by practitioners wishing to conduct evaluations of information utilization within their own organizations.

1.5 DISSERTATION ORGANIZATION

The chapters that follow are sequenced in accordance with steps required to execute an empirically-based investigation of the research question. Chapter 2 reviews the literature encountered during the search for a basis on which to construct a model in which information integration is treated as an antecedent of individual performance. All literature relevant to the investigation is not reviewed in Chapter 2; some literature awaits the context of the research model developed in Chapter 3. Based on the literature reviewed in Chapter 2, Chapter 3 develops the research model in which various components of information integration are hypothesized to be causes of individual performance. Chapter 3 goes on to formulate a structural equations representation of the research model including both measurement and latent variable components. A set of research hypotheses emerges from this process.

While the first three chapters are primarily concerned with theory development, the remaining chapters are primarily concerned with theory testing. Chapter 4 describes the field study methodology employed to obtain data for hypothesis testing. The multi-phased methodology involved discussion sessions with a group of senior executives and, subsequent to these discussions, highly structured interviews with 102 subjects and, finally, retrieval of archival performance measures for these subjects. The interviews included extensive scale completion. Chapters 5 and 6 report on the various analyses used to assess research model validity and to perform hypothesis testing. Chapter 5 reports on the measurement components of the research model while Chapter 6 reports on the structural component. Chapter 7 summarizes the study's findings, discusses the implications of these findings for both management and research, details the study's limitations, and suggests directions for further research.

CHAPTER 2

LITERATURE REVIEW

The past three decades have witnessed the production of a growing academic literature concerning information technology (IT) and its relationship to the strategic interests of the firm. In particular, the most recent decade has produced a plethora of conceptual frameworks ostensibly for identifying opportunities for gaining strategic advantage through the deployment of IT. In spite of the frequent occurrence of the term 'integration' throughout this literature, the notion of integration as the state of information utilization within an organization does not emerge as a major theme. However, this literature is relevant to this study in several respects: (1) it validates the IT-strategy linkage by placing information and its means of delivery, information technology, at the center of strategic decision-making and the achievement of long-term organizational performance, (2) it emphasizes the important role that information and IT play in dealing with the competitive exigencies in an organization's environment, and (3) it provides a conceptual basis for information relevance in specific organizational contexts.

The last of these primarily refers to the research on critical success factors, research that was heavily relied upon in the conceptual development of the research model that was used to guide this investigation. The first two, while less central to the development of the research model, refer to the general academic context to which the study seeks to contribute. A selection of literature in all three respects is summarized and briefly discussed in Appendix 2.1. Some of the articles in Appendix 2.1 are directly relevant to the research question posed in Chapter 1 and are encountered again in the main body of this Chapter as a literature base is formed to facilitate research model development.

Much of the research reported in the strategic-IT literature sets out to build theory; however, the bulk of work in this area has been harshly criticized for its lack of success in exposing a set of accepted principles and for its generally superficial treatment of the linkage between the deployment of information technology and the strategic concerns of the organization (Bakos and Treacy 1986, Clemons and Kimbrough 1986). More recently, Jarvenpaa and Ives (1990) conclude that "the work in the area has been anecdotal or conceptual rather than empirical or theoretical." As a consequence of the state of this literature, the search of literature for this study had to extend beyond this area to find a conceptual basis on which to construct a research model that could be used to guide an empirical investigation of the research question.

Chapter Overview

The chapter is organized around the discussion of five areas of literature. The first area reviews general concepts of integration in organizations. Literature here addresses the general nature of integration and its relationship to performance. The second area is a collection of views on the notion of information systems integration. Considerable conceptual diversity characterizes this area. The third area reviews empirical studies which include some aspect of the integration of information systems. This literature finds integration treated in highly disparate ways: as a quasi-experimental treatment, as a concomitant variate, and as a construct manifestation. The fourth area examines previous research on the relationship between information system use and performance. The focus of this area of research is more on 'information systems' than on 'information' but some support is found for a relationship between the use of what is produced by information systems and performance. The issue of information relevancy in specific organizational contexts led to the the fifth literature area. Here the research on critical success factors is examined as a potential basis for information relevancy.

EXHIBIT 2.1

General Concepts of Integration

Source	Description/Definition
Barnard, 1938	Coordination is the organizational function which correlates the efforts of individuals in such a way with the conditions of the cooperative situation as a whole that purpose may be accomplished [p. 136].
Lawrence & Lorsch, 1967b	Integration refers to the quality of the state of collaboration that exists among departments that are required to achieve unity of effort by the demands of the environment [p. 11].
Thompson, 1967	Interdependence takes three forms: (1) pooled interdependence wherein each organizational unit, while not necessarily interacting with others, must perform adequately or the total organization is jeopardized, (2) sequential interdependence wherein there is a direct and ordered interaction between organizational units, and (3) reciprocal interdependence wherein the outputs of each organizational unit become the inputs for other units [p. 54-55].

2.1 GENERAL CONCEPTS OF INTEGRATION IN ORGANIZATIONS

Management writers in fields other than Information Systems have developed various notions which provide a general referent for the conceptual development of a construct of information integration. Barnard's "coordination" (1938) and Thompson's "interdependence" (1968) are conceptually similar to the concept of "integration" developed by Lawrence and Lorsch (1967a and 1967b). Exhibit 2.1 compares these concepts. These writers probably did not intend their concepts to relate exclusively, or even primarily, to information; however, more recent writers place great emphasis on the role of information and IT in relation to these same and similar concepts (Tushman and Nadler 1978, Rockart and Short 1989), especially in the context of IT-related organizational restructuring (Drucker 1988, Benjamin and Scott Morton 1988, Schein 1989).

The studies undertaken by Lawrence and Lorsch during the 1960s were probably the most prominent stream of research addressing integration. These researchers found a relationship between the state of integration and organizational performance. Information systems, referred to by the term "paper systems," were included in the set of "major integrative devices" along with integrative departments, cross-functional teams, multi-level managerial contact, and managerial hierarchies [1967b, p. 138]. While Lawrence and Lorsch indicate that information systems are integrative devices distinct from the other integrative devices, they also seem to suggest that all integrative devices incorporate, to varying degrees, some component of information exchange. Essentially, the use of information delivered to individual organizational members through either formal or informal systems is fundamental to the Lawrence and Lorsch concept of integration.

An important issue raised by Lawrence and Lorsch is whether integration should be viewed as an organizational state or an organizational process. At one point these authors assert that "integration is defined as the *process* of achieving unity of effort among the various subsystems in the accomplishment of the organization's task" [1967a, p. 4, emphasis added] while at another point they define integration as "the quality of the *state* of collaboration that exists among departments that are required to achieve unity of effort by the demands of the environment" [1967b, p. 11, emphasis added]. In their discussions associated with the latter definition, Lawrence and Lorsch recognize this difference but go on to say that their use of the term "integration" primarily refers to an organizational state and not to an organizational process.

2.2 CONCEPTS OF INFORMATION SYSTEMS INTEGRATION

The integration of an organization's information systems has been the subject of discussion by several information systems academicians. In spite of these efforts, little in the way of definitional consensus seems to exist. Dooley (1990) reports a similar lack of consensus among information systems practitioners. Exhibit 2.2 presents a selection of how integration has been described by various academicians. While having access to a collection of organizationally relevant information seems to emerge as a unifying theme, considerable conceptual diversity is apparent in many respects. These points of diversity include the issue of state versus process, the explicitness of concern with organizational tasks or goals, and the extent to which definitions are technology-dependent.

As with the Lawrence and Lorsch work on organizational integration, the contention between integration as a state versus integration as a process is evident here as well. In many instances, definitions appear to be primarily concerned with the process of achieving the integration of information systems and secondarily with the state of information utilization in an organization. In contrast to Lawrence and Lorsch, the various notions of information systems integration are not explicitly concerned with organizational goals. The one exception is that put forth by Nolan (1973). With its emphasis on "the management of computer resources," Nolan's view diverges substantially from the others with their emphasis on systems as information delivery mechanisms.

An interesting point of variability in the various delineations of integration is the extent to which each is bound to the use of computer-based technology. (In many cases this extent of technology-dependence only becomes clear when examples are given or when operationalization procedures are disclosed.) Ein-Dor and Segev (1982) and Buckelew (1985) tie their notions of integration to the use of computer-based technology while Scott (1986) and Smith (1982) put forth concepts of information integration that are independent of any specific item of technology. These latter writers suggest that the manual transfer of data from one point to another is just as much an integrating device as the transmission of

EXHIBIT 2.2

Concepts of Information Systems Integration

Source	Description/Definition
Hussain & Hussain, 1985	Integration of an information system refers to the logical organization and linkage of functional subsystems to give management access to data bases designed for different classes of users. Horizontal, vertical, and longitudinal components are identified [p. 452].
Ein-Dor & Segev, 1982	MIS integration has two aspects (1) the integration of data from different areas of the organization by means of a database, and (2) integration of models when the output of one model becomes the input to another [p. 56].
Smith, 1982	The flows of data and information between organizational units indicate relative degrees of integration, and some organizations are more integrated than others [p. 140].
Buckelew, 1985	Integrated systems are defined as those which were designed and built to work together. Nonmodular integrated systems require the entire system whereas modular systems allow the subsystems to be implemented on a piecemeal basis, when required [p. 295].
Nolan, 1973	Integration is the mature stage reached by a firm in the management of its computer resources wherein the role of the computer resource in organizational goal achievement is rethought [p. 403].
Davis & Olson, 1985	Integration is achieved through the planned federation of subsystems, developed and implemented as needed but conforming to an overall plan, standards, and procedures for MIS [p. 10].
Scott, 1986	Integration is the interlocking of systems so that data from one system can be routinely passed to, or retrieved by, one or more other systems. Integrating systems requires the identification of potentially useful interactions between organizational units. Three types are identified: hierarchical, horizontal, and cross-functional [pp. 84 - 86].
Bailey & Pearson, 1983	Integration of systems refers to the ability of systems to communicate/transmit data between systems servicing different functional areas [p. 543].

data through electronic communication channels. They do not, however, suggest that the same state of information utilization will result from these two modes of data transmission.

There is another group of literature which limits the concept of integration to the use of specific items of computer-based technology. Probably the largest sub-group of this literature is that which is concerned with integration in the context of the implementation and use of data base management systems (Kerschberg, Marchand, and Sen (1983), Batini, Lenzerini and Navathe (1986), and Wang and Madnick (1989) are examples). Interestingly, these works are not limited in their view of information utilization throughout an organization but they deal with achieving integration almost exclusively through the use of data base technology and techniques. Such technology-dependent concepts of integration tend to ignore the reality that information delivered by computer-based systems is only a subset of the information utilized by individuals in organizational settings (Dearden 1972).

2.3 EMPIRICAL RESEARCH ON INFORMATION SYSTEMS INTEGRATION

Little in the way of empirical work has addressed the relationship of information integration and the strategic concerns of the organization. Exhibit 2.3 summarizes three empirically-based studies dealing with integration in an information systems context that were encountered during a search of the literature. Venkatraman and Zaheer (1989) were concerned with the impact of "electronic integration" on strategic advantage. Ein-Dor and Segev (1982) used the "degree of MIS integration" as a dimension of "MIS structure." Bailey and Pearson (1983) treated the "integration of systems" as a "factor" in measuring "computer user satisfaction."

Since the Venkatraman and Zaheer study sought to establish the impact of integration on the performance of information-using individuals, it holds particular relevance for this investigation. These authors sought to establish a relationship between "electronic integration" and "strategic advantage." Their study was conducted, like this one, in the insurance industry and was concerned with the effect of integration on the performance of individuals. A quasi-experimental design using two matched groups was employed. The investigation found that electronic integration had a statistically significant effect on

EXHIBIT 2.3

Empirical Research on Information Systems Integration

Source	Purpose	Results	Method(s)
Venkatraman and Zaheer, 1989	To investigate the effect of electronic integration on the performance of insurance agents.	Differential performance was statistically different for efficiency measures but not for effectiveness measures.	Quasi-experimental design using two matched groups (treat. n = 85 control n = 75). Longitudinal log transformed. differential performance data collected from 6-month pre- and post-tests.
Ein-Dor and Segev, 1982	To investigate relationships between organizational context and MIS structure.	MIS structure is significantly correlated with organizational structure and organizational size. MIS integration is higher in less centralized organizations.	Structured interviews, archival data, and published material on 53 companies. Kendall's τ used to analyze data.
Bailey and Pearson, 1983	To develop a technique for measuring and analyzing computer user satisfaction.	Of the 39 factors in the scale, 32 had reliability coefficients exceeding 0.90 and none was below 0.75.	Panel of DP professionals for face validity. Questionnaire-based methods (n = 29) to establish reliability.

"efficiency" performance measures ("number of policies") but no effect on "effectiveness" performance measures ("financial performance indices"). The authors concluded that "the results indicate modest support for the hypothesis of performance effects due to integration."

Four aspects of the Venkatraman and Zaheer study should be noted to clarify how this investigation differs from that of Venkatraman and Zaheer: (1) integration was considered a treatment by Venkatraman and Zaheer and not a construct whose concomitant variation with the dependent variables was assessed, (2) the incremental impact of "electronic integration" on performance was evaluated and not the overall state of information utilization on performance, (3) the research setting and the information system "treatment" were inter-organizational in nature,[1] and (4) strategic advantage was operationalized through the use of individual performance measures. Like the Venkatraman and Zaheer study, this investigation relies on a similar connection between individual performance and strategic advantage. In contrast to their study, this investigation (1) treats information integration as an antecedent construct to performance and not as an experimental treatment, and (2) attempts to measure the level of information integration that arises from all systems at an individual's disposal, both intra- and inter-organizational systems.

Ein-Dor and Segev (1982) identified MIS integration as a dimension of MIS structure in an investigation of the relationships between "organizational context" and "MIS structure." Their investigation employed the organization as its unit of analysis. Their definition of integration, shown in Exhibit 2.2, was operationalized in three ways: (1) the proportion of data in shared databases, (2) the number of applications using common files, and (3) the number of functions served by application. The values for each of these variables took three values: "low, average, high." Their technology-dependent view of integration combined with the limited range of values for the manifest variables probably did not capture the variability of the state of information utilization in an organization. However, their admission that the research design was such that the testing of "hypotheses call[ed] for strong monotonic relationships between pairs of variables" in combination with the finding that integration was significantly correlated with other variables appears to lend strong support to the notion of information systems integration as an observable variable at the organizational level.

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1 Venkatraman and Zaheer take great pains to describe the inter-organizational nature of the research setting and the information system. However, nothing in their report suggests that the inter-organizational circumstances were in any way a determinant of the results.

Bailey and Pearson (1983), in a report on Pearson's (1977) work on the development of a set of formative scales for "computer user satisfaction," claim that their results show "integration of systems" (defined in Exhibit 2.2) to be a reliable and valid component of a construct of computer user satisfaction. This result was replicated by Ives, Olson, and Baroudi (1983). Measurements of integration were based on the semantic differential of six adjective pairs: (1) complete versus incomplete, (2) sufficient versus insufficient, (3) successful versus unsuccessful, and (4) good versus bad, (5) satisfactory versus unsatisfactory, (6) important versus unimportant. The form of the operationalization and the focus on computer systems suggest that the complete set of 39 "factors" captured the state of information utilization in an organization only indirectly; however, the results lend some support to the notion of integration as an observable variable at the individual level. Interestingly, a subset of "factors" in the computer user satisfaction scale appear to relate directly to information utilization. As will be seen in Chapter 3, these were heavily relied upon in developing the measurement component of the research model.[2]

2.4 EMPIRICAL RESEARCH ON INFORMATION SYSTEM USAGE AND PERFORMANCE

In terms of a direct assessment of concomitant variation, the relationship of information integration and performance has not been the subject of any empirical study. However, there has been work done on the relationship between the use of computer-based information systems and performance. These studies have taken place at both the individual level (Lucas 1975, Neumann and Segev 1980, Venkatraman and Zaheer 1989) and the organizational level (Cron and Sobol 1983). Exhibit 2.4 summarizes these studies and the results obtained. Support was found for the relationship; however, the associations

2 The stream of research emanating from Pearson's (1977) work on an "Information Product" component of computer user satisfaction is examined in much greater depth in the discussions in Chapter 3 on the development of the measurement component of the research model.

EXHIBIT 2.4

Empirical Research on IS Usage and Performance

Source	Purpose	Results	Method(s)
Cron and Sobol, 1983	To investigate the effect of (1) type of computer usage, (2) number of computer uses, and (3) computer ownership status on the financial structures of firms in the the medical supply industry.	Computerization is related to overall performance, although bi-modal results were observed in the case of very high or low performers.	Data taken from the 1979 annual survey done by an industry trade association. A convenience sample was used (n = 138). ANOVA and Chi-square analysis carried out.
Neumann and Segev, 1980	To evaluate the IS in a bank by investigating the relationship between the use of information and branch manager performance.	Correlations between the information evaluations and nine performance measures were small or "modest."	A 62-page questionnaire on information use was completed by 81 branch managers. Performance data were three-year averages and were obtained from archival records.
Lucas, 1975	To test a descriptive model of the relationship between IS and performance for sales personnel.	A weak association between performance and IS use was found.	A field study in 3 divisions of a clothing manufacturer. Data were obtained from questionnaires and corp. files on 398 subjects. Stepwise multiple regression was employed.

NOTE: Also see the summary of Venkatraman and Zaheer (1989) in Exhibit 2.3.

observed were generally weak and more complex than anticipated. None of the studies were concerned with the overall state of information utilization by individuals or organizations beyond that provided by a specific computer-based information system (Lucas 1975, Venkatraman and Zaheer, 1989) or a well-defined collection of such systems (Neumann and Segev 1980, Cron and Sobol 1983).

Beginning in the early 1970s, a number of experimental studies were carried out on the structure of information and decision effectiveness (Chervany and Dickson 1974, Kozar 1972, Smith 1975, Barkin 1974, Senn 1973, Wynne and Dickson 1975, Benbasat and Schroeder 1974, Chervany and Sauter 1975, Schroeder and Benbasat 1975). These became collectively known as the Minnesota Experiments (Dickson, Senn, and Chervany 1977) and this stream of experimentally-based research has continued into the following decade (Benbasat, Dexter, and Todd 1986 would be an example). While the results of these experiments were mixed, some support was shown for the existence of relationships between information system characteristics and decision effectiveness. In all these investigations the state of information utilization facing the experimental subject was far from the level of comprehensiveness that would be realized by information-using individuals in specific organizational settings. Consequently, this stream of research does not directly address the research question posed for this study; albeit, it does lend some empirical support to the existence of a relationship in which information content and form is an antecedent of performance (decision-making) at the individual level.

Crowston and Treacy (1986) review a collection of studies which deals with information technology as an antecedent construct at the organizational level. However, information content and utilization are not attributes of this construct; instead, independent variables such as IT-investment levels and computer ownership are used. The Cron and Sobol study summarized in Exhibit 2.4 is among those reviewed in the Crowston and Treacy article.

2.5 INFORMATION-BASED DETERMINANTS OF PERFORMANCE

In general the research on performance and IS utilization, including the limited amount concerned with information integration, has not explicitly incorporated constructs reflecting the competitive circumstances of an organization. Consequently, an important basis for information relevance in an organizational context has essentially been ignored. An area of research that appears to have considerable potential to address this conceptual gap is the work on critical success factors. Exhibit 2.5 presents a selection of the notions that have

EXHIBIT 2.5

Selected Critical Success Factor Concepts

Source	Ter ıinology	Definition
Daniel, 1961	Success Factors	A company's information system must be discriminating and selective. It should focus on "success factors." In most industries there are usually three to six factors that determine success; these key jobs must be done exceedingly well for a company to be successful [p. 116].
Zani, 1970	Key Success Variables	These variables are activities on which the company must score high if it is to succeed. They name the key tasks of the company and thus help identify the priorities for information system development. The systems must provide information that make the individual managers' performance of these tasks easier [p. 98].
Bullen and Rockart, 1981	Critical Success Factors	CSFs are the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, or organization.
Scott, 1986	Key Tasks	Each organization has some tasks that must be managed extremely well in order for the organization to survive. Typically, an organization has three to seven such key tasks. Most of an organization's key tasks are cross-functional in nature, in that information pertaining to several functional areas is essential for their successful accomplishment [p. 82].

been put forth in this respect. While these can readily be traced to Daniel's (1961) article, the notion that attention to certain "factors" (or "tasks" or "variables") is critical to both organizational and individual performance has probably been around as long as academics have been concerned with the management of organizations. Barnard's (1938) notion of "strategic factors" could be considered the conceptual antecedent of Daniel's (1961) "success factors" and Zani's (1970) "key success variables" and Rockart's (1979) "critical success factors" as well as Scott's (1986) "key tasks."

While the terminology has varied, the general assertion in this area is that there are a limited number of factors which, if astutely managed, will result in successful competitive performance. Further, these factors cannot be managed if adequate information is not available to monitor them, control them, and support the various tasks required as a consequence of their pursuit. Thus, the extent of the utilization of information relevant to these factors is hypothesized to be a determinant of both individual and organizational performance.

The acceptance of this hypothesis has resulted in the use of critical success factors (CSFs) as a basis for determining information needs (Rockart 1979, Munro and Wheeler 1980, Davis 1982, Martin 1982, Zmud 1983, Boynton and Zmud 1984, Shank, Boynton and Zmud 1985, Davis and Olson 1985, Sprague and McNurlin 1986), particularly at the strategic level in an organization (Henderson, Rockart and Sifonis 1987, Henderson and Sifonis 1988).[3] The research in this area, a selection of which has been summarized in Exhibit 2.6, has generally assumed that the relationship between CSF-relevant information and performance is true. Consequently, it has largely been preoccupied with evaluating CSF-based methodologies for information needs identification. This preoccupation sometimes resulted in the CSFs not even being reported (Munro and Wheeler 1980, Boynton and Zmud 1984). Only one study (Jenster 1986) investigated the relationship between the use of CSF-relevant information and organizational performance. Jenster found support for the relationship; however, he employed a generic set of CSFs across the 124 organizations studied. His use of generic CSFs places substantial limits on the validity of his results since the literature strongly suggests that, in general, the set of CSFs is unique to both individuals and the organizations.

The concept of information integration in the context of CSFs receives some attention. Jenster (1986) and Boynton and Zmud (1984) briefly mentioned CSFs as a basis for

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3 The term 'critical success factors' (Rockart 1979) was adopted for this investigation. This term appears to be more widely used than the others in Exhibit 2.5. Also, a significant stream of research emanating from that by Rockart has used this term.

integration. Benjamin and Scott Morton (1988) suggest a role for CSFs in "electronic integration" [p. 92]. However, Sullivan (1985) suggests that a CSF-based approach "is more helpful in designing support systems for isolated senior executives than in resolving company-wide issues of integrated information systems. While it fills a niche, the limitations of this approach for interdepartmental systems projects make it no more of a methodological panacea than its predecessors" [p. 5]. Without some evidence that CSF-relevant information is related to performance across a wide range of organizational members, it is difficult to disagree with this position. However, this investigation sought to test Sullivan's assertion.

2.6 LITERATURE AND RESEARCH: SOME CONCLUSIONS

In view of the research question posed in Chapter 1 and the general area to which this study hopes to contribute, several major points should be noted with respect to the contributions of the writers and researchers discussed throughout this chapter:

- Although there is general agreement that integration is 'good' and that more integration is better than less integration, the literature, both academic and professional, lacks any consensus on the specific nature of information integration. The major dimensions for the variance in concepts of IS integration appear to be (1) state versus process and (2) IT-dependence versus IT-independence.

- Evidence was found for a relationship between organizational integration and performance but the antecedent construct was not one that related primarily to the utilization of information.

EXHIBIT 2.6

Critical Success Factors: A Summary of Selected Research

Source	Purpose	Results	Method(s)
Rockart, 1979	To reveal the critical factors to be used as a basis for identifying the information needs for management control.	A finite and mutually distinct number of critical success factors were revealed. The number of CSFs ranged from 5 to 8.	Two sessions of structured interviews (2.5 hours each) with chief executives in five organizations.
Munro and Wheeler, 1980	To help define the information needs of senior and middle level managers with control responsibilities.	Identification of CSF methodology advantages and disadvantages for managers and analysts. Specific CSFs were not reported.	A field study of CSF methodology application at a large natural resources company.
Martin, 1982	To explore the CSFs of a group of chief MIS managers in successful organizations.	Seven CSFs were identified and considered generic to MIS/DP organizational subunits.	Questionnaires to 15 chief MIS executives of sizable business or government organizations.
Rockart, 1982	To investigate the evolution of the role of the IS executive from a CSF perspective.	CSFs for CIOs differ across firms. Their number ranged from 5 to 7. A set of 4 generic CSFs were derived.	Structured interviews with multiple informants in each of 9 organizations.
Boynton and Zmud, 1984	To assess the strengths and weaknesses of the CSF method in supporting MIS planning and information requirements.	Strengths: CSF method supports top level planning and analysis, helps identify competitive IS uses, well received by senior managers Weaknesses: difficulties for lower level managers, needs identification incomplete.	Two case studies using structured dialogues to disclose personal CSFs. Organization CSFs were identified as the personal CSFs that were "consistently referenced."
Shank, Boynton, and Zmud, 1985	To explore the use of the CSF methodology in identifying corporate information needs and developing an IS plan.	Four CSFs were identified for a private deposit insurer. Guidelines were developed for the use of the CSF methodology.	One case study on the application of the CSF methodology. Structured interviews and a "retreat" were used.
Jenster, 1986	To investigate the relationship between firm performance and executive monitoring of critical success factors.	Support was found for the existence of a relationship between CSF monitoring and firm performance. The relationship and the extent of monitoring differed across strategy types.	Questionnaire mail survey of key informants (COOs) in 124 firms. Strategy types: Defenders, Reactors, Analyzers, and Prospectors. Generic CSF areas used. Data analysis used ANOVA.

- Some support was found for the validity of a construct of information integration at both individual and organizational levels; however, this support was not established in the context where information integration was treated as an antecedent to performance at either level. Also, the constructs only partially reflected the state of information utilization in the contexts in which they were tested.

- Evidence was found for a relationship between the utilization of information systems and performance at both individual and organizational levels. However, the observed relationships are, at best, weak associations and the antecedent construct(s) did not comprehensively reflect the state of information utilization.

- The literature on critical success factors strongly asserts that such factors are an important basis for selecting information that will lead to successful performance at both individual and organization levels. However, this assertion has only been indirectly tested.

In summary, no empirical research has been carried out which investigated a relationship in which information integration is an antecedent to the performance of organizational work. However, the presumption of such a relationship pervades a significant segment of the academic literature and is often the basis for (extensive and expensive) action by information systems practitioners.

CHAPTER 3

RESEARCH MODEL DEVELOPMENT

Previous work on information utilization as an antecedent of performance did not produce a general conceptual framework within which theory testing could take place. This theoretical gap exists in spite of some empirical evidence in support of the relationship. The previous work on information integration was even more deficient. Little in the way of theoretical development is available and even the notion of integration in the context of information systems lacks consensus. In preparing a study to address the critical research tasks posed in Chapter 1, such deficiencies represer^ considerable obstacles. This chapter attempts to address these deficiencies. Its purpose is the construction of a model extensive enough to adequately test the presumption embodied in the research question and lay a foundation for further theoretical development.

With confirmatory testing being an equal concern with conceptual development, the model construction undertaken in this chapter extends beyond theoretical considerations to include aspects of measurement. This concern with measurement not only facilitates testing but also yields enhanced meaning for theoretical concepts. This responds to the need, at this stage in the research on information integration, for a research model in which theoretical development is allowed to interact with the means of measurement in a manner that permits an effective evaluation of the validity of what is being proposed. Accordingly, the reader will find this chapter as preoccupied with measurement issues as it is with theoretical issues.

Chapter Overview

The chapter formulates an initial conceptual model at an organizational level that is based upon themes emerging from the literature reviewed in the previous chapter. Certain of these themes are reasonably well accepted notions in the information systems discipline; others are controversial. The assumed relationship of CSFs to performance is an example of the former while the definition of information systems integration is an example of the latter. The initial model is based on some fairly restrictive assumptions and subsequent chapter sections propose model reformulations that relax these assumptions and extend the generality of the model. These reformulations also position the model to be extended in a way that allows conceptual-level variables to be conveniently associated with empirical-level variables. In the final development of the model a segment is isolated and put forth as the definition of information integration at an individual organizational member level. It is this segment that is the subject of the study's empirical work.

The empirical-level variables for information integration emerged from a review of the user information satisfaction (UIS) literature. Some customization of definitions was necessary but the work on UIS proved fruitful in constructing a measurement model to match the information integration aspects of the conceptual model. The empirical-level variables for performance were those readily available from the organizational setting in which the research took place. Performance measures were selected that are closely related to overall organizational performance. Performance constructs were then derived from these measures. This chapter reports on this derivation along with validity assessments on the constructs that emerged.

The presumption that improved integration contributes to performance suggests that a significant part of the meaning of integration comes from its relationship with performance.

Consequently, validating constructs for information integration should be done in the context of a nomological net which includes dependent constructs for performance. The final sections of the chapter formalize this network of constructs and empirical variables in the language of structural equations modeling. The structural equations approach permits a simultaneous evaluation of both information integration and performance constructs in a network that includes the relationships hypothesized between constructs and between each construct and its associated empirical variables. Chapter 3 concludes with an inventory of all hypothesized relationships in a form convenient for confirmatory testing.

3.1 INITIAL MODEL FORMULATION

From the literature reviewed in Chapter 2, four themes were selected as the background for the construction of the research model. These correspond to a conceptual basis which:

1) takes the Lawrence and Lorsch view that integration is an organizational state (and not a process),
2) does not tie the definition of information integration to any particular item or area of information systems technology but instead employs a construct for information integration that captures the state of information utilization arising from both electronic and non-electronic information sources,
3) incorporates the notion that a finite number of factors or key tasks are critical to both individual and organizational performance, and
4) posits the existence of relationships between information integration and performance at both individual and organizational levels.

Of these four, the most fundamental is the notion that for any competing organization there exists a finite set of factors which determine the tasks that are critical to the organization's successful performance.

These critical success factors (CSFs) may be explicitly derived from the organization's competitive strategy or they may arise implicitly from the exigencies of competitive survival and/or the collective propensities of organizational members. Formally, it is assumed that a set, F, consisting of D critical success factors can be associated with an organization. Let $F \equiv \{f_1, f_2, \ldots, f_D\}$. It is proposed that the state of information integration, Ω, for the organization is given by:

$$\Omega = \frac{\sum_{i=1}^{N} d_i}{N \times D} \quad \ldots\ldots \quad (3.1)$$

where N represents the number of organizational members who are end users of information, and

d_i refers to the number of CSFs (i.e., the number of elements of $\{f_1, \ldots, f_D\}$) about which the i^{th} member ($i = 1, \ldots, N$) of the organization is adequately informed. Note that $0 \leq d_i \leq D$.

Equation 3.1 essentially represents a ratio of (1) the extent to which CSF-relevant information is being used by an organization to (2) the total potential CSF-relevant information base of the organization. Examples of information could include monthly financial reports, the results of access to online databases, trade association publications on (say) markets and market shares, the information content of telephone conversations or any combination of these. Each of these examples only becomes CSF-relevant information when (1) it is used by a member of the organization for decision-making or as a basis for taking action, and (2) it be can be associated with at least one of the elements of

$F \equiv \{f_1, f_2, \ldots, f_D\}$. If an information-using organizational member associates information with an additional factor that matches any of the CSFs in the set, F, then the ratio given in Equation 3.1 increases. When this happens, we say that both the organizational member and the organization have reached a higher state of information integration. If instead the information is associated with a factor that is not any one of $f_1, f_2, \ldots, f_D$, then Ω does not change.

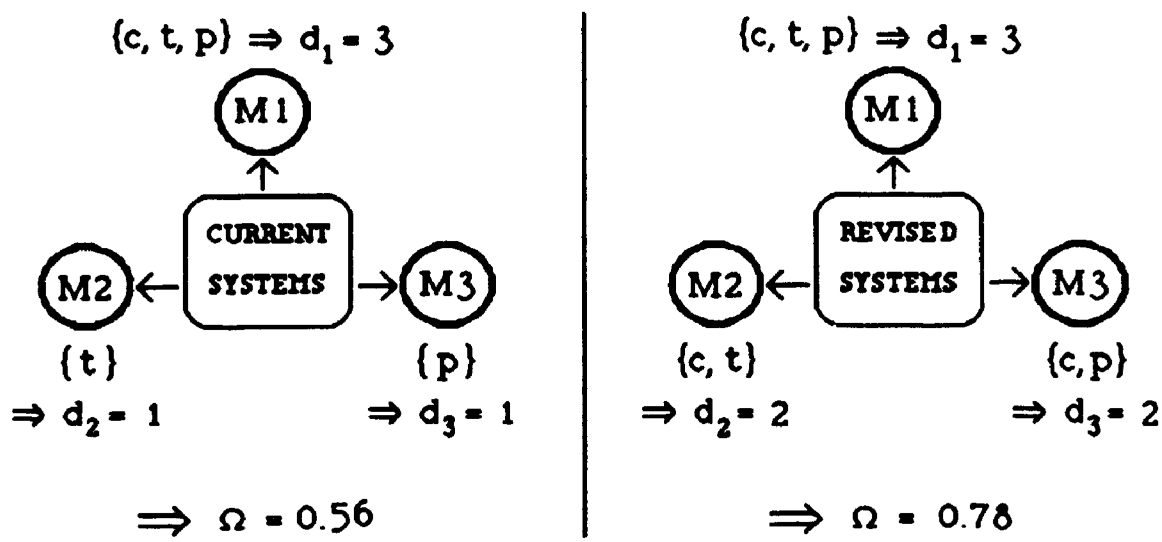
An Explanatory Application

A highly simplified application of Equation 3.1 illustrates the general concept of what is being proposed. Suppose the critical success factors (CSFs) for an equipment maintenance and repair firm are low cost (c), low mean-time-to-repair (t), and high parts availability (p). Thus, we have F = {c, t, p} and D = 3. Further, suppose the firm has three (and only three) information-using organizational members: a general manager, a service manager, and a parts inventory manager denoted by M1, M2, and M3, respectively. Thus, N = 3. The left-hand plate of Exhibit 3.1 presents a situation where M1 utilizes information on all three CSFs (thus $d_1 = 3$); M2 only utilizes information on repair times (resulting in $d_2 = 1$); and M3 only utilizes information on availability of parts (resulting in $d_3 = 1$). Applying Equation 3.1 yields $\Omega = 0.56$.

Now suppose this organization implements some item of information technology which results in M2 and M3 being made aware of various cost performance indicators and incorporating this information into their decisions and actions. This new IT implementation could take many forms: a company-wide DBMS for cost control, the use of new technologies (e.g., a local area network) and/or, enhancements to an existing system (e.g., another column on a monthly report). Thus, M2 uses information on costs when making decisions about service while M3 uses information on costs when setting inventory levels. Now the organization's IS integration structure changes to that represented by the right-

EXHIBIT 3.1

Determining an Organization's Ω



hand plate of Exhibit 3.1. The implementation of the new or revised information technology has raised the organization's Ω from 0.56 to 0.78.

Critical Assumptions

In addition to the assumption of CSFs as a finite set of factors critical to successful performance, several other important assumptions accompany Equation 3.1. First, only end-use information affects the state of information integration, in other words, only information that is 'consumed' by an organizational member for decision-making and action-taking changes the value of Ω. CSF-relevant information that is received but not used in any way for decision-making or action-taking does not affect Ω nor will CSF-relevant information that is merely received and redistributed. However, CSF-relevant information that is 'consumed' by one organizational member and then communicated or retransmitted to another member for further 'consumption' would be considered end-use information for both organizational members. The second assumption holds that all d_i's take only integral values in the range ($0 \leq d_i \leq D$). This assumes that any organizational member is either fully informed or completely uninformed with respect to any CSF. The third assumption posits that all elements in the set, F, are of equal importance to the organization. (An examination of Equation 3.1 reveals that each of $f_1, f_2, \ldots, f_D$ has an implicit weight of 1/D.) The latter two simplifying, but restrictive, assumptions will be relaxed in the model development that follows.

3.2 MODEL REFORMULATION: INFORMATION VARIABILITY

The formulation of Ω given in Equation 3.1 does not provide for CSF-relevant information that is less than fully adequate. Any determination of Ω would involve some process whereby the information set of each organizational member is evaluated vis-a-vis each CSF. Either the information is perfectly adequate for the CSF (and d_i is incremented by 1) or it is completely inadequate (and d_i remains unchanged). This lacks intuitive appeal since, conceivably, the level of adequacy would generally fall at some point between these two extremes. This dichotomous restriction on the increments in d_i can be relaxed by defining d_i in terms of a variable, a_{ij}, ranging over the interval [0,1] and reflecting the extent to which the set of CSF-relevant information being used by the i^{th} organizational member deviates from a set of information that is fully adequate for the j^{th} CSF. With this construction, d_i is defined as the sum of these information set deviations:

$$d_i = \sum_{j=1}^{D} a_{ij} \qquad \ldots\ldots \quad (3.2)$$

On substituting Equation 3.2 in Equation 3.1, we obtain a formulation which reflects information variability across each element of $\{f_1, f_2, \ldots, f_D\}$:

$$\Omega = \frac{\sum_{i=1}^{N} \sum_{j=1}^{D} a_{ij}}{N \times D} \quad . \ . \ . \ . \ (3.3)$$

The behavior of Equation 3.3 under various limiting conditions should be compared with the notions one might have about any variable that claims to represent information integration. Keep in mind that a_{ij} represents an index of deviation for the adequacy of the set of information utilized by the i^{th} organizational member with respect to the j^{th} CSF, f_j, and note that $i = 1, \ldots, n, \ldots, N$ and $j = 1, \ldots, d_i, \ldots, D$. We can see that low values of integration are predicted (i.e., $\Omega \rightarrow 0$) when information is generally inadequate across substantially all information-using organizational members (i.e., $a_{ij} \approx 0$, when $n \approx N$) or when only a few organizational members are extremely well informed about the firm's CSFs (i.e., $d_i \approx D$ for some $n << N$) or when a large number of organizational members are well informed about a small subset of $\{f_1, f_2, \ldots, f_D\}$ (i.e., $d_i \approx 0$ for $n \approx N$). Various combinations of these terms at intermediate points in their ranges may also yield low Ω values. High levels of integration (i.e., $\Omega \rightarrow 1$) will result when information is generally adequate across most or all organizational members (i.e., $a_{ij} \approx 1$ for $n \approx N$) and when all the firm's CSFs are recognized by most, or all, organizational members (i.e., $d_i \approx D$ for $n \approx N$).

Although the complexity of the formulation of information integration has been somewhat increased, this revision affords several advantages. First, it is more reflective of the reality of the information base that is utilized by organizational members in actual settings: a base that is usually far from ideal but rarely non-existent. Second, the conceptual similarity between information integration and other constructs in the literature is more readily seen. Goodhue's (1986) construct of "correspondence" and Galbraith's (1973) concept of "task uncertainty," which, in both cases, were formulated as antecedents to performance, are not unlike a_{ij}. However, these authors do not explicitly associate

CSFs or some equivalent notion with their constructs. Finally, the nature of a_{ij} as an assessment of the adequacy of a collection of information allowed the research to draw upon the work done on user information satisfaction (UIS) when developing instrumentation to measure information integration.

3.3 MODEL REFORMULATION: FACTOR IMPORTANCE VARIABILITY

The literature is not clear on how an organization deals with the issue of the relative importance of each of its critical success factors. Some writers suggest that CSFs by their very definition must all be managed with equal attention. Others suggest that some factors are more important than others and that the attention given to each factor must somehow be prioritized. Intuitively, when D is large, 'prioritization' of factors seems reasonable; however, when D is small, it seems reasonable that attention to each factor must be 'balanced.' At the organizational member level, the relative importance of each element of $\{f_1, f_2, \ldots, f_D\}$ would likely be subject to even greater variance. In view of the labour and functional specialization generally present in all organizations, it seems reasonable to expect that certain factors will be more important to some organizational members than to others.

The model reformulation given in Equation 3.4 responds to these concerns by relaxing the restriction that all factors are of equal importance at an individual level. This was done by associating a weight, κ_{ij}, with each a_{ij}. It can be seen that Equations 3.1 and 3.3 implicitly include a weight of $\kappa_{ij} = (1/D)$. Equation 3.4 was constructed by associating the term (1/D) with the inner summation in Equation 3.3 and then substituting κ_{ij} for this term. Thus,

$$\Omega = \frac{\sum_{i=1}^{N} \sum_{j=1}^{D} a_{ij} \kappa_{ij}}{N} \qquad . \; . \; . \; . \; (3.4)$$

To represent the assumption that any 'prioritization' or 'balancing' of factors will be done in relation to one another, the following restriction is imposed upon the weights:

$$\sum_{j=1}^{D} \kappa_{ij} = 1 \qquad . \; . \; . \; . \; (3.5)$$

3.4 HYPOTHESIZED CAUSAL RELATIONSHIPS

Using the terms of the framework developed above, the presumed organizational-level causal relationship between performance, P, and information integration discussed at the outset can now be formally stated:

$$\Omega \rightarrow P \qquad . \; . \; . \; . \; (3.6)$$

where "$\rightarrow$" denotes a positive causal relationship between these two constructs. It is not suggested that information integration is the only determinant of organizational performance but, ceteris paribus, changes in the level of information integration will cause changes in organizational performance. It should also be said at this point that no specific functional form for the relationship is being hypothesized; however, as will be seen in what follows, this investigation sought to establish the existence of a statistical relationship on the basis of an assumption of linearity.

From Equation 3.4 a definition for information integration at the organizational member level can be obtained. Note that the inner summation of this equation is composed of terms that reflect the adequacy and importance of CSF-relevant information for each organizational member. Extracting this term from Equation 3.4 provides a definition for the state of information integration, ω, at the organizational member level:[1]

$$\omega = \sum_{j=1}^{D} a_j \kappa_j \qquad . \ . \ . \ . \ (3.7)$$

If p denotes the performance of an organizational member then the research question is addressed by testing the hypothesis that:

$$\omega \rightarrow p \qquad . \ . \ . \ . \ (3.8)$$

where, here again, "→" is used to denote that, at the individual level as well as the organizational level, a positive causal relationship is hypothesized. At this level as well it is not suggested that information integration is the only determinant of individual performance nor that it is the most important. Also, no theoretical rationale is put forth for the specific functional form of the relationship; however, this study's use of Partial Least Squares methods of analysis required an assumption of linearity in the relationships investigated.

Issues of Causality

A consideration of the causality hypothesized in Equation 3.8 was guided by Cook and Campbell's (1979) criteria for inferring cause. Cook and Campbell hold that causal inference depends on three factors: (1) the existence of covariation between the presumed cause and its effect, (2) temporal precedence of the cause, and (3) the elimination of rival hypotheses about the cause and effect relationship. The first criterion requires that covariation of cause and effect be established. Doing so was a major objective for this

---

1 The subscript (i) has been removed from a_{ij} and κ_{ij} since these terms are only defined at the individual level and carrying it through what follows would be redundant.

study. As reported in Chapter 5 the results provide support for covariation between the constructs for information integration and performance.

The second criterion requires that the cause, a change in information integration ($\Delta\omega$), must precede the effect, a corresponding change in performance (Δp). This research did not incorporate a design based on a temporal sequencing of cause and effect. Consequently, no argument for causal direction can be made on the basis of realized results. However, many have theorized that information utilization precedes decision-making or action-taking, one of the most notable being Herbert Simon (1960) in his widely known model of decision making which posits that information gathering and utilization temporally precede action. Results obtained using the longitudinal design of the Venkatraman and Zaheer (1989) study on electronic integration and performance also support the temporal precedence of information use to individual performance. The findings of the "Minnesota Experiments" (Dickson, Senn, and Chervany 1977) provide further evidence in this respect. Intuitively, the causal direction may be seen as plausible when one considers the effect on the performance of information-using individuals when their information set is entirely removed or extensively reduced.

An argument can also be made for causation in the reverse direction: changes in performance cause changes in the level of information integration. Changes in performance may motivate a search for further information thereby increasing the level of information utilization and, consequently, the level of information integration. This generally involves the enactment of some process to develop a system to capture, process, and deliver the additional information. Such a systems development process could be extremely trivial (e.g., an information-using organizational member resolving to more closely examine reports that are already being delivered) or extremely complex (e.g., the implementation of a corporate-wide data base for cost control). However, the causal chain in this case is one in which changes in performance lead to changes in information delivery behavior (i.e., systems development) whereas the causal chain of interest to this study is one in which changes in the state of information utilization lead to changes in performance. As mentioned in an earlier chapter, changes in the state of information utilization (i.e., the level of information integration) are brought about by the process of systems development. This latter relationship provides a perspective on resolving the direction of causation: the argument for the reverse direction of causation is not in contradiction to what is hypothesized; instead, it refers to a relationship at a different point in the same causal chain:

$$\Delta p \rightarrow \Delta \text{ (systems development behavior)} \rightarrow \Delta\omega \rightarrow \Delta p \quad . . . \quad (3.9)$$

The first "→" indicates the effect of performance on systems development behavior; the second "→" indicates the effect of systems development behavior on the level of information integration; and the third "→" indicates the effect of information integration on performance. The third causation is the one of interest here.

Control and Causality

The third criterion of causality, ruling out alterative hypotheses that purport to account for cause and effect, presents a considerably greater challenge. As Cook and Campbell (1979) state (while acknowledging their debt to J. S. Mill):

> The third criterion is the difficult one; and Mill's most significant contribution--for causal analysis purposes--consists of his work on the methods of agreement, differences, and concomitant variation related to this third criterion. The Method of Agreement states that an effect will be present when the cause is present; the Method of Differences states that the effect will be absent when the cause is absent; and the Method of Concomitant Variation implies that when both of the above relationships are observed, causal inference will be all the stronger since certain other interpretations of the covariation between cause and effect can be ruled out. . . . At its core the Method of Concomitant Variation involves examining a somewhat complex pattern of data in order to induce whether a treatment is associated with effect and whether some rival causal explanations can be

> ruled out on the basis of when the treatment and effect are and are not related. . . . The concept of a control group is implicit here and is clearly central to Mill's thinking about cause.
>
> There are research contexts where random assignment, the physical isolation of units, and the like fulfill the same ends as Mill's canons. Where such design features are not available, as is usually the case in field research, the researcher has to make explicit the inferential threats which remain implicit in controlled settings where the procedural niceties of isolation and random assignment are possible [pp. 18-19].

It is clear that methodology is the primary concern of the third criterion. The requirement for control by the researcher is key in assessing the ability of a particular method to eliminate alternative interpretations of the causal linkage. While the procedural details of the methods employed in this study are left to Chapter 4, the methodology employed was essentially field research. As Cook and Campbell say above, this methodology is one which does not readily lend itself the degree of control that would satisfy Mill's third criterion for causality. However, the method used did attempt to address some the issues associated with this criterion. Most notably was the selection of subjects such that measurements of information integration would become available for various levels of performance. Thus, situations were examined in which the effect was present or absent and how this presence or absence covaried with the hypothesized cause. Although the tests raised by the third criterion were addressed to some extent, it must stand as a limitation of this research, as with field research generally, that there was no active manipulation of causal agents.

Also frustrating the clarity with which causality can be assessed as well as the complexity of maintaining control is the myriad of other factors that are thought to concurrently impact individual performance in organizational work. The major concern of this research is the construct of information integration. However, no claim is made that it is the only antecedent to individual performance nor that it is the antecedent having the greatest effect on performance. Thus, the fact that measurements of information integration were to be taken in a field setting in which many other performance antecedents would be operative, led to an a priori expectation of low multiple correlation values. This expectation is consistent with the generally low correlations reported by Churchill, Ford, Hartley and Walker (1985) in their meta-analysis of 116 studies on the determinants of salesperson performance. These researchers found an average correlation across 1653 "reported associations" of 0.188 and concluded that "on average less than 4% of the variation in salesperson performance is associated with a single predictor of that performance" [p. 104]. Results such as these suggest that any field study using performance as a dependent construct would require an exceedingly complex design in order to respond to the control requirement of Mill's third criterion for causality.[2]

This study was not designed with a level of control that addresses a range of performance determinants. Its response to Mill's third criterion consists of the utilization of subject selection criteria to aid in the observance of performance variability and to ensure that subjects had at least minimal levels of experience with job-related tasks. Although this was far from supporting the realization of complete normalization across all performance determinants in the research setting, it helped to ensure that subjects had reached at least minimal levels on many important determinants thereby reducing the observed variance of these determinants. While this approach tended to mitigate "inferential threats" from performance determinants, it also had the effect of reducing the variance in the antecedent constructs of interest. However, as reported in Chapter 6, variance reduction did not occur to the extent that the relationships of interest could not be observed.

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2 The degree of design complexity can be readily appreciated from the results of the Churchill et al. meta-analysis. The 1653 "single predictors" were classified into 6 categories: (1) aptitude factors with 832 associations, (2) skill level factors with 178 associations, (3) motivation factors with 126 associations, (4) role factors with 59 associations, (5) personal factors with 407 associations, and (6) organizational/environmental factors with 51 associations.

Addressing Causal Issues: A Summary

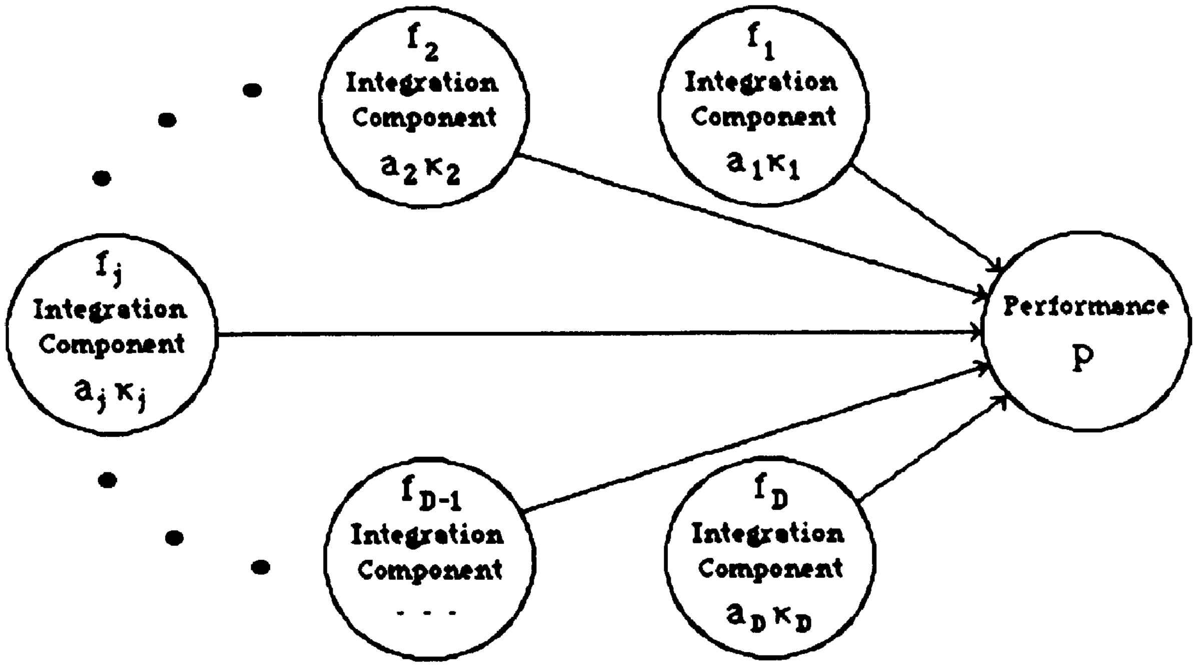
The way in which each of the three criteria for causation are satisfied varies in both method and extent. The first criterion, covariation of presumed cause and effect, is assessed as one of the objectives of this research. The second criterion, temporal precedence, is addressed through consideration of a causal chain that encompasses the relationship under investigation here. There is also reliance on the generally accepted tenant that information utilization precedes action. The third criterion, elimination of rival hypotheses, is addressed through features of the field-based methodology which support the elimination of alternative interpretations through maximization of performance variation in combination with reduction of variance in performance determinants.

3.5 GENERAL MODEL COMPONENTS

To permit analysis at the lowest possible level, the relationships were hypothesized and investigated for each of ω's components: $a_1\kappa_1, a_2\kappa_2, \ldots, a_D\kappa_D$. Exhibit 3.2 illustrates the conceptual model in which these CSF-components of information integration are posited as antecedents of performance. Each component is illustrated as a latent variable which captures both the importance of its associated CSF as well as the adequacy of the information set used by organizational members with respect to that CSF. An analysis at the component level was done in anticipation of observing variation in the relative strengths of the relationships across the elements of $\{f_1, \ldots, f_D\}$ arising from variation in either $a_1, \ldots, a_D$ or $\kappa_1, \ldots, \kappa_D$. This approach also allowed for the observation of negative relationships at the component level; something which would not be possible if testing occurred at the ω level. Negative relationships were in fact observed, an occurrence which could likely result in the observation of weak or non-existent relationships had testing been done at a higher level.

EXHIBIT 3.2

CSF-Components of Information Integration



At this point the development of the research model yields a framework within which an investigation of the research question could proceed through testing the following set of hypotheses:

Research Hypothesis	Formalized Hypothesis
• the f_1-component of information integration is an antecedent of individual performance.	$a_1 \kappa_1 \rightarrow p$
• the f_2-component of information integration is an antecedent of individual performance.	$a_2 \kappa_2 \rightarrow p$
•	•
•	•

- the f_j-component of information integration is an antecedent of individual performance. $a_j\, \kappa_j \rightarrow p$

• •

• •

- the f_D-component of information integration is an antecedent of individual performance. $a_D\, \kappa_D \rightarrow p$

3.6 INFORMATION INTEGRATION: CAPTURING CONSTRUCT VARIABILITY

Capturing the variability in the indep ndent latent constructs of Exhibit 3.2 required the determination of values for a_j, κ_j, and D. The value of D was an outcome from the process used to identify CSFs and the κ_j's were obtained by having subjects apply a constant-sum-points-distribution to a list of the CSFs. Chapter 4 reports the procedures used in these determinations. The operationalization of a_j required further development of the research model in order to provide the basis for the construction of data collection instrumentation. In the formulation of Equation 3.3, a_j is developed conceptually in terms of the adequacy of the information used by organization members to support task performance vis-a-vis a specific CSF. Some means was sought to operationalize 'adequacy' that would capture the way in which each information integration component would manifest its variability across organizational members.

UIS Research

The search for a convenient and tested scheme of measuring information adequacy led to the literature on user information satisfaction (Gallagher 1974, Pearson 1977, Zmud 1978, Larcker and Lessig 1980, Bailey and Pearson 1983, Ives, Olson and Baroudi 1983, Srinivasan 1985, Iivari 1987, Swanson 1987, and Baroudi and Orlikowski 1988). These reports were reviewed with two contradictory concerns in mind: (1) obtaining a scale that captured the multiple attributes of a_j, and (2) doing so in manner that would not place a high response burden on the study's participants. The second concern becomes greater as the number of CSFs increase. The instrument capturing the multiple attributes of a_j must be applied for each information integration component and (from Exhibit 3.2) there are, in general, D of these components. Thus, it became important to adopt or adapt instrumentation that was highly focussed on a_j's attributes.

The UIS literature provided a selection of potential instruments to capture information adequacy and there was much in the way of conceptual and measurement similarity across various studies. However, three studies constituting a stream of research on the same instrument provided a foundation for extending the research model: (1) the Bailey and Pearson (1983) report on Pearson's (1977) work on the development of a questionnaire to measure "computer user satisfaction," (2) the Ives, Olson, and Baroudi (1983) replication of Pearson's work, and (3) the Baroudi and Orlikowski (1988) test of a "short-form" UIS measurement scheme proposed by the Ives, Olson, and Baroudi study.

Bailey and Pearson (1983) synthesized a 39-scale UIS questionnaire to measure satisfaction "with computer products and services" from the results of three activities: (1) "a review of 22 studies of the computer/user interface," (2) a review by "a set of three data processing professionals," and (3) the use of a "critical incident analysis technique" on 32 subjects in eight organizations. Four to six weeks after the third activity, 29 of the 32 subjects used for the critical incident analysis also completed the final questionnaire. Exhibit 3.3 provides a list of the scales used and the reliability coefficients that resulted. Subjects responded to semantic differential scales with each scale consisting of six items. Each of the six items is a seven-point ordinal response scale anchored at each end by bipolar adjectives. The reliability coefficients were calculated based on four of the six bipolar pairs in each scale. Exhibit 3.4 contains one of the scales as it appeared to respondents.

An Information Product Component of UIS

An examination of Exhibit 3.3 indicates that Pearson's work produced a set of scales that cover a wide range of "factors" related to computer use. While his primary concern was computer products and services, many of the 39 scales are applicable to both these and other aspects of information processing systems, both computer-based and non-computer-based, including the information products of these systems. Selecting scales to focus on an area of concern seems important in view of both the number of scales and the multiple dimensions captured. Bailey and Pearson recognize this and invite those who use the questionnaire to be selective: "For specific applications . . . it is reasonable to remove irrelevant factors and redefine the factors in situation specific terms" [p. 538].

The work represents a fruitful ground for selecting scales to use in extending the research model to include a mechanism for capturing the variability of the information integration components. However, it was not empirically clear from Pearson's work which scales should be selected. Scales concerned with information product were most appropriate but a dimension in this respect did not emerge from Pearson's study. He attempted a factor analysis to confirm unidimensionality of computer user satisfaction construct but the low number of datum points (29 cases) relative to the number of variables did not, and likely could not, reveal a distinct information product dimension. However, an informal content analysis of the scales in Exhibit 3.3 suggested that those referring to "output information" could form such a dimension. Note in particular scales 6, 17, 19, 25, 26, 28, 29, and 36.

EXHIBIT 3.3

Scales for Computer User Satisfaction

Scale Number	Questionnaire Label Presented to Respondents	Reliability Coefficient
1	Relationship with EDP staff	0.93
2	Processing of requests for changes to existing systems	0.85
3	Means of input/output with the EDP center	0.93
4	Interdepartmental competition with the EDP unit	0.75
5	Confidence in Systems	0.98
6	Timeliness of output information	0.92
7	Charge-back method of payment for services	0.94
8	Perceived utility (worth versus cost)	0.97
9	Vendor support of hardware and software	0.90
10	Computer language used to interact with systems	0.98
11	Expectations (expected versus actual level of computer-based support)	0.91
12	Correction of errors	0.87
13	Security of data	0.93
14	Degree of EDP training provided to users	0.98
15	Understanding of systems	0.93
16	Feeling of participation	0.93
17	Currency (up-to-dateness) of output information	0.95
18	Attitude of the EDP staff	0.94
19	Reliability of output information	0.97
20	Top management involvement in EDP activities	0.91
21	Format of output	0.92
22	Response/turnaround time	0.95
23	Determination of priorities for allocation of EDP resources	0.94
24	Convenience of access (to utilize the computer capability)	0.96
25	Relevancy of output information (to intended function)	0.86
26	Volume of output information	0.83
27	Personal job effect resulting from the computer-based support	0.91
28	Accuracy of output information	0.96
29	Precision of output information	0.96
30	Communication with EDP staff	0.97
31	Organizational position of the EDP function	0.81
32	Time required for new systems development	0.93
33	Personal control of EDP service received	0.95
34	Schedule of recurring output products and services	0.95
35	Documentation	0.97
36	Completeness of the output information	0.97
37	Technical competence of the EDP staff	0.96
38	Flexibility of systems	0.97
39	Integration (automated sharing of information) of system databases	0.98

Source: Pearson (1977, pages 155 and 248).

EXHIBIT 3.4

Pearson's Computer User Satisfaction Scale No. 17

17	Currency (up-to-dateness) of the output information

good	:___:___:___:___:___:___:___:	bad
timely	:___:___:___:___:___:___:___:	untimely
adequate	:___:___:___:___:___:___:___:	inadequate
reasonable	:___:___:___:___:___:___:___:	unreasonable
satisfactory	:___:___:___:___:___:___:___:	unsatisfactory

To me, this factor is

important	:___:___:___:___:___:___:___:	unimportant

Source: Pearson (1977, p. 260).

Empirical support for identifying a selection of scales for information product adequacy was found in Ives, Olson, and Baroudi (1983). This article reports on a "replication and extension" of Pearson's work on computer user satisfaction; however, the work had a much greater focus on information and thus moved away, at least in stated emphasis, from Pearson's concern with "computer products and services." The definition used by Ives, Olson and Baroudi keeps computer products and services in the background and increases the prominence of end-use information: "UIS is defined as the extent to which users believe the information system available to them meets their information requirements" [p. 785]. While information requirements appears to be a key concern, these researchers also appear to feel that other "components of UIS" are also important. The methodology they employed supported a factor analytic approach to revealing a multidimensional UIS structure.

Ives et al. performed their factor analysis on the questionnaire responses from a survey of 280 production managers in U. S. manufacturing firms. "Employing a [factor loading] cutoff level of 0.50, a 5-factor structure resulted with 22 scales loading at that level" [p. 789]. Column (3) of Exhibit 3.5 shows the factor loading for items that were substantively interpreted by these authors to constitute an "information product" component. They gave the name "information product" to two of the five emergent structures. The loadings reported for the second information product component are also shown in column (3) of Exhibit 3.5. Only two of the scales load on the second information product component above the study's "cutoff level." The labels for these two scales ("Timeliness" and "Currency") suggest that the second component might be capturing a temporal dimension of information; however, Ives et al. do not make such an interpretation and the low loading levels suggest that considerable caution must be exercised in doing so.

As with Bailey and Pearson (1983), Ives, Olson, and Baroudi also recognized the need "to reduce the time to complete the instrument without losing any of its positive psychometric qualities" [p. 789]. They attempted to do this by eliminating scales and by reducing the number of items per scale. Scale elimination was done by ranking each scale by measures for reliability, content validity, and construct validity. Six scales that ranked poorly in two of the three criteria were removed: scales numbered 4, 7. 9, 10, 13, and 21 on Exhibit 3.3. The number of items per scale was reduced to two by "removing those items within a scale that had the lowest correlations with the other items" [p. 791]. All this produced a UIS instrument with 33 scales each consisting of two items per scale. While this reduction in size would somewhat reduce the instrument's response burden, Ives et al.

EXHIBIT 3.5

UIS Scales - Information Product Component

Scale No.	UIS Scale Label	Ives, Olson, and Baroudi (1983) (n = 280) λ	α	Baroudi and Orlikowski (1988) (n = 358) λ	α	Pearson (1977) (n = 29) α
5	Confidence in Systems	0.61	0.97	N/I	N/I	0.98
6	Timeliness of Output Information		0.91	N/I	N/I	0.92
	- 1st Information Product Factor	(0.47)				
	- 2nd Information Product Factor	0.66				
17	Currency of Output Information		0.95	N/I	N/I	0.95
	- 1st Information Product Factor	0.54				
	- 2nd Information Product Factor	0.50				
19	Reliability of Output Information	0.74	0.95	0.82	0.91	0.97
25	Relevancy of Output Information	0.74	0.94	0.77	0.91	0.86
26	Volume of Output Information	0.56	0.86	N/I	N/I	0.83
28	Accuracy of Output Information	0.80	0.94	0.82	0.89	0.96
29	Precision of Output Information	0.80	0.96	0.82	0.84	0.96
36	Completeness of Output Information	0.70	0.95	0.75	0.93	0.97

N/I indicates a scale not included in this UIS form.

state that "it is still rather long" and go on to briefly propose an even shorter form. Some testing on this latter UIS short form was undertaken; however, the same data sample employed for the first two forms was also used to evaluate the third. As well, the details of the final UIS short form were not disclosed in the article. Disclosure of the final UIS short form instrument and its testing on another sample awaited the work of Baroudi and Orlikowski (1988).

Baroudi and Orlikowski analyzed the responses to the UIS short-form questionnaires that were completed by a total of 358 subjects from 26 different organizations. Thirteen scales make up the questionnaire with each scale consisting of two semantic differential items. Five of the thirteen scales correspond to the information product factor that emerged from the Ives, Olson, and Baroudi study: reliability, relevancy, accuracy, precision, and completeness. UIS short-form scale number 13 (completeness) is shown in Exhibit 3.6 as it appeared to respondents. (Note that the UIS short-form scale number 13 corresponds to UIS long-form scale number 36. See Exhibit 3.3)

The study hypothesized that a three-factor structure would emerge: (1) EDP Staff and Services, (2) Information Product, and (3) Knowledge and Involvement. Factor analysis confirmed the a priori structure: a three-factor solution emerged which accounted for 68% of the total variance. The factor loadings for "Information Product" are provided in column (5) of Exhibit 3.5 along with their associated reliability coefficients (Cronbach's alphas) in column (6). A review of these figures indicates that the Baroudi and Orlikowski results confirm those of the Ives et al. with respect to the existence of a distinct information product component of UIS.

EXHIBIT 3.6

UIS Short-Form Scale No. 13

13 Completeness of the output information

sufficient :__:__:__:__:__:__:__: insufficient

adequate :__:__:__:__:__:__:__: inadequate

Source: Baroudi and Orlikowski (1988, p. 58).

Scale Selection

Although Baroudi and Orlikowski's respondents were employed in organizations which operated in a variety of industrial settings, these authors are careful not to over-generalize their results and suggested that the instrument should be tailored to the specific context in which it will be used:

> It should be borne in mind that the short-form measure in this paper is not a universally applicable and immutable measure. It thus may be appropriate in various circumstances to modify the measure to more adequately reflect the requirements of the specific organization. A means to customize the UIS measure could be redefinition of the factors in specific situation terms. That is, in an attempt to make the questionnaire within the context of a particular organization or information system, scale titles and definitions can be made installation-specific [p. 55].

These authors also recommend, based on feedback from respondents, that "if lack of clarity is likely to be a problem [then] full explanation of the scales be included" [p. 55]. They also suggest that single-item measures would be appropriate and could yield higher levels of validity when there is "no interest in particular areas of content or discontent" [p. 55]. As will be seen in Chapter 4, much of what they recommend is relied upon in construction of the instrumentation used in this research.

The UIS scales that emerged as those capturing the variance in the information product component of UIS were, with modification, used to capture the variance in a_j, the index of deviation used in Equation 3.2 for the adequacy of the set of information utilized by organizational members with respect to the j^{th} CSF. Exhibit 3.7 presents the labels for each along with the definition employed by this study and, as recommended by Baroudi and Orlikowski, shown to respondents. The final column of Exhibit 3.7 contains the definition used by Pearson (1977) and the two later studies (Ives et al. 1983 and Baroudi and Orlikowski 1988). With the exception of UIS scale number 29 (Precision) to be discussed below, all the information product scales were incorporated into the instrument used in this study.

An examination of the factor loadings in Exhibit 3.5 could lead the reader to suspect the validity of Confidence in Systems, Timeliness, and Currency. However, two of the three studies had low ratios of sample size to number of scales (7:1 for Ives, Olson, and Baroudi (1983) and 0.74:1 for Pearson (1988)) while the study by Baroudi and Orlikowski did not include these scales in its UIS form. Thus, there was no strong empirical support for the exclusion of these scales from data collection instrumentation for information product. On the contrary, the substantive interpretation of Ives et al. is relied upon in this study to support the inclusion of these scales.

Exhibit 3.7 reveals that the definitions employed here were modifications of those used by the three UIS studies. Since this study was primarily concerned with information and not with its delivery mechanisms, definitions were modified to reflect this change in emphasis. The word "output" was removed from the definitions for Reliability, Timeliness, Completeness, Accuracy, and Currency. It was felt that in the research context of this study the word "output" was both redundant and held connotations that could restrict study participants in what they might consider to be information (i.e., only computer-based information). For similar reasons, the word "computer-based" was removed from the definition for Volume and the reference to "services" was eliminated from the definition for Relevancy. While Confidence in Systems stills refers to the means of information delivery, it was modified to reflect the focus on information. In addition to the removal of "services," the definition of Relevancy was further modified to improve its comprehensibility to respondents. A similar simplification was made in the definition of Volume.

EXHIBIT 3.7

Manifest Variables for a_j

Label	Definition - This Study	Pearson's "Factor" Definition
Reliability	The consistency and dependability of the information.	The consistency and dependability of the output information.
Timeliness	The availability of the information at a time suitable for its use.	The availability of the output information at a time suitable for its use.
Relevancy	The degree to which the information corresponds to what is needed.	The degree of congruence between what the user wants or requires and what is provided by the information products and services.
Confidence in Systems	Your feeling of assurance or certainty about the means (systems, procedures) by which the information is developed and delivered.	The user's feelings of assurance or certainty about the systems which support him [sic].
Completeness	The comprehensiveness of the content of the information.	The comprehensiveness of the output information content.
Accuracy	The correctness of the information.	The correctness of the output information.
Currency	The age of the information.	The age of the output information.
Volume	The amount of the information that is supplied to you.	The amount of information conveyed to a user from computer-based systems. This is expressed by not only the number of reports or outputs but also by the voluminousness of the output contents.

Source for Column (3): Pearson (1977, pp. 230-232).

A scale called Precision is also contained in the UIS scales for Information Product. (Note scale number 29 on Exhibit 3.5). Pearson defined Precision as "the variability of the output from that which it purports to measure" [p. 231]. The reader will note that "Precision" is missing from the list of manifest variables proposed for a_j shown in Exhibit 3.7. This scale was eliminated for two reasons. First, a careful review of the information product scales led to the conclusion that there is considerable conceptual overlap between Precision and several of the other information product scales, particularly with respect to Relevancy in its modified form and, to a lesser extent, with respect to Accuracy, Currency, and Reliability. Second, the bipolar adjectives used on the two semantic differential scale items in the UIS short-form for Precision were (1) low/high and (2) definite/uncertain. Combining Pearson's definition of Precision with the bipolar adjectives probably leads one to suggest that highly precise information would correspond to *low* variability; however, respondents would probably have provided a score on the *high* end of the differential scale when evaluating information that they would have considered highly precise. A similar situation exists with respect to the second semantic differential item in the UIS short-form and as well as with the two additional items used in the long form: (3) sufficient/insufficient and (4) consistent/inconsistent. Thus, respondent scoring is placed at odds with the definition employed by the research which evaluated both forms of the instrument. This led to difficulty when interpreting the appropriateness of the scale in capturing the variability of information integration components. Consequently, because of the conceptual overlap and the ambiguity of interpretation, a scale for Precision was not included in the instrument used in this study.

3.7 EMPIRICAL VARIABLES AND THEORETICAL CONSTRUCTS

The scales listed in Exhibit 3.7 were used as empirical (or manifest) variables for each a_j which in turn became a factor in the theoretical (or latent) constructs for each component of information integration. Up to now it was not necessary to formally distinguish between 'variable' and 'construct.' However, in what follows it is important to maintain a conceptual demarcation between the two. Nunnally (1978) explains:

> To the extent that a variable is abstract rather than concrete, we speak of it as being a *construct* (italics in original). Such a variable is literally a construct in that it is something that scientists put together from their own imaginations, something that does not exist as a isolated, observable dimension of behavior. A construct represents a hypothesis (usually only half-formed) that a variety of behaviors will correlate with one another in studies of individual differences . . . [p. 96].

The linking "hypothesis" between these two types of variables is variously referred to by such terms as epistemic correlation, epistemic relationship, or correspondence rule (Fornell 1984). Various structural equations analysis techniques allow researchers to model different forms of the linkage between empirical and theoretical variables depending on, among other things, considerations such as the degree of existing theoretical development, the research objective, and whether the manifests are assumed to *cause* the latent or the manifests is assumed to be an *effect* of the latent (Fornell 1984). Considerations in these respects are dealt with later in this chapter and in subsequent chapters; however, as a basis for a more detailed discussion of epistemic relationships, the nature of the correspondence between the potential variability in the manifests and the unobservable variability in the latent construct that these manifests purport to measure should be made explicit.

Correspondence Rules

The linkages between the manifests and their respective a_j are based on hypotheses which posit that higher values for the manifests will be observed whenever an individual is more highly integrated informationally with the j^{th} CSF. In other words, a high level of information integration (which is not directly observable) will cause, or be reflected in, high observed values on the manifest variables. This high information integration level may result from highly-focussed information delivery systems or from the individual's choice of information sources or from some combination of these. The specific manner in which this high level comes about is outside the scope of this study; instead, the concern here is with the manner in which this high level is manifested. The variables listed in Exhibit 3.7 were taken to be indirect observations of an individual's level of information integration. Thus, whenever an individual utilizes an information set in a way that results in a high level of integration the scores recorded for Reliability through Volume should be high. This suggests the following set of correspondence rules for each of the D exogenous latent variables in the model shown in Exhibit 3.2:

C1: Reliability. The higher the level of the f_j-component of information integration, the more consistent and dependable the information set used for CSF_j-related tasks.

C2: Timeliness. The higher the level of the f_j-component of information integration, the better the availability of the information set when needed for CSF_j-related tasks.

C3: Relevancy. The higher the level of the f_j-component of information integration, the better the correspondence between the information set and what is needed for CSF_j-related tasks.

C4: Confidence in Systems. The higher the level of the f_j-component of information integration, the greater the level of assurance or certainty about the means by which the information set for CSF_j-related tasks is developed and delivered.

C5: Completeness. The higher the level of the f_j-component of information integration, the more comprehensive the content of the information set used for CSF_j-related tasks.

C6: Accuracy. The higher the level of the f_j-component of information integration, the greater the correctness of the information set used for CSF_j-related tasks.

C7: Currency. The higher the level of the f_j-component of information integration, the less the age (or the better the "up-to-dateness") of the information set used for CSF_j-related tasks.

C8: Volume. The higher the level of the f_j-component of information integration, the more appropriate the amount of information that forms the information set used for CSF_j-related tasks.

Correspondence rules C1 through C8 were adapted from the definitions of the UIS measures in a straight-forward way: greater levels (of say Relevancy) are indicative of greater levels of information integration. Rule C8 required some change in how the correspondence is stated to reflect that more Volume is not necessarily better than less Volume and that some balance is best. The attempt to assess the extent to which this balance occurs was a concern in the two UIS studies which included Volume. A concern that is more easily seen in the adjective pairs that are used than it is from the definitions given in Exhibit 3.7. These pairs are (1) concise/redundant, (2) sufficient/insufficient, (3) necessary/unnecessary, and (4) reasonable/unreasonable (Pearson 1977, p. 264). Rule C8 incorporates this concern and implies that individuals with a high level of information integration will use an information set in which the amount of information is appropriately balanced between having too little and having too much. Thus Volume scores indicate the extent to which the balance is appropriate with high scores indicating that an individual perceives a good balance and low scores indicating information disintegration due to an inappropriate balance. The latter can occur for two reasons: (1) a high degree of information overload or (2) a high degree of information absence.

A ninth correspondence rule was also proposed. It addresses an individual's overall level of satisfaction with the information set employed for each component of information integration. Its inclusion was motivated by similar inclusions in the studies which developed and tested instruments based on the UIS long-form (Pearson 1977 and Ives et al. 1983). These studies did not employ a separate scale for satisfaction; however, one of the six semantic differential items used in each UIS scale is an adjective pair with satisfactory/unsatisfactory bipolars. Exhibit 3.4 illustrates the manner in which this was done. In this study it was decided that a separate scale for information set satisfaction would be included in the manifests used for each information integration component. Thus, it was proposed that:

C9: Overall Information Satisfaction. The higher the level of the f_j-component of information integration, the greater the level of satisfaction with the information set used for CSF_j-related tasks.

Correspondence rules C1 through C9 link nine indicator variables with a_j. These nine variables must be further transformed to form proxies for the component of information integration that is associated with a_j. From Exhibit 3.2 and Equation 3.7, it can be seen that a_j is combined with κ_j to form the j^{th} component of information integration. Recall from the development of Equation 3.4 that κ_j captures any prioritization or balancing of CSFs. Let ξ_j represent this component. From Exhibit 3.2 it can be seen that ξ_j is defined as:

$$\xi_j = a_j \kappa_j$$

Applying this definition to the correspondence rules for a_j yields a set of indicator (or manifest) variables for ξ_j.[3] This permits essentially the same set of epistemic relationships to be used for ξ_j as those developed above for a_j. Letting R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, and O_j represent the manifests for ξ_j generated from transforming the corresponding manifests for a_j (r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, and o_j) by applying κ_j to the latter, the correspondence rules for the linkage between any ξ_j and its manifests can be stated as:

C1: $\xi_j \rightarrow R_j = \kappa_j r_j$ (Reliability)

C2: $\xi_j \rightarrow T_j = \kappa_j t_j$ (Timeliness)

3 Keep in mind that κ_j is a scalar for each individual within each CSF-component of information integration. As previously mentioned, κ_j was estimated by having subjects apply a constant sum points distribution to a list of CSFs. The details of this procedure are found in Chapter 4.

$$C3:\ \xi_j \rightarrow L_j = \kappa_j\, l_j \qquad \text{(Relevancy)}$$

$$C4:\ \xi_j \rightarrow S_j = \kappa_j\, s_j \qquad \text{(Confidence in Systems)}$$

$$C5:\ \xi_j \rightarrow C_j = \kappa_j\, c_j \qquad \text{(Completeness)}$$

$$C6:\ \xi_j \rightarrow A_j = \kappa_j\, w_j \qquad \text{(Accuracy)}$$

$$C7:\ \xi_j \rightarrow U_j = \kappa_j\, u_j \qquad \text{(Currency)}$$

$$C8:\ \xi_j \rightarrow V_j = \kappa_j\, v_j \qquad \text{(Volume)}$$

$$C9:\ \xi_j \rightarrow O_j = \kappa_j\, o_j \qquad \text{(Overall Information Satisfaction)}$$

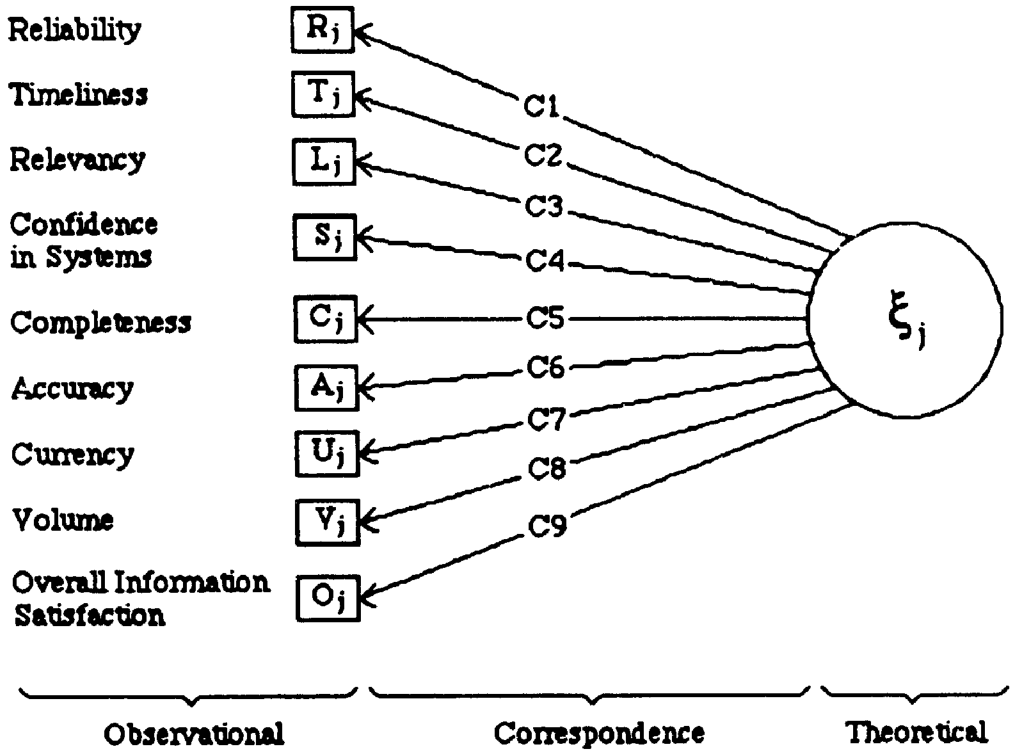
Exhibit 3.8 illustrates how each information integration component of the research model was extended to incorporate the manifests for each ξ_j. Note the observational, correspondence, and unobservational (or theoretical) divisions in the structure of this extension; divisions that are consistent with theory testing methods using structural equations (Bagozzi 1984).

3.8 PERFORMANCE CONSTRUCTS

A similar structure of observational manifests, correspondence rules, and unobservable latent constructs was also developed for performance, the dependent side of the research model. Consistent with this study's primary concern of defining and evaluating the independent constructs, the structure of the dependent constructs was developed on the basis of what was available and meaningful in the research setting and not on the basis of a comprehensive investigation of individual performance in organizational settings. Thus, the generalizability of performance-related results does not extend beyond the organizational setting in which the research took place. Even within the organization, results must be interpreted with caution since the study selected organizational members in a way that maximized observed performance variance. Choosing a sample that is representative of a wider group was not an objective. Consequently, intra-organizational

EXHIBIT 3.8

Observational, Correspondence, and Unobservational Structures
for ξ_j, the j^{th} Information Integration Component



generalizations to the entire group of individuals of the type studied should be made cautiously.

The method of sample selection reflects the research's emphasis on internal validity (i.e., observing the causal relationship) and away from external validity (i.e., generalizing the results beyond the research setting). The primary purpose, then, of the dependent construct is that it permits the formation of a nomological net within which the validity of the independent constructs can be assessed with reference to, inter alia, their relationship to dependent variables that are meaningful proxies for organizational effectiveness. Thus, a view of individual performance is adopted which is consistent with that of Churchill et al. (1985): "Performance is behavior evaluated in terms of its contributions to the goals of the organization" [p. 116]. This allows the theory testing reported in Chapters 5 and 6 to be consistent with conceptual developments in this chapter wherein both ω, individual information integration, and p, individual performance, are derived from Ω, organization information integration and P, organizational performance, respectively. Consequently, manifestations of individual performance which reflect organizational effectiveness are those of primary interest to this research.

Organization-Specific Measures of Performance

The specific manifestations of individual performance of organizational work are generally unique to each organization. However, not all organizations capture, or even can capture, meaningful performance measures. The organization that participated in this study was a particularly valuable research site for three reasons: (1) it captured and retained multiple individual performance measures for a large portion of its work force, (2) its measures of overall effectiveness could be meaningfully associated with the individual performance measures, and (3) it was willing to disclose performance information on the individuals selected for participation in the study.[4] Four performance measures for each individual were forthcoming from the participant organization. Values for each of the four measures were supplied for four time periods: (1) calendar year 1988, (2) calendar year 1989, (3) year-to-date first-half of 1990, and (4) calendar year 1990. Three of these time periods preceded this study and the measures for these periods were used to form the

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4 Qualifying organizations in these respects dramatically restricted the number of organizations and industrial settings that could be considered potential candidates for the research. However, as will be discussed in Chapter 4 considerable observational convenience was realized from conducting the research in such an organization.

observational-correspondence-theoretical structure for the dependent variables. The fourth set of performance measures was used to test the model.

The four performance measures were (1) number of sales (Units), (2) sales credit (Value), (3) membership status in a five-level performance club (Achievement), and (4) persistency of policies sold (Quality). The first performance measure, number of sales, is generally the number of new policies sold; however, certain 'conversions' of existing policies also affect this variable. The second performance measure, sales credit, is derived from sales commissions and 'product weightings' assigned by the organization. Product weights are generally different across products. The third performance measure, achievement-club status level, provides recognition to sales representatives for high sales levels, low rates of policy cancelation, and sales of specific products. There are five status levels with each successive level representing higher performance. Levels were coded 0 through 4. The fourth performance measure, policy persistency, is the portion of policies still in effect one year after placement. The labels Units, Value, Achievement, and Quality were used to refer to the four measures, respectively. Exhibit 3.9 provides selected descriptive statistics on each of the four measures for the 102 individuals who participated in both the pretest and final test phases of the study. The high standard deviation values are artifacts of the subject selection procedure which, as previously mentioned, was designed to maximize performance variation.

Performance Construct Unidimensionality

Initially, the four measures were to be treated as manifests of a single latent construct for performance. To check the validity of treating the manifests in this way, an analysis was done to assess the construct validity of the resultant latent variable. A principal components analysis was undertaken to examine the assumption that the four measures converged on an unidimensional factor. Principal components analysis forms linear

EXHIBIT 3.9

Descriptive Statistics for Pre-Study Values of Performance Manifests

(n = 102)

	Calendar Year 1988		Calendar Year 1989		YTD June 1990	
Measure	Mean	S. D.	Mean	S. D	Mean	S. D.
Units	93	45	94	41	46	22
Value ('000s)	2471	1543	2655	1413	1426	851
Achievement	1.6	1.3	1.8	1.4	1.6	1.4
Quality	87	13	84	10	85	15

combinations of manifest variables wherein successive linear combinations (components) explain progressively smaller portions of total sample variance and all components are uncorrelated (Norusis 1985). Adequate construct validity would be indicated by the extraction of a single linear combination, or factor, with high loadings of the four manifests on that factor.

Exhibit 3.10 presents results from the analyses undertaken separately for each of the three time periods prior to the study. The 'Single Latent Assumption' section provides the results of including all four performance manifests in each analysis. A single factor was extracted in each of the three time periods; however, only three of the four manifests had loadings exceeding the 0.7-level. The same three manifests (Units, Value, and Achievement) load above the 0.7-level in each of the three time periods. Consequently, the derived factor consistently explains the greatest percentage of variance in each of these three. The fourth performance manifest, Quality, loads poorly with the derived factor and does so consistently in each time period. Its low loadings indicate that it has little in common with the other three manifests.

EXHIBIT 3.10

Principal Components Analysis of Performance Construct Assumptions
Using Pre-Study Performance Manifests Values

(n = 102)

	Calendar Year 1988	Calendar Year 1989	YTD June 1990
Single Latent Assumption:			
Units	0.942	0.957	0.954
Value	0.904	0.918	0.915
Achievement	0.888	0.889	0.908
Quality	0.437	0.314	0.372
Percent of Variance	67%	66%	68%
Reliability (Cronbach's α)	0.81	0.72	0.82
Double Latent Assumption:			
Units	0.956	0.970	0.960
Value	0.910	0.924	0.926
Achievement	0.902	0.887	0.917
Percent of Variance	85%	86%	87%
Reliability (Cronbach's α)	0.92	0.92	0.93
Inter-Construct Squared Correlation	8%	4%	6%

Percent-of-Variance figures in Exhibit 3.10 for the 'Single Latent Assumption' indicate that the portion of the total variance of the manifests shared with the construct is very much toward the low side of what would be considered satisfactory in research situations (Hair, Anderson, and Tatham 1987, p. 247). These figures are above 50%, the level that Fornell, Tellis, and Zinkhan (1982) propose is "a reasonable condition for satisfying convergence." At levels above 50%, the variance shared with the construct is greater than the variance due to error. However, the levels obtained here are not indicative of strong construct validity.

Scale reliability figures (Cronbach's α's) were used to obtain an assessment of internal consistency for the performance construct. From Exhibit 3.10, it is seen that the α-values are at levels above what Nunnally (1978) considers acceptable (0.70 represents "modest reliability" [p. 245]). However, two aspects of using α's in this situation should be noted: (1) their determination assumes that the scale items (i.e., the four manifests) weight equally in the scale and (2) "since a reliability coefficient is a correlation coefficient, the size of the reliability coefficient is directly related to the standard deviation of the obtained scores for any sample of subjects" [p. 241]. Loadings on the fourth manifest render the assumption of equal weights suspect and the subject selection procedure (wherein variance is maximized) artificially inflates the observed standard deviation and, consequently, the value determined for each α. Thus, for these two reasons little reliance was placed on the observed α-levels in drawing conclusions about internal consistency.

Performance Construct Multidimensionality

The 'Single Latent Assumption' analysis shows the manifests to be consistent in their levels of convergence on a single factor over time and over time periods of differing length. (Note that the third time period is only half the first two.) This result is suggestive of the sought after unidimensionality; however, the low fourth manifest loadings and the percent-of-variance figures led to some concern about the extent to which unidimensionality is a realistic assumption. This concern was heightened by the consistency of these results across the three different sets of data. These findings combined with a content review of the manifests led to a research decision whereby the assumption of a single latent was abandoned. Serious thought had been given to eliminating the fourth manifest from the scale and, subsequently, from the research model; however, the aspect of performance that it represents is an important one in the organizational context in which the study takes place. Its inclusion in any nomological network that attempts to capture performance is important in maintaining and assessing many aspects of research model validity. Consequently, in the interest of undertaking this investigation with as comprehensive a model as possible, individual performance was posited to consist of two separate components. The first component is associated with the Units, Value, and Achievement manifests while the second is identified with the single Quality manifest.

A substantive interpretation of the results of the principal components analysis produced labels for the two components. The first is labelled 'Performance Quantity' since a strong common theme in the definitions of the three manifests appears to relate to the amount that is produced by the individuals involved. (In the participating organization, 'sales' are referred to as 'production.') The second component was called 'Performance Quality' since its single manifest appears to capture the quality of the business produced by each individual. Recall that this variable refers to policy persistency, the portion of policies that persist (i.e., continue to pay premiums and thereby remain in effect) for one year after placement. From discussions with the organization's management, selling policies that persist means an individual "produces quality business."

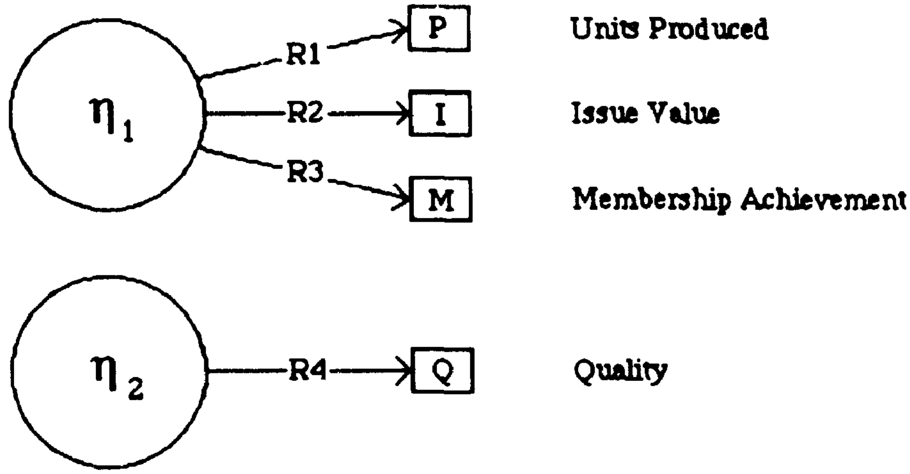
Two Performance Constructs: Validity Issues

An assessment of construct validity similar to that described above was performed on the two constructs for performance. The results are given in the section of Exhibit 3.10 under the sub-heading 'Double Latent Assumption.' Again, a principal components analysis was done for each of the three years but using only the three manifest variables associated with the first performance construct, Performance Quantity. The loadings and the percent-of-variance figures indicate improved levels of convergent validity and this result is consistently obtained in each of the three time periods. The reliability coefficients also improved and in view of the greater equality of the loadings a little more reliance can be placed on them as indicators of internal consistency. However, the subject selection procedure remains the same under both the single and the double latent assumptions, thus coefficient values are still inflated to some extent, although the factor loading pattern is consistent with an observation of high α values. Reliability and loading figures for the second component, Performance Quality, are not shown in Exhibit 3.10. Since this component is tied to only one manifest, the factor loading takes a value of one and the α-value is undefined.

Moving from a single-construct representation of performance to a two-construct representation raises an additional validity issue, that of discriminant validity. This refers to the degree to which a construct is different from other constructs (Fornell, Tellis, and Zinkhan 1982). These authors propose that the criterion for discriminant validity is one whereby the shared variance between any two constructs must be lower than the variance shared between a construct and its measures. The shared variance between Performance Quantity and Performance Quality was determined by squaring the correlation coefficient between the factor scores for Performance Quantity and the raw scores for Quality (the single manifest for Performance Quality). These inter-construct squared correlations are shown on the last line of Exhibit 3.10. The Percent-of-Variance figures in the same section of this exhibit indicate the shared variance between the Performance Quantity construct and its manifests. A comparison of these figures shows that, with respect to Performance Quantity, the construct-to-construct shared variance is substantially lower than the manifests-to-construct shared variance. This result is indicative of strong discriminant validity. The criterion for discriminant validity with respect to the other performance construct, Performance Quality, is also satisfied but this is an artificial result since the loading between a single manifest and its associated construct is 1.0 by definition.

EXHIBIT 3.11

Observational, Correspondence, and Unobservational Structures for the Two Performance Constructs



The foregoing strongly suggests that the two-construct assumption appears to be a better fit with each of the three pre-study performance datasets, datasets which permitted a longitudinal examination of this assumption. An improved level of convergent validity is observed and strong discriminant validity is realized. Exhibit 3.11 illustrates the configuration of these two constructs along with their respective manifest variables and the correspondence rules which link the former with the latter. Consequently, the research model evolved two endogenous constructs for performance: (1) Performance Quantity, denoted by η_1, and (2) Performance Quality, denoted by η_2.

Correspondence Rules

The epistemic relationships between the performance constructs and their respective manifests assume a direction of causality from the construct to the manifests. In other words, the constructs are 'causes' and the manifest are 'effects.' Formally, these relationships are captured in the following correspondence rules:

As an individual's η_1 increases, there will be:

R1: an increase in P, the number of units produced by an individual.

R2: an increase in I, the total value of policies issued by an individual.

R3: an increase in M, the level of membership achievement by an individual.

As η_2 increases, there will be:

R4: an increase in Q, the quality (persistency) of the business produced by an individual.

Thus, all performance manifests are hypothesized to be reflective (and not formative) of their respective underlying constructs.

3.9 SELECTING A STRUCTURAL EQUATIONS METHOD

The previous two sections provided a formal development of the exogenous (independent) constructs, $\xi_1, \ldots, \xi_D$, for information integration and the endogenous (dependent) constructs, η_1 and η_2. This section discusses structural equations methods to link these two groups of constructs in a manner allowing simultaneous testing of both the relationships between exogenous and endogenous constructs as well as the epistemic relationships between each construct and its respective manifest variables. Two prominent methods are compared, LISREL and Partial Least Squares (PLS). For reasons arising from the conditions of the research, PLS was selected as the most appropriate.

General Capabilities

Fornell (1984) refers to structural equation modeling as a "second generation of multivariate analysis" and compares its capability to other, more traditional, multivariate analysis techniques:

> [A] member of the second generation of multivariate analysis . . . has the capability to analyze (1) multiple criterion and predictor variables, (2) unobservable theoretical variables, (3) errors in measurement ..., and (4) confirmatory applications. By confirmatory, it is merely implied that the analyst must make some [emphasis in original] explicit substantive (theoretical) and measurement assumptions or hypotheses that can be tested statistically. While some first generation methods can address one to three of [these] none is well equipped to deal with all four. For example, traditional factor analysis handles unobservable variables but is not confirmatory; multiple regression can be applied in a (weak) confirmatory sense by testing the significance of estimated parameters and the regression equation, but it is limited to a single observable criterion variable [p. 13].

All four capabilities are needed to analyze and test the research model that has been developed: (1) η_1 and η_2 represent multiple criterion variables, (2) ξ_1 through ξ_D as well as η_1 and η_2 are put forth as unobservable theoretical variables, (3) the research setting is one in which an assumption of error-free measurements is unrealistic, and (4) a major objective of the research is to statistically test hypothesized relationships between theoretical constructs (seen in a single dependent construct context in Exhibit 3.2) as well as epistemic relationships between observational and non-observational variables (seen in Exhibits 3.8 and 3.11).

PLS and LISREL

Two approaches to estimating structural equation models have been extensively utilized in social science research: (1) Joreskog's (1967, 1973) Iterative Maximum Likelihood Factor Estimation method, often referred to by the name of an associated computer program called LISREL (Fornell 1983), and (2) Wold's (1982) method of Partial Least Squares. Both approaches analyze latent variable models within the context of hypothesized causal relationships and both operate on the covariance matrix of manifest variables. Also, both are evaluated on, among other things, the extent to which they minimize residual covariance (see Bollen (1989, p. 276) for LISREL and Lohmoller (1989,

p. 55) for PLS). However, PLS and LISREL differ substantially with respect to estimation methods useo and assumptions made about underlying population distributions.

LISREL utilizes Maximum Likelihood (ML) estimation and assumes that the manifests are governed by a joint multivariate normal distribution. ML estimation operates to maximize the probability of the observed data given the hypothesized model. PLS utilizes Least Squares (LS) estimation and requires no assumptions about the distributions which underlie the manifests.[5] PLS estimation operates a series of interdependent ordinary least square regressions in a manner that minimizes residual variances under a fixed point constraint.[6] As a consequence of the different estimation procedures the sample size requirements differ for each approach, with LISREL generally requiring a sample that is much larger than PLS. The objective of LISREL's estimation procedure is maximum parameter accuracy while that for PLS is high prediction accuracy (Wold 1982). In the light of estimation objectives (optimal parameter accuracy versus optimal prediction), assumptions (or lack thereof) and estimation requirements (large versus small sample sizes), the two approaches are more clearly seen, not as competing approaches but instead, as complementary techniques, each having its own appropriate area of applicability.

Many other issues can be raised in the course of comparing LISREL and PLS (e.g., the consequence of under-, just-, and over-identification, the consistency of parameter estimates, and the implication of factor indeterminacy); however, not all are of primary concern here. The major issues, with respect to this study, which affect the decision to use

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[5] This is source of PLS being termed "soft modeling," it was "soft" or undemanding with respect to distributional assumptions (Bookstein 1980, Lohmoller 1989).

[6] Details on the algorithms employed are beyond the scope of this work. Introductions to, and overviews of, the mechanics of PLS can be found in Barclay, Duxbury, and Higgins (1991), and Fornell and Bookstein (1982). More detailed algorithmic expositions can be found in Wold (1982), Dijkstra (1985) and Lohmoller (1989).

either LISREL or PLS are three: (1) the purpose of the research vis-a-vis the computational objective of the technique, (2) the feasibility of obtaining large sample sizes, and (3) prior knowledge of, or willingness to make, assumptions about underlying populations. This study has a primary interest in the existence of latent variables for information integration and the observation of causal relationships within a nomological net; consequently, parameter estimation is an important concern. This favours LISREL. The procedures employed for data collection (described in Chapter 4) are such that a relatively small number of individual cases could be feasibly obtained. Also, the assumption of multivariate normality was not one for which support could be found. Given the extent of research on information integration there is no distributional knowledge for the independent constructs or their manifests. Thus, on the basis of sample size and a priori knowledge of population distributions, the most appropriate structural equations technique is PLS.

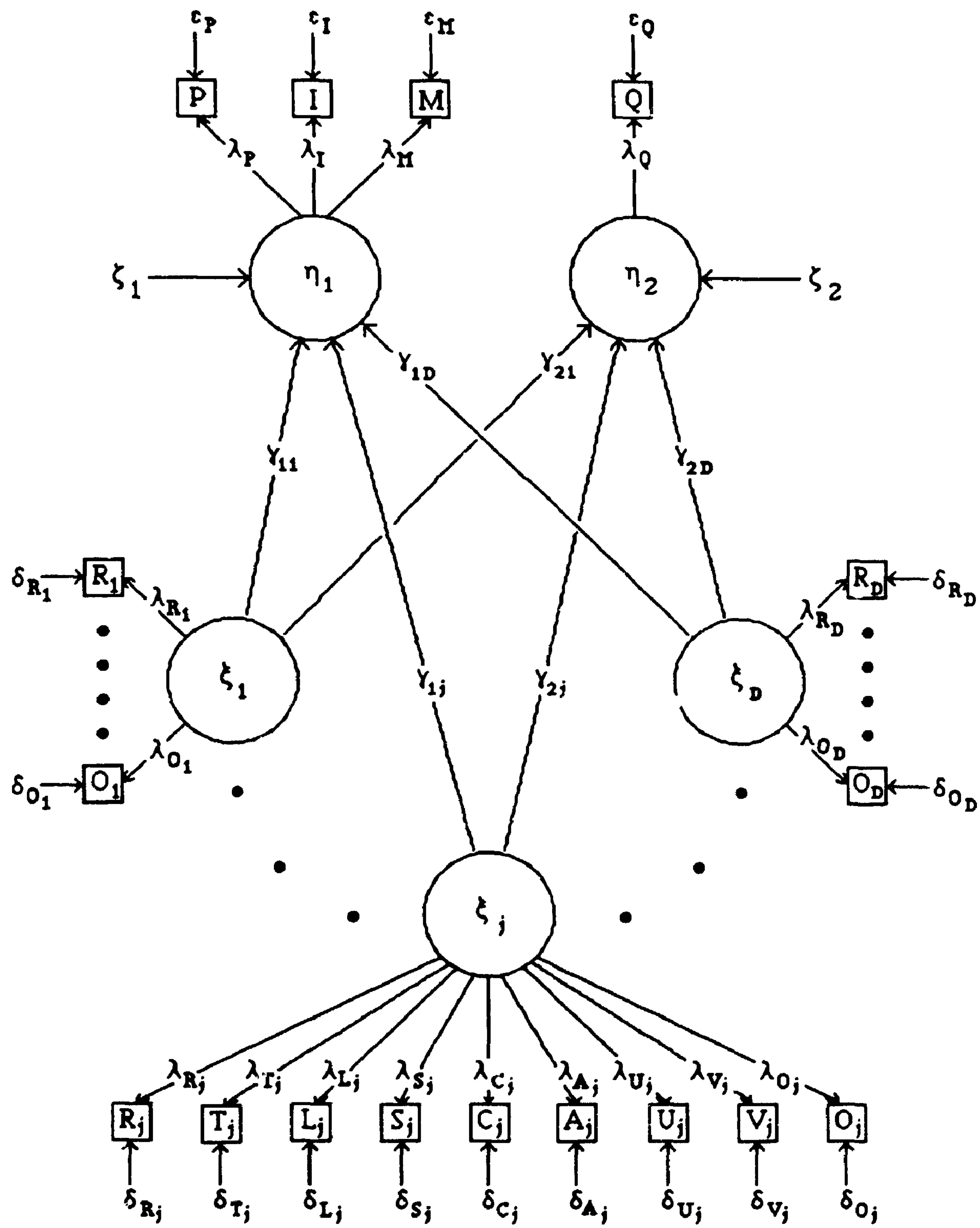
In general, using PLS compromises the accuracy of parameter estimates to pursue its goal of predictive optimality. However, two points should be noted in this respect: (1) PLS parameter estimates will generally approximate those produced by LISREL (Dijkstra 1985) and can be the same under certain conditions (Fornell and Bookstein 1982, Lohmoller and Wold 1982), (2) PLS does not produce improper solutions (e.g., negative variances and/or correlations greater than one) while LISREL's estimation methods can produce such solutions. Thus PLS provides approximate parameter estimates that are more often interpretable than those of LISREL. This is an important feature given the early stage of research. Also, as will be discussed later, PLS was employed in a mode which directed its preoccupation with predictive optimality away from the criterion latents and toward validity assessments of the independent latents. This resulted in an application of PLS that is consistent with a primary concern of this research: assessing the validity of the constructs of information integration.

3.10 PARTIAL LEAST SQUARES REPRESENTATION

The use of Partial Least Squares as a means of testing structural models is not without precedent in information systems research (Rivard and Huff 1988, Pavri 1988, Igbaria 1990, Grant and Higgins 1991, and Thompson, Higgins and Howell 1991). These instances of PLS use have engaged researchers in a process of formulating their research models in terms of two sets of equations: (1) equations for the structural model (often referred to as the inner model) and (2) equations for the measurement model (or outer model). In what follows, these two sets of equations are presented and discussed for the research model to be tested. These equations consolidate the initial structural model (shown in Exhibit 3.2 in its single dependent construct form), the measurement models for each of the D independent constructs of information integration (shown in Exhibit 3.8 for the j^{th} information integration component), and the two performance constructs along with their respective measurements model (shown in Exhibit 3.11). Exhibit 3.12 illustrates the consolidation of the research model along with the parameters of the structural and measurement equations.

EXHIBIT 3.12

Consolidation of Structural and Measurement Models



Structural Model

The general form of the structural equations (the inner model) representing the non-observational linear relationships among the latent variables is given by:

$$B\eta = \Gamma\xi + \zeta \qquad .\ .\ .\ .\ (3.10)$$

where η is an (m x 1) column vector representing the m (= 2) endogenous constructs for performance (note η_1 and η_2 in Exhibit 3.12),

B is an (m x m) coefficient matrix of the effects of the endogenous latent variables among themselves (since there is no path between η_1 and η_2, this matrix is simply a 2 x 2 identity matrix in this case),

ξ is a (D x 1) column vector of the D exogenous constructs for information integration (note $\xi_1, \ldots \xi_j, \ldots, \xi_D$ in Exhibit 3.12),

Γ is an (m x D) coefficient matrix of the effects of the D exogenous latents for information integration on the two endogenous latents for performance (note $\gamma_{11}, \gamma_{12}, \ldots \gamma_{1j}, \gamma_{1j}, \ldots, \gamma_{1D}, \gamma_{2D}$ in Exhibit 3.12), and

ζ is an (m x 1) column vector of residuals, or errors, in the structural equations (note ζ_1 and ζ_2 in Exhibit 3.12).

Presented in scalar equation form, the correspondence between the parameters in the algebraic form of the structural model (Equation 3.10) and their graphical depiction in Exhibit 3.12 is more readily seen. Also, the necessity of determining D, the number of exogenous constructs, is made obvious. Recall that D is, in general, different for each organization, thus its determination awaited the execution of the study' [illegible] collection procedures. (These procedures are the subject of Chapter 4). We have.

$$\eta_1 = \gamma_{11}\,\xi_1 + \ldots + \gamma_{1j}\,\xi_j + \ldots + \gamma_{1D}\,\xi_D + \zeta_1 \quad . \; . \; . \quad (3.11)$$

$$\eta_2 = \gamma_{21}\,\xi_1 + \ldots + \gamma_{2j}\,\xi_j + \ldots + \gamma_{2D}\,\xi_D + \zeta_2 \quad . \; . \; . \quad (3.12)$$

Equations 3.11 and 3.12 represent the research hypotheses contained in Equations 3.7 and 3.8 in a form which facilitates testing of these hypotheses using PLS. The representation above embodies the PLS assumption of linear relationships between dependent and independent constructs. This imposes a linear functional form on the hypothesis that $\omega \rightarrow p$ (Equation 3.8), an imposition for which there is little evidence and, consequently, one which was avoided when Equation 3.8 was being developed. However, this study's realization of statistically significance for all but two of $\gamma_{11}, \gamma_{12}, \ldots \gamma_{1j}, \gamma_{1j}, \ldots, \gamma_{1D}, \gamma_{2D}$ suggests that a linear functional form, at least in the ranges observed, was not an unreasonable assumption.

Measurement Model

In addition to the structural (or inner) model, the measurement (or outer) model must also be formulated. The equations of the measurement model represent the epistemic relationships between the constructs and their respective manifests. PLS provide[illegible] two basic 'modes' in which these relationships can be modeled: reflective mode and formative mode. Manifests subject to construct-manifest relationships that are analyzed in reflective mode are referred to as reflective manifests (or reflective indicators) while manifests subject to construct-manifest relationships that are analyzed in formative mode are referred to as formative manifests (or formative indicators). Generally, manifests are considered reflective when the relationships between them and their respective constructs are argued to be causal with the construct as the *cause* and each manifest as an *effect*. Reflective mode presumes the existence of an underlying unobservable variable which accounts for the variability in its associated manifests. Formative epistemic relationships are fundamentally different. In formative mode, the unobservable variable is conceived of as an effect of its corresponding manifests rather than a cause.

Fornell and Bookstein (1982) comment on the conceptual distinction between reflective and formative modes:

> Indicator mode is . . . shaped by an aspect of the substantive theory behind the model: the way in which the unobservable construct is conceptualized. Constructs such as "personality" or "attitude" are typically viewed as underlying factors that *give rise* to something that is observed. Their indicators tend to be realized, then, as reflective. In contrast, when constructs are conceived as explanatory *combinations* of indicators (such as "population change" or "marketing mix") which are determined by a combination of variables, their indicators should be formative [p. 442, italics in original].

To illustrate the fundamental nature of formative epistemic relationships, these writers briefly expand on the nature of "population change." The variables posited to enter its composition are natality, mortality, and migration. These, conceivably, are not the effects of "population change" but instead determine (i.e., form) "population change."

The distinction between the two modes is more than merely conceptual. This can be seen by the equations comprising the measurement model for each mode. When the epistemic relationships are reflective, the measurement equations are:

$$y = \Lambda_y \eta + \varepsilon \qquad \ldots\ldots (3.13)$$

$$x = \Lambda_x \xi + \delta \qquad \ldots\ldots (3.14)$$

where η and ξ are as previously defined (and consist, for the purpose of this study, of η_1 and η_2 and $\xi_1, \ldots, \xi_D$, respectively, as illustrated in Exhibit 3.12),

$\mathbf{x}$ is an (9D x 1) column vector of 9D measures for the D exogenous constructs of information integration (a vector in which the elements for this study are shown in Exhibit 3.12 as R_1, T_1, L_1, S_1, C_1, A_1, U_1, V_1, O_1 , . . ., R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, O_j, . . ., R_D, T_D, L_D, S_D, C_D, A_D, U_D, V_D, O_D),

Λ_x is an (9D x D) matrix of factor loadings of the 9D information integration manifests on their respective exogenous constructs (a matrix in which the elements, hypothesized to be non-zero in this study, are shown in Exhibit 3.12 as λ_{R_1}, λ_{T_1}, λ_{L_1}, λ_{S_1}, λ_{C_1}, λ_{A_1}, λ_{U_1}, λ_{V_1}, λ_{O_1} , . . ., λ_{R_j}, λ_{T_j}, λ_{L_j}, λ_{S_j}, λ_{C_j}, λ_{A_j}, λ_{U_j}, λ_{V_j}, λ_{O_j} , . . ., λ_{R_D}, λ_{T_D}, λ_{L_D}, λ_{S_D}, λ_{C_D}, λ_{A_D}, λ_{U_D}, λ_{V_D}, λ_{O_D}),

$\mathbf{y}$ is a (p x 1) column vector of the p (= 4) measures for the endogenous performance constructs (a vector in which the elements for this study are shown in Exhibit 3.12 as P, I, M and Q), and

Λ_y is a (p x m) matrix of factor loadings of the four measures for the m (= 2) endogenous performance constructs (a matrix in which the elements, hypothesized to be non-zero in this study, are shown in Exhibit 3.12 as λ_P, λ_I, λ_M and λ_Q), and

ε and δ are (p x 1) and (9D x 1) column vectors of the endogenous and exogenous errors in measurement, respectively.

When the epistemic relationships are formative, the measurement equations become:

$$\eta = \pi_y \, y + \upsilon_y \quad . \; . \; . \; . \quad (3.15)$$

$$\xi = \pi_x \, \mathbf{x} + \upsilon_x \quad . \; . \; . \; . \quad (3.16)$$

where η, ξ, x, and y are as defined above,

π_x is an (9D x D) matrix of regression weights for the 9D manifests in respective association with the D exogenous constructs of information integration (the elements for this matrix are not shown in Exhibit 3.12)[7],

π_y is a (p x m) matrix of regression weights the p (= 4) performance measures in respective association with the m (= 2) the endogenous performance constructs (the elements for this matrix are not shown in Exhibit 3.12), and

υ_x and υ_y are (D x 1) and (m x 1) column vectors, respectively, of inner residuals scores which are assumed to be zero for estimation purposes.

Computational Objectives and Indicator Modes

A comparison of the measurement equations will reveal substantial differences in the estimation procedures between formative and reflective epistemic relationships. The analyst is faced with different computation objectives for each mode. In reflective mode, PLS maximizes variance explained in the set of observed measures in the factor analytic tradition. In formative mode, PLS maximizes variance explained in the structural relationships in a fashion similar to regression, by minimizing residuals in the structural relationships. PLS also accommodates mixed mode models wherein some epistemic relationships are reflective and others are formative. Mixed mode models will generally

7 To be appropriately shown in Exhibit 3.12 the hypothesized non-zero elements of this matrix ($\pi_{R_1}, \ldots, \pi_{O_D}$) must replace ($\lambda_{R_1}, \ldots, \lambda_{O_D}$) and the indicator directions must all be reversed.

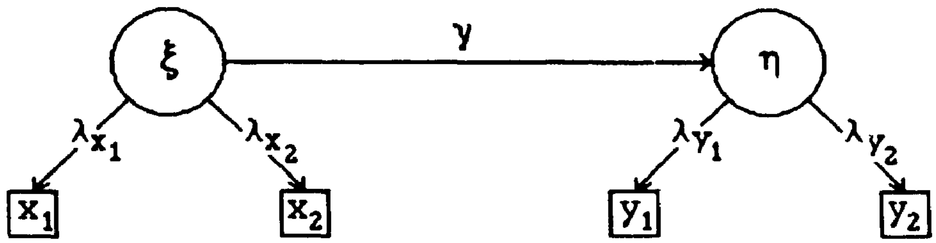
have different computational objectives than models that are either purely formative or purely reflective.

Exhibit 3.13 illustrates the configuration of causal model components for each mode. In Mode A (all reflective), PLS maximizes the variance explained in the manifests (i.e., the λ^2's on both independent and dependent manifests). This is consistent with an intent to explain the variance in the observed variables by way of the unobserved variables. An analysis with this intention could have aspects of construct validity (e.g., convergent validity, discriminant validity) as a primary concern. In this mode, assessments of validity would focus on the λ^2's for both the x's and the y's in the top plate of Exhibit 3.13 (or, the squared values of λ_{R_j} through λ_{O_j} and λ_P, λ_I, λ_M, and λ_Q of Exhibit 3.12).

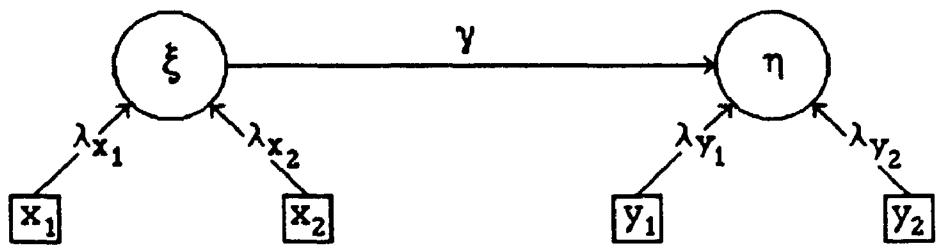
In Mode B (all formative), PLS minimizes the residuals in the inner model. This is consistent with an intent to explain the variance in dependent constructs by way of the independent constructs. Since the inter-construct relationships are the primary concern in this mode, an analysis with this intent could be preoccupied with internal validity (or nomological validity in the sense proposed by Fornell, Tellis, and Zinkhan (1982)). In this mode, an assessment of validity would focus on the γ of the middle plate of Exhibit 3.13 (or, after indicator redirection, γ_{11}, γ_{12}, . . . γ_{1j}, γ_{1j}, . . ., γ_{1D}, γ_{2D} of Exhibit 3.12).

EXHIBIT 3.13

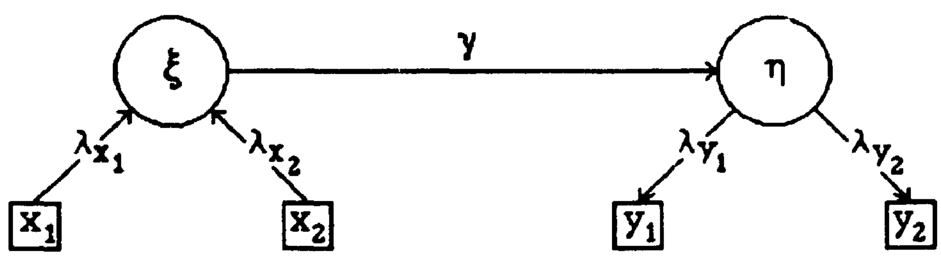
Alternative Epistemic Relationships



Mode A: Reflective Indicators



Mode B: Formative Indicators



Mode C: Formative Exogenous Indicators and Reflective Endogenous Indicators

Source: Adapted from Fornell and Bookstein (1982, p. 441).

In Mode C, there are many possible epistemic relationship configurations. The configuration shown in Exhibit 3.13 has its exogenous construct in formative mode and its endogenous construct in reflective mode. This particular Mode C configuration would be used when the analyst is interested in explaining the variance in the observed criterion variables by way of the unobservable variables (Fornell and Bookstein 1982).[8] An analysis with this focus could have predictive validity as the primary concern. In this mode, validity assessments would focus on the λ^2's for the y's in Exhibit 3.13 (or, after indicator redirection, the squared values of λ_P, λ_I, λ_M, and λ_Q of Exhibit 3.12).

Choice of Epistemic Relationships

Each PLS epistemic relationship mode will, in general, produce different results. Thus, a choice must be made about which mode is most appropriate based on the overriding concerns of the research. The epistemic relationships for the construct-manifest relationships in this study are reflective. Note the direction of 'causality' between the constructs and their respective manifests in Exhibit 3.12. The primary consideration in making this mode choice was the nature of the construct which underlies the set of manifests associated with that construct. Recall previous discussions in which each manifest was argued to be a reflection of its associated unobservable. Also recall that arguments consistent with the use of reflective epistemic relationships were advanced for both independent and dependent constructs. Thus, the set of the measurement equations utilized for this study consists of Equations (3.13) and (3.14).

The choice of reflective epistemic relationships results in PLS proceeding to maximize the variance explained in the manifests at the expense of both explaining variance in

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8 In models with multiple endogenous and exogenous constructs, this analysis objective is achieved by using formative indicators for all exogenous constructs and reflective indicators for all endogenous constructs.

dependent constructs and explaining variance in the observed criterion variables. This implies that various aspects of construct validity will be the primary concern with internal, nomological, and predictive validity taking second place. Recall from Chapter 1 that this research faces two important tasks: (1) developing measures of information integration that are valid, reliable, and managerially meaningful (i.e., construct validity) and (2) establishing the existence of a relationship between information integration and the performance of individuals with respect to organizational work (i.e., internal validity). The choice of reflective indicators is consistent with the first task; however, this choice will compromise an analysis of results with respect to the second since PLS will not have dependent construct variance explanation as a computational goal. Thus, limits are placed on parameters which evidence internal validity. Consequently, detecting the "existence of the relationship" faces a more stringent test than it would have had to face had formative epistemic relationships been hypothesized for some or all of the antecedent constructs.

3.11 RESEARCH HYPOTHESES

Throughout this chapter many hypotheses have been advanced with each being discussed in different ways and being represented using different notation. The use of different notation was intentional. It clarifies the distinction between the research model represented by equations (3.1) through (3.8) from the PLS model represented by Equations (3.10) through (3.14). The notation used to represent the research model captures theoretical developments without the encumbrance of the notation used in the theory testing technique. The notation used by the research model's PLS representation facilitates theory testing by easing the move from theory building to theory testing, particularly with respect to accessing PLS literature, using PLS software, and interpreting PLS results. To help clarify the correspondence between equivalent representations and to summarize what has been proposed, an inventory of relationships is provided in Exhibits 3.14, 3.15, and 3.16.

These exhibits divide the presentation of hypothesized relationships into three sections: (1) research hypotheses for the structural model, (2) epistemic relationships for the measurement model's antecedent constructs, and (3) epistemic relationships for the measurement model's dependent constructs.

The structural model evolved from that shown in Exhibit 3.2 to subsequently consist of two dependent performance constructs and each of the D information integration constructs is hypothesized to be an antecedent of each of the two. Consequently, there are 2 x D structural model research hypotheses. (Chapter 4 reports that D is 6 for the research site used in this study; thus, 12 structural model hypotheses are proposed.) Each of these hypotheses is presented in Exhibit 3.14 in four forms: words (column 1), research model component (column 2), PLS path representation (column 3), and null hypothesis (column 4). Note that the research model hypothesis representations (column 2) are the same for each type of performance. This reflects the intent of theoretical development. The PLS path representation equations (column 3) and their associated test parameters (column 4) change with each type of performance. This reflects the reality of the organizational setting in which the theory testing takes place. The last hypothesis representation (column 4) in Exhibit 3.14 is the focus of PLS analysis.[9]

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[9] Since PLS is 'distribution free', it was necessary to employ Tukey's Jackknife when testing these hypotheses (Wold 1982). Chapter 6 provides an overview of Jackknifing.

EXHIBIT 3.14

Structural Model Research Hypotheses

Hypothesis	Research Model Component	PLS Path Representation	Null Hypothesis
The f_1-component of information integration is an antecedent of Performance Quantity.	$a_1 \kappa_1 \rightarrow p$	$\xi_1 \rightarrow \eta_1$	$\gamma_{11} = 0$
The f_1-component of information integration is an antecedent of Performance Quality.	$a_1 \kappa_1 \rightarrow p$	$\xi_1 \rightarrow \eta_2$	$\gamma_{21} = 0$
The f_2-component of information integration is an antecedent of Performance Quantity.	$a_2 \kappa_2 \rightarrow p$	$\xi_2 \rightarrow \eta_1$	$\gamma_{12} = 0$
The f_2-component of information integration is an antecedent of Performance Quality.	$a_2 \kappa_2 \rightarrow p$	$\xi_2 \rightarrow \eta_2$	$\gamma_{22} = 0$
	•		
	•		
	•		
The f_j-component of information integration is an antecedent of Performance Quantity.	$a_j \kappa_j \rightarrow p$	$\xi_j \rightarrow \eta_1$	$\gamma_{1j} = 0$
The f_j-component of information integration is an antecedent of Performance Quality.	$a_j \kappa_j \rightarrow p$	$\xi_j \rightarrow \eta_2$	$\gamma_{2j} = 0$
	•		
	•		
	•		
The f_D-component of information integration is an antecedent of Performance Quantity.	$a_D \kappa_D \rightarrow p$	$\xi_D \rightarrow \eta_1$	$\gamma_{1D} = 0$
The f_D-component of information integration is an antecedent of Performance Quality.	$a_D \kappa_D \rightarrow p$	$\xi_D \rightarrow \eta_2$	$\gamma_{2D} = 0$

Exhibit 3.15 shows the hypothesized epistemic relationships for the measurement model associated with the antecedent constructs. From Exhibit 3.12 it can be seen that each of the D antecedent constructs has nine manifests. Consequently, the total number of relationships in this respect is 9 x D (or 54 with D = 6). Since the measurement model has not been paralleled by theoretical development in a manner similar to that for the structural model, each correspondence rule appears in Exhibit 3.15 in only three forms: words (column 1), epistemic relationship (column 2), and test statistic (column 3). Column 1 summarizes the correspondence rules (C1 through C9) developed earlier in this chapter. Column 2 uses "→" to indicate that each epistemic relationship is reflective. Column 3 provides the statistic that is the focus of validity assessment for each epistemic relationship.

Two sets of conditions form the basis for assessing the validity of the epistemic relationships associated with the antecedent constructs:

(1) $\lambda_{X_j} \leq 0.7$, for $j = 1, \ldots, D$ while $X = R, \ldots, O$ and

(2) $\lambda_{X_j} \leq$ all $\lambda^*_{X_j}$, for $j = 1, \ldots, D$ while $X = R, \ldots, O$.

The first set of conditions assesses whether the variance that a manifest shares with its associated construct is greater than the variance due to error. This addresses the issue of convergent validity. The second set of validity conditions tests whether a manifest has a stronger relationship with its associated construct than it does with any other construct. This addresses the issue of discriminant validity. (Note that λ^* designates a cross loading.)

EXHIBIT 3.15

Measurement Model Epistemic Relationships - Antecedent Constructs

Correspondence Rule	Epistemic Relationship	Test Statistic
Increases in the f_1-component of $\omega \rightarrow$ increases in CSF_1's information set reliability.	$\xi_1 \rightarrow R_1$	λ_{R_1}
•	•	•
•	•	•
Increases in the f_1-component of $\omega \rightarrow$ greater overall satisfaction with the CSF_1's information set.	$\xi_1 \rightarrow O_1$	λ_{O_1}
	•	
	•	
	•	
Increases in the f_j-component of $\omega \rightarrow$ increases in CSF_j's information set reliability.	$\xi_j \rightarrow R_j$	λ_{R_j}
Increases in the f_j-component of $\omega \rightarrow$ increases in CSF_j's information set timeliness.	$\xi_j \rightarrow T_j$	λ_{T_j}
Increases in the f_j-component of $\omega \rightarrow$ increases in CSF_j's information set relevancy.	$\xi_j \rightarrow L_j$	λ_{L_j}
Increases in the f_j-component of $\omega \rightarrow$ greater confidence in the systems delivering CSF_j's information set.	$\xi_j \rightarrow S_j$	λ_{S_j}
Increases in the f_j-component of $\omega \rightarrow$ increases in CSF_j's information set completeness.	$\xi_j \rightarrow C_j$	λ_{C_j}
Increases in the f_j-component of $\omega \rightarrow$ increases in CSF_j's information set accuracy.	$\xi_j \rightarrow A_j$	λ_{A_j}
Increases in the f_j-component of $\omega \rightarrow$ increases in CSF_j's information set currency.	$\xi_j \rightarrow U_j$	λ_{U_j}
Increases in the f_j-component of $\omega \rightarrow$ a more appropriate balance in CSF_j's information set volume.	$\xi_j \rightarrow V_j$	λ_{V_j}
Increases in the f_j-component of $\omega \rightarrow$ greater overall satisfaction with the CSF_j's information set.	$\xi_j \rightarrow O_j$	λ_{O_j}
	•	
	•	
	•	
Increases in the f_D-component of $\omega \rightarrow$ increases in CSF_D's information set reliability.	$\xi_L \rightarrow R_D$	λ_{RD}
•	•	•
•	•	•
Increases in the f_D-component of $\omega \rightarrow$ greater overall satisfaction with the CSF_D's information set.	$\xi_D \rightarrow O_D$	λ_{OD}

EXHIBIT 3.16

Measurement Model Epistemic Relationships - Dependent Constructs

Correspondence Rule	Epistemic Relationship	Test Statistic
Increases in Performance Quantity → increases in the number of units produced.	$\eta_1 \rightarrow P$	λ_P
Increases in Performance Quantity → increases in the value of units produced.	$\eta_1 \rightarrow I$	λ_I
Increases in Performance Quantity → increases in the level of achievement recognition.	$\eta_1 \rightarrow M$	λ_M
Increases in Performance Quality → increases in the quality (persistency) of the units produced	$\eta_2 \rightarrow Q$	λ_Q

Exhibit 3.16 presents the hypothesized epistemic relationships for the measurement model of the dependent constructs. As seen in Exhibit 3.12, there are two constructs with a total of four manifests: three manifests are associated with one construct while the other construct is associated with a single manifest. As with the measurement model for the antecedent constructs, each correspondence rule is given in Exhibit 3.16 in three forms: words (column 1), epistemic relationship (column 2), and test statistic (Column 3). Column 1 summarizes the correspondence rules (R1, R2, R3, and R4) discussed previously in this chapter. Column 2's use of "→" designates that all epistemic relationships are reflective. Column 3 provides the statistic that is the focus of validity assessment for each epistemic relationship.

As with the measurement model for the antecedent constructs, testing the epistemic relationships associated with the dependent constructs is primarily concerned with two sets of validity conditions:

(1) λ_P, λ_I, and $\lambda_M \leq 0.7$, and

(2) $\lambda_P \leq$ all λ^*_P, $\lambda_I \leq$ all λ^*_I, and $\lambda_M \leq$ all λ^*_M.

The first set tests the level of shared variance in the hypothesized construct-manifest relationships, and addresses the issue of convergent validity. The second set tests the level of shared variance in all unhypothesized construct-manifest relationships, and addresses the issue of discriminant validity. (Recall that λ^* designates a cross loading.) Note that λ_Q is not included in either of the two sets of validity conditions. Because it is associated with the sole manifest for η_2, λ_Q is defined as one and all its λ^*'s are assumed to be zero. As a consequence of this definition, both the convergent and discriminant conditions for λ_Q are assumed to hold and their statement is unnecessary.

3.12 SUMMARY

Three groups of relationships were generated from the developments reported in this chapter: (1) 2 x D structural relationships for the inner (structural) model linking D antecedent constructs with two dependent constructs, (2) 9 x D epistemic relationships for the outer (measurement) model linking nine manifests with each of the D antecedent constructs, and (3) four epistemic relationships for the outer model wherein three manifests are associated with one of the dependent performance constructs while the fourth is associated the other. In sum, an evaluation of the research model involves the testing of 11 x D + 4 relationships. Chapter 4 reports that D takes a value of six in the organizational setting used for the research, thus the study sought to test a total of 70 relationships: 12 structural relationships and 58 epistemic relationships.

These relationships emerged from the formulation of a structural equations representation of the conceptual model combined with manifest variables in association with their respective latent variables (constructs). The Method of Partial Least Squares (PLS) was selected as the structural equations technique that is used to estimate the parameter values needed for hypothesis testing. PLS estimation is appropriate in circumstances where distributional knowledge is limited and where sample size is small. Both circumstances confront this study.

A fundamental concern is the explanation of variance. PLS can be directed at variance explanation in a number of ways. This chapter described three of these: (1) variance in the dependent construct, (2) variance in the manifests associated with independent constructs, and (3) variance in the criterion manifests. However, a single PLS analysis mode will maximize only one and does so at the expense of all others. Thus, a choice had to be made. For reasons associated with the conceptual nature of constructs, PLS is used with reflective indicators whereby measures are treated as manifestations of their associated construct. This choice of PLS mode directs estimation procedures toward explaining the variance in the manifests by way of their constructs.

The measures for the dependent constructs were selected on the basis of their availability and their directness of association with organizational performance. The measures for the antecedent construct of information integration were adopted and adapted from the research on UIS with modifications appropriate to the conceptual nature of the constructs. Performance measures are organization-specific whereas the measurements of information integration are developed without reference to any organization.

The conceptual model of information integration and performance to be tested at the individual level ($\omega \rightarrow p$) was derived from a parallel conceptual model at the organizational level ($\Omega \rightarrow P$). This latter model was constructed from the assumption that for any competing organization there is a finite number of factors which determine tasks that are critical to successful performance. The model hypothesizes that changes in the level of information utilization vis-a-vis these factors (i.e., the level of information integration) directly affect the performance of organizational work.

The chapter begins with the development of this conceptual model using some highly restrictive assumptions which it subsequently relaxes through successive model reformulations. These reformulations extend the generality of the model and position it to more readily incorporate empirical components. It now remains to assign values to these components. The methods by which this was done are the subject of the next chapter.

CHAPTER 4

RESEARCH METHODOLOGY

The previous chapter closes with the research model needing further specification; the number of independent constructs for information integration remains unknown. Consequently, the specific number of hypotheses remains unknown and this prevents a complete determination of the data base needed for model testing. This chapter describes the methodology used to completely specify the model and then obtain the data needed to perform hypotheses testing and evaluate the research model. This two-phased approach results in a research model that emerges in final form only after the completion of certain data collection procedures. Thus, like the performance measures discussed in the previous chapter, the final testable model had to be customized to the organizational setting before the set of research hypotheses could be completely identified and subsequently tested.

4.1 METHODOLOGICAL AND PROCEDURAL OVERVIEW

The necessity for further research model specification, the requirement to obtain manifestations of information integration, and the use of organization-specific performance measures impose three distinct methodological tasks: (1) determining the value of D and supplying labels for each element of $\{f_1, \ldots, f_D\}$, (2) capturing values for R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, and O_j for each f_j-information integration component and (3) retrieving values for P, I, M, and Q. The first of these was accomplished using a procedure which obtained management group consensus on the names for, and the number of, CSFs; the second was accomplished through the use of highly structured interviews with selected organizational members about their use of information; and, the third drew upon the archives of the participating organization to acquire performance measures for these selected organizational members.

Methodological Tasks

The first task sought labels for the each of the CSFs, labels that were brief (to support efficient instrumentation) yet meaningful in the organizational context (to support effective communication). The importance of the CSF labels to instrument construction and eventual use cannot be underestimated. Subsequent to identification, the labels were incorporated into the protocol used to collect the manifestations of information integration and served as prominent objects of reference when subjects provided responses.

The method used to obtain CSF labels consisted of discussion sessions with a group of senior managers in the participating organization. Labels for each element of $\{f_1, \ldots, f_D\}$ emerged from a series of sessions which elicited successive sets of CSFs that eventually converged on $\{f_1, \ldots, f_D\}$. Because of their importance, the labels were subjected to further validation by a group of organizational members selected from the pool of potential respondents. Label identification and validation also yielded a value for D, the number of CSFs or, equivalently, the number of independent constructs in the structural model. The labels were also used to give names to these constructs that are meaningful in the context of the participating organization. With a value for D and names for each element of $\{f_1, \ldots, f_D\}$, the structural model could be specified in its final organization-specific form. Consequently, all the hypotheses to be tested became known.

The second task sought manifest values for each of the D constructs of information integration for a subset of organizational members. The methodology involved highly structured interviews combined with scale completion to capture the extent of information integration with respect to each element of $\{f_1, \ldots, f_D\}$. The interview sessions involved interviewer-subject interaction interspersed with the completion of consecutive sections of a 'protocol guide' to capture the raw data needed to calculate values for $\{R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, O_j\}$. Subjects were selected for the interviews in a way that resulted in the manifest values for information integration being obtained across various levels of performance.

The third task sought to obtain values for the four indicators of performance (P, I, M, and Q) that are attached to the structural model's two performance constructs. This involved the retrieval of values for the four measures from the participating organization's files on individual performance. This was done for all the subjects interviewed as part of the second methodological task. The performance measures were identified by the participating organization's management on the basis of availability, use in individual feedback and evaluation processes, and directness of association with organizational performance.

Chapter Overview

This chapter details each of the three methodological tasks. Beginning with research site identification, it outlines the criteria used to select organizations in a way that afforded the study a heightened level of observational convenience. It then describes the pursuit of several organizations satisfying these criteria and provides a narrative on the organization that eventually agreed to participate. This narrative includes a description of the group constituting a focal point for investigating the hypothesized relationships. The chapter goes on to outline the identification and validation activities used to construct the final form of the research model. These activities relied on data from two sources: (1) a panel of senior managers who engaged in the identification exercise, and (2) a selection of thirteen individuals within the participating organization's focal group. The second source was engaged to, among other things, validate the findings of the first.

Because of the importance of CSF validation, the chapter gives considerable attention to the results of a pre-test on the thirteen subjects. These results were a critical component in laying the foundation for both final model specification and protocol development. An outline is given of the lessons learned as an initial version of the protocol was developed, used, and extensively revised. This is followed by a detailed review of the final protocol and its approach to capturing the raw data that are subsequently transformed to become the manifest values for information integration. The specifics of this transformation procedure are also reported. The chapter ends with a section on protocol execution, including the specifics of subject selection, a rationale for the use of interviews, the retrieval of performance measures, and the issues and procedures surrounding the maintenance of the confidentiality of the information supplied by subjects during their interviews.

4.2 RESEARCH SITE IDENTIFICATION

The relationships developed in the previous chapter are posited to hold for any organization. However, for reasons of observation convenience, only organizations with specific characteristics were considered to be potential research sites for this investigation. It was felt that if the hypotheses were to find support, this support would most likely be forthcoming from data collected under certain observational conditions (to be subsequently given). Lack of support under such conditions would cast serious doubt upon what is posited. Thus, organizational selectivity provides a strong test when the research hypotheses are weakly supported. At the same time, such selectivity provides a weak test when the research hypotheses are strongly supported. In other words, when the probability of the observation of the relationships is increased and the null hypotheses are not rejected, then strong evidence is provided for the non-existence of what has been propcsed. On the other hand, when the same situation provides results that reject the null hypotheses it may do so for reasons associated with the selection of organizations. This arises from the limited generalizability (external validity) implicit in selecting test sites (i. e., organizations) with certain characteristics. However, in view of the stage of research in this area, a primary concern of the investigation at this point is observing the proposed relationships (internal validity). The deliberate use of research site selectivity reflects an investigative orientation that is primarily concerned with internal validity and secondarily concerned with external validity.

Observational Convenience

Organizational selectivity sought to qualify an organization on the basis of its having a sizable collection of individuals for whom the association between individual and organizational CSFs and the parallel between individual and organizational performance would be as clear as possible. The posited existence for such parallel conditions between individual and organizational levels is a major theme in conceptual developments of the previous chapter. We saw that:

$$\Omega = \frac{\sum_{i=1}^{N} \sum_{j=1}^{D} a_{ij} \kappa_{ij}}{N}$$ is an antecedent of organizational performance, P,

and $$\omega = \sum_{j=1}^{D} a_j \kappa_j$$ is an antecedent of individual performance, p.

where a_j reflects the adequacy of the information set used by an organizational member for CSF_j-related tasks and κ_j captures the importance of CSF_j for that organizational member. Recall that the same set of CSFs (i.e., that for the organization) is used for a basis for defining information integration at both individual and organizational levels. This does not suggest that, in general, there is a convergence of the CSFs for the individual level with the CSFs for the organization but that information integration is defined in terms of the latter and not the former. However, it is suggested that the study is afforded some measure of observational convenience when specific research settings are used where the individual-organizational CSF association is close and where individual performance is not unlike that of the organization.

Many examples of such organizations are found in professional services industries. Stockbrokerage firms, insurance companies, and real estate concerns are examples. These firms commonly consist of a large group of information-using organizational members who directly serve the clientele of their firms and for whom individual performance is qualitatively similar to that of the firm. The performance of a stockbrokerage firm is essentially the sum of the individual performance of each of its stockbrokers. The nature of the revenues for a brokerage firm directly parallels the nature of income for the individual broker. The success of an insurance fir. . is essentially dependent on the success of its agents. The firm's performance is negatively impacted whenever its agents fail to place policies. The firm's failure would directly parallel individual failure in this critical group of organizational members. Consequently, in these organizational settings, factors critical to the success of individuals within a certain group will be closely related to factors critical to the success of the organization. Also, the nature of individual performance within this group will be closely related to that of organizational performance. This study used the term 'target group' to refer to the collection of organizational members for which the existence of these conditions can be reasonably assumed.

Research Site Selection Criteria

The convenience of observing the hypothesized model was thought to be greatest in a target group. Four criteria were used to select organizations with appropriate target groups:

(1) The organization must consist of a large proportion of information-using organizational members for whom the performance measures of the organization would not be substantially different from their own.

(2) The performance of these organizational members must be critical to the overall success of the organization.

(3) The use of information by these critical organizational members is generally an important factor in the successful execution of organizational work.[1]

(4) The number of these information-using critical organizational members is large enough to provide a sample exceeding 10 x D cases (for final hypothesis testing) plus another dozen cases (to pre-test the instrument used to capture measures of information integration and to validate the CSF labels).[2]

Of the many organizations identified on the basis of the criteria given above, a limited number were contacted and actively pursued as potential research sites. Initial contact was made by telephone with descriptive information on the research project being forwarded if the project seemed of interest to the organization. All contacts were senior executives. Appendix 4.1 contains the project information that was forwarded to those expressing an interest in participating along with one of the actual covering letters. The information package summarizes the motivation for the study (the impact of information use on

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[1] Bakos (1987) promises increased levels of observational convenience under such conditions when researchers are investigating information-related and information technology-related constructs and relationships.

[2] The 'ten-times' factor is based on the guideline that ten cases are needed per independent variable in the most complex regression implicit in the PLS equations for the structural and measurement models (Barclay 1987). The use of reflective constructs means that only simple regressions are executed when estimating parameters of the measurement model; thus, the most complex regression takes place in the structural model which consists of D predictor variables.

individual and organizational performance), discusses the specific focus of the research (information integration), identifies the source of financial support for the research (none required from the participating organization), provides a general description of the research procedure (which was later modified as a result of pre-test activities), outlines benefits for the participating organization (an evaluation of the firm's information systems vis-a-vis a critical group of information-using individuals), and gives the general conditions for participation (making available the time of 'target group' individuals and their performance measures). Follow-up telephone conversations were held after the contact received and reviewed the information package in order to assess the level of continued interest in the project.

Four organizations were actively pursued. None refused to participate but project timing presented a problem for some. The first acceptance came from a stockbrokerage firm. The contact was the chief operating officer whose direction of a major systems integration project had been reported in an information systems trade publication (Moad, 1989b). This senior manager was eager to use the project to evaluate the resulting level of integration brought about by the information technology that had been deployed. Approval to proceed was received from the firm's executive committee; however, this approval was subsequently withdrawn when the firm experienced an unexpected ownership change. New management directives resulted in the project being deferred for an indefinite period of time.

The pursuit of other organizations resulted in project acceptance by a major insurance company. Fortunately, this firm saw the project through to the completion of all model specifications and data collection activities. Like the stockbrokerage firm, this company was also undergoing a significant implementation of new and revised information systems and information technology and valued the assessment of information use that would result from the study. Management was particularly interested in such assessments being targeted to the company's sales representatives, a group of information-using individuals critical to the company's overall performance. Consequently, a division of sales representatives in this insurance company became the target group for the research.

The Research Site

One of the two sales divisions of the London Life Insurance Company was the research site for this study. London Life is a major provider of individual life insurance in Canada. According to its 1990 annual report, the firm had insurance in force exceeding $95 billion, supplied $296 million in dividends and net income to policyowners, and received $1.65 billion in premium income together with another $947 million in investment income. The firm's earnings per share for 1990 was $158 with a return on shareholder's equity exceeding 19%. The firm has generally experienced steady growth over the past decade: insurance in force showed an 11% growth rate during those 10 years, while earnings per share grew by 13%, and per share dividends to shareholders grew by 23%. There was evidence that London Life occupied a strong competitive position. Its market share for individual life insurance was around 15%, a level estimated to be twice that of its nearest competitor. It had relationships with more than 1.5 million customers across Canada and had recently received a financial strength rating that placed it among the best financial institutions in the country. London Life consists of over 5,600 employees of which approximately 2,200 worked as sales representatives in one of its two sales divisions. Exhibit 4.1 provides selected figures on the firm's current and past performance.

EXHIBIT 4.1

The London Life Insurance Company
Selected Performance Data

(Dollar amounts are in millions except per share amounts)

	1990 Fiscal Year	10 Year Compounded Growth Rate
Life Insurance Issued	$ 9,558	8.5 %
Life Insurance in Force	95,619	11.1
Premium Income - Individuals	1,080	12.5
Premium Income - Groups	571	9.6
Benefits to Policyowners and Beneficiaries	978	11.6
Dividends and Net Income to Policyowner	296	7.3
Investment Income	947	11.9
Assets Under Administration	11,056	11.1
Number of Employees	5648	2.5
Earnings Per Share	158	13.1
Dividends Per Share	65	23.3

Source: 1990 Annual Report of the London Life Insurance Company.

The head office of London Life is situated in London, Ontario, Canada. The company was founded there in 1874 by a group of local businessmen to offer life insurance and other financial services to southern Ontario. By the turn of the century it had established a dominant position in its home region. During the first two decades of the century it experienced rapid growth, almost doubling in size every five years during the period 1903 to 1918. Strong growth continued through the 20's, 30's, and 40's. By 1949, the value of its assets exceeded $300 million. By 1981, this had grown to over $4.2 billion and by 1990 reached $10.5 billion. From its beginnings in London it has grown into a national operation with almost 200 offices across Canada. Throughout its history, the company has maintained a 'good corporate citizen' profile both locally and nationally. The family of its first president and founding member, Joseph Jeffery, has continued to this day to be involved in the firm. London Life only operates in Canada and takes pride in being a Canadian company. The firm has a reputation for being a good employer, in recent years it has been recognized for its fair hiring and promotion practices and has been reported among the best companies to work for in Canada.

The majority of the sales force at London Life is organized into two divisions: the General Sales Division with over 660 sales representatives and the District Sales Division with about 1,520 sales representatives. The General Sales Division (GSD) serves upper income markets (those with complex insurance needs, multiple income sources, often combined with estate and ownership problems). The District Sales Division (DSD) serves lower and middle income consumers (those with less complicated income sources, limited type of insurance needs, and few estate problems). Each DSD sales representative is responsible for sales in a specific geographic area (his/her district) with emphasis on service in the customer's home. The DSD was selected as the target group for this research.

A comparison of the characteristics of London Life and its DSD with the four criteria for selecting organizations with appropriate target groups for this research indicates that this organization and its DSD meet the requirements to qualify as a research site. First, the DSD represents a group of significant size within the organization. Performance measures for individuals within the DSD are not substantially different from those for the organization. In fact, organizational performance measures such as 'Life Insurance Issued' and 'Life Insurance in Force' (see Exhibit 4.1) have direct links with the individual performance measures of 'Sales Volume', 'Issue Credit' and 'Persistency.' Second, DSD performance is critical to the overall success of the organization. General non-performance in this division would seriously impact the overall performance of London Life. Third, members of the DSD rely heavily on various information sources when prospecting for new leads, tracking existing clients, and maintaining a knowledge of London Life's product line and the product lines of competitors. Four, the number of DSD members (1,520) vastly exceeds the sample size needed for both pre-testing and final testing. Even with a large value for D (greater than 10 say), this target group would easily yield a sample of the required size.

4.3 FINAL MODEL SPECIFICATION

As long as the number of independent constructs remained unknown, there was no basis on which to construct a protocol to collect the manifest values of information integration. Quite simply, the number and nature of CSFs had to be determined before questions about them could be asked. The primary objective of this phase of the research was the production of the protocol that would be used to yield values for hypothesis testing. This could not be accomplished without completing the specification of the research model which, in turn, required the determination of a valid set of CSFs. Developments in Chapter 3 provided the basis to construct scales to capture trait data (i.e., $\{R_j, \ldots, O_j\}$). However, the objects needed for reference by subjects when providing trait values required determination with respect to the specific organizational setting. Consequently, an initial concern of this phase was the determination of D, the number of CSFs (i.e., the objects), and the provision of labels for each element of $\{f_1, \ldots, f_D\}$ (i.e., names for the objects).

The identification and validation of the CSFs involved two activities: (1) initial identification by a group of senior managers in a series of working sessions to elucidate and articulate a complete CSF set, and (2) validation of this set by respondents from the organization's target group during a pre-test of the protocol. The first activity consisted of four working sessions in which a group of senior managers were introduced to CSF concepts generally, discussed them with respect to the competitive context of their own organization specifically, and eventually agreed upon a set of CSFs that they felt were valid. There were five members in the group ranging in rank from upper middle manager to vice-president. The group ultimately identified six CSFs. In the second activity, thirteen members of the target group evaluated the importance of each CSF and were also given an opportunity to add or subtract from the set of CSFs. While importance was found to vary across the six factors, the results of the second activity validated the six factors identified in the first. More details are given on each of the two CSF identification and validation activities in what follows.

CSF Identification Sessions

A total of five sessions took place with the group of senior managers. The first four were held at various times over a month and focussed on the identification of CSFs while the fifth was used to identify performance measures and arrange for their retrieval. The first session was primarily concerned with an orientation to the project: its objectives, how it would proceed, and what immediate and practical use could be made of its results. This included discussions on the notion of information integration and its referent concept of critical success factors. Materials were supplied to group members with respect to both concepts and their interrelatedness: information integration was explained in summary notes developed from preliminary Chapter 3 material, the concept of critical success factors was discussed using excerpts from John Rockart's (1979) article on this topic. Much interaction took place with respect to the concepts involved and the procedures to be employed. As was found by previous researchers (Boynton and Zmud 1984), the concept of critical success factors was easily grasped by the group of managers. The first session ended with a brief discussion on what the organizational CSFs might be. A tentative set was fc d but more for the purpose of illustrating the concepts involved than for the purpose of identifying a valid set.

The second session was almost exclusively concerned with CSF identification. After some further discussion on the notion of CSFs, the session continued in a brainstorming fashion with the group building on the initial set from the previous session. Reference was also made to material on the "four prime sources" of critical success factors: (1) industry structu , (2) competitive strategy, (3) environmental factors, and (4) temporal factors (Rockart 1979). The session proceeded with the researcher listing possible CSFs as they were mentioned by a member of the group. The list was kept on a white board visible to all group members. The session ended with eleven factors identified; however, the group felt that some of the factors related more to individual characteristics than to factors important to the organization.[3] It was felt that another session was required to further refine the CSF set.

The third session began with a review of the eleven factors that had emerged from the second. The problem of confusing factors with individual characteristics was also addressed. One member of the group distributed an article he had obtained and read in the course of his ruminations about CSF identification during the time since the previous meeting. This brief article (Brenner 1990) proved to be extremely useful in making the distinction between critical activities and important individual characteristics. The article

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3 The eleven factors were (1) existing policy owners, (2) prospecting, (3) timely issuance of policy, (4) product knowledge, (5) competitive products, (6) London Life relationship value, (7) communication skills, (8) sales support material, (9) initiative (self-management), (10) training, and (11) results orientation.

contained a list of 6 activities which became the basis for the discussion that ensued.[4] It was felt that these activities could correspond to a generic set of CSFs which could be modified to reflect the organization's specific values, its style of doing business, and its manner of interacting with clients. The group proceeded to reinterpret and modify Brenner's individual-level critical activities to form a revised set of CSFs with an organizational-level focus. Eventually, convergence was reached on six factors: (1) prospecting, (2) service to existing clients, (3) value of the representative's association with the organization, (4) knowledge of the organization's current product offerings, (5) knowledge of the product offerings of competitors, and (6) client needs analysis. There was some concern about the criticality of CSF5 but the group ultimately decided, in view of recent competitive conditions, that it should remain in the set.

A fourth session was held to further review the CSFs and to obtain points of explanation and/or clarification for each CSF label. These points of explanation/clarification were used to further enlighten the researcher on what was meant by each CSF label and to facilitate the researcher's subsequent communication with subjects. Unlike the CSF labels which were developed with an organizational-level orientation in mind, these points were prepared with the goal of maximizing meaningfulness to an individual in the target group. Apart from some change in the phraseology of the CSF labels, they essentially remained unchanged from those proposed in the previous session. Exhibit 4.2 lists these labels along with their corresponding points of explanation/clarification.

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4 The six activities were (1) prospecting, (2) needs analysis, (3) selling and closing, (4) policy service and administration, (5) personal and professional development, and (6) planning and goal setting (Brenner 1990, p. 11).

EXHIBIT 4.2

CSF Labels and Associated Points of Clarification

CSF Label	Points of Clarification
Prospecting	• Locating leads. • Getting an interview under favourable circumstances. • Qualifying potential clients. • Further development of existing clients.
Providing service to existing clients	• Supplying requested information on presently held policies. • Making existing clients aware of legislative changes, new products, options, etc. • Building client relationships: "London Life cares . ." • Policy maintenance: changes re: beneficiary, bank, address, name, etc.
Recognizing the value of being associated with London Life	• Assessing the advantages of staying/associating with London Life. • Determining what London Life does for you and your client.
Maintaining a knowledge of London Life's current products	• Maintaining an awareness of the features and benefits of current products.
Obtaining a knowledge of competitors' products	• Maintaining an awareness of how London Life's products "stack up" against competing products.
Analyzing the needs of clients	• Being familiar with government benefits (CPP, etc.). • Determining dreams/goals. • Matching problems and solutions. • Assessing ability to pay.

Evaluation of the CSFs Identified

A review of the CSFs shown in Exhibit 4.2 may lead the reader to question the validity of these factors as those critical to the overall organization. Several factors appear to have an individual-level focus. This point received considerable attention throughout the four sessions. It seemed reasonable that prospecting (CSF1), providing service (CSF2), obtaining a knowledge of competitors products (CSF5), and analyzing client needs (CSF6) were important at an organizational level. If the organization did not have some function which performed these activities then it would surely face serious competitive consequences. These four factors also seem important to individuals in the target group. This is not surprising since the target group was deliberately created to fulfil these functions on behalf of the organization. Thus, for CSFs 1, 2, 5 and 6 the assumption of a close association between individual-level and organization-level CSFs appears reasonable.

CSFs 3 and 4 might seem like critical factors that are only valid for an individual. However, in an industry that experiences high turnover with the consequent need for training and retraining, these factors are as critical for the organization as they are for the individual. It was thought to be important *to the organization* that members of the target group recognize value in their association with the organization (CSF3) and that they maintain a knowledge of the organization's products (CSF4). Consequently, CSFs 3 and 4 were also taken to be organizational level factors.

Although the CSFs listed in Exhibit 4.2 represent areas of critical importance to the organization, there is no guarantee that they represent all the CSFs of the firm. A firm in the insurance business could potentially have other areas that are of critical concern: no factor in the list of CSFs relates directly to the importance of product innovation or effective capital management. It may be that these (and other factors) are less important than, or are consequences of, those identified. Also, the group that was used to develop the set of CSFs primarily came from sales backgrounds. As well, all were aware that the study's target group consisted of the organization's sales group. These two situations may have biased their view of what is critically important to the organization and what is not. Thus, while the set of CSFs identified has an organizational focus it may not represent the entire set for the organization. Consequently, the levels of integration that were subsequently observed were those with respect to the CSFs identified, which were *assumed* to represent a complete set for the organization.

Pre-Test CSF Validation

Using the CSFs identified by the management group, an initial protocol was developed and tested using thirteen subjects. This protocol consisted of a set of worksheets to be used by subjects during an interview with the researcher. These interviews had three objectives: (1) to identify the information sources used by each subject for CSF-related tasks, (2) to rate these sources with respect to each manifest (R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, and O_j) for each CSF-based component of information integration ($\xi_1, \ldots, \xi_D$), and (3) to obtain importance scores (values for $\kappa_1, \ldots, \kappa_D$) for each of the CSFs (i. e., for each element of $\{f_1, \ldots, f_D\}$). An assessment of the operation of the protocol with respect to the first two objectives resulted in substantial protocol revisions as the pre-test was carried out. These revisions addressed protocol *form* to a much greater extent than protocol *content* and eventually culminated in the protocol guide shown in Appendix 4.2. Much more will be said about this guide in a later section; at this point, our primary concern is the values obtained for $\kappa_1, \ldots, \kappa_D$. In this respect, the initial protocol turned out to be stable enough to provide some assessment of the validity of the CSFs.

Values were captured for $\kappa_1, \ldots, \kappa_D$ by having subjects apply a constant-sum points distribution to a list of the CSFs. Recall from conceptual developments in the previous chapter that the weights, reflecting the importance attached to each element of $\{f_1, \ldots, f_D\}$, were restricted to represent the assumption that any prioritization or balancing of CSFs will be done within the set of CSFs. We saw that:

$$\sum_{j=1}^{D} \kappa_{ij} = 1 \qquad \ldots\ldots \quad (3.5)$$

Exhibit 4.3 shows the section of the protocol used to capture values for $\kappa_1, \ldots, \kappa_D$. Subjects distributed 100 points across the six factors in a way that reflected the importance to them of each factor. Subjects were given the opportunity to add other factors that they thought should be in the list with the proviso that whenever a factor is added, points must be subtracted from the importance assigned to one or more factors already in the list and reassigned to the additional factor or factors.

Exhibit 4.3 shows the term 'job aspects' being used instead of 'critical success factors.' It was felt that referring to CSFs as 'important job aspects' afforded two advantages: (1) it reduced interview time by the amount needed to explain the concept of critical success factors (the term 'job aspect' needed almost no explanation), and (2) the issue of 'successful competitive performance' was avoided, which would not have been the case had an explanation of the concept of critical success factors been necessary. A discussion of critical factors for successful performance would have undoubtedly been intimidating for some subjects who might have interpreted the interview as a thinly disguised performance evaluation. In fact, some subjects were openly suspicious in precisely this way.

EXHIBIT 4.3

Interview Protocol Segment Used to Capture Estimates for $\kappa_1, \ldots, \kappa_6$

The Relative Importance of Job Aspects

Please indicate the relative importance of each of the job aspects by supplying a number between 0 and 100 in the space provided below. Ensure that the sum of the numbers comes to 100.

	Importance
1. Prospecting	______
2. Providing service to existing clients	______
3. Recognizing the value of being associated with London Life	______
4. Maintaining a knowledge of London Life's current products	______
5. Obtaining a knowledge of competitors' products	______
6. Analyzing the needs of clients	______
Other job aspects: (Name as many as you like.)	
______________________________	______
______________________________	______
Total	100

Exhibit 4.4 presents results from the pretest for the segment of the protocol used to capture values assigned to job aspect importance. When reviewing this exhibit, the reader may wish to keep in mind that a score of 16.7 would result when all job aspects are rated equally *and* when none other than the six job aspects are rated. The figures in Exhibit 4.4 suggest the existence of considerable variance both within and across job aspects.

Prospecting (CSF1) was rated highest with a mean importance score of 38.5. It also has the largest range: 25 to 75. Mean importance scores for Service (CSF2) and Needs Analysis (CSF6) indicate that these job aspect are above 'average' in importance (i.e., above 16.7). The ranges for these also indicate considerable variability in their importance. The low mean importance scores observed for CSF3 (Relationship Value), CSF4 (Product Knowledge) and CSF5 (Competitor Products) could lead one to suspect their criticality; however, the upper end of the range for two of these (CSFs 3 and 4) suggest that they are of some importance to certain members of the target group. CSF5 displayed both a low mean and a low range, although none of the thirteen respondents considered it completely unimportant (i.e., no one responded with a score of zero). Interestingly, this result supported the suspicions of the group of senior managers about the criticality of CSF5.

Only one of the thirteen subjects added another job aspect to the original list. This subject supplied the label "Solving the needs of clients" and assigned it an importance score of 25.[5] Subsequent discussions about this additional job aspect led the subject to suggest that the additional factor was probably subsumed under CSF6 since one of the points of clarification/explanation for CSF6 was "matching problems with solutions" (see Exhibit 4.1). Thus, with this single exception (which actually may not be an exception at all), no other additional job aspects were identified.

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[5] The mean importance score for "other" in Exhibit 4.4 was consequently computed on the basis of 12 scores with zero values and 1 score with with a value of 25.

EXHIBIT 4.4

Pre-Test Estimates for $\kappa_1, \ldots, \kappa_6$

(N = 13)

Job Aspect	κ	Mean	Standard Deviation	Minimum	Maximum
Prospecting	κ_1	38.5	15.6	25	75
Service	κ_2	19.0	7.8	5	30
Relationship Value	κ_3	6.5	4.1	2	15
Product Knowledge	κ_4	10.0	5.7	2	20
Competitor Products	κ_5	3.5	1.6	1	5
Needs Analysis	κ_6	20.6	6.7	12	40
Other		1.9	6.9	0	25
	Total	100.0			

Two concerns about the validity of the set of CSFs were raised after a review of the pre-test results: (1) the existence of an additional factor and (2) the criticality of CSF5 (obtaining a knowledge of competitors' products). These concerns were discussed with members of the management group. It was decided that the additional factor suggested by one of the pretest subjects would not be treated as a separate factor. It would be subsumed under CSF6 and merely remain referred to in the list of explanations/clarifications associated with CSF6. This action would likely be one with which the subject providing the response would agree. The issue of CSF5 criticality was considerably more contentious.

There was little doubt about the general importance of CSF5, the organization needed to know how its products stacked up against the offerings of its competitors. The issue was whether CSF5 was *critically* important. The organization preferred to appeal to its customers on the basis of its institutional attributes large, stable, Canadian, reputable, etc. It had also achieved some recent success by appealing to customers on the basis of advertising that portrayed a vision of how the customer might see his/her future and then backed this advertising with a selection of products and financial instruments that could be configured for each customer. Consequently, competing against specific products was not a major strategic thrust.

However, competitive conditions had recently been changing. Therein lay the uneasiness with eliminating CSF5. Competitors in niche markets were making gains at the organization's expense. Customers were confronting the firm's sales representatives with competing policies that appeared to be far more attractive. Many customers intended to replace the firm's policies with those of competitors, and many actually did. Against this background, it seemed critically important to know about competing policies and to be prepared to respond effectively to customer concerns. Consequently, obtaining a knowledge of the product offerings of competitors appeared to be of great importance to successful performance. With this in mind, it was decided that CSF5 would remain on the critical list, at least for the time being.[6]

In view of the low number of subjects used in the pre-test, no statistical conclusions could be drawn about the validity of the factors. However, the pre-test findings combined with the group working sessions for initial CSF identification provides considerable face validity for the set of six CSFs. This is also bolstered by the selection of pre-test subjects

6 This CSF appears to fit the temporal classification of Rockart's prime CSF sources.

across the organization's five achievement classifications: two pre-test subjects were in the top two classifications, seven were in the middle two classifications, and four were in the lowest. It should also be noted that the interviews in which the scores were obtained lasted from one to three hours. As will be seen in later discussions on the protocol employed, the six job aspects were major interview themes. This resulted in subjects engaging in an in depth consideration of the six aspects for some time prior to their giving estimates for κ_1 through κ_6.

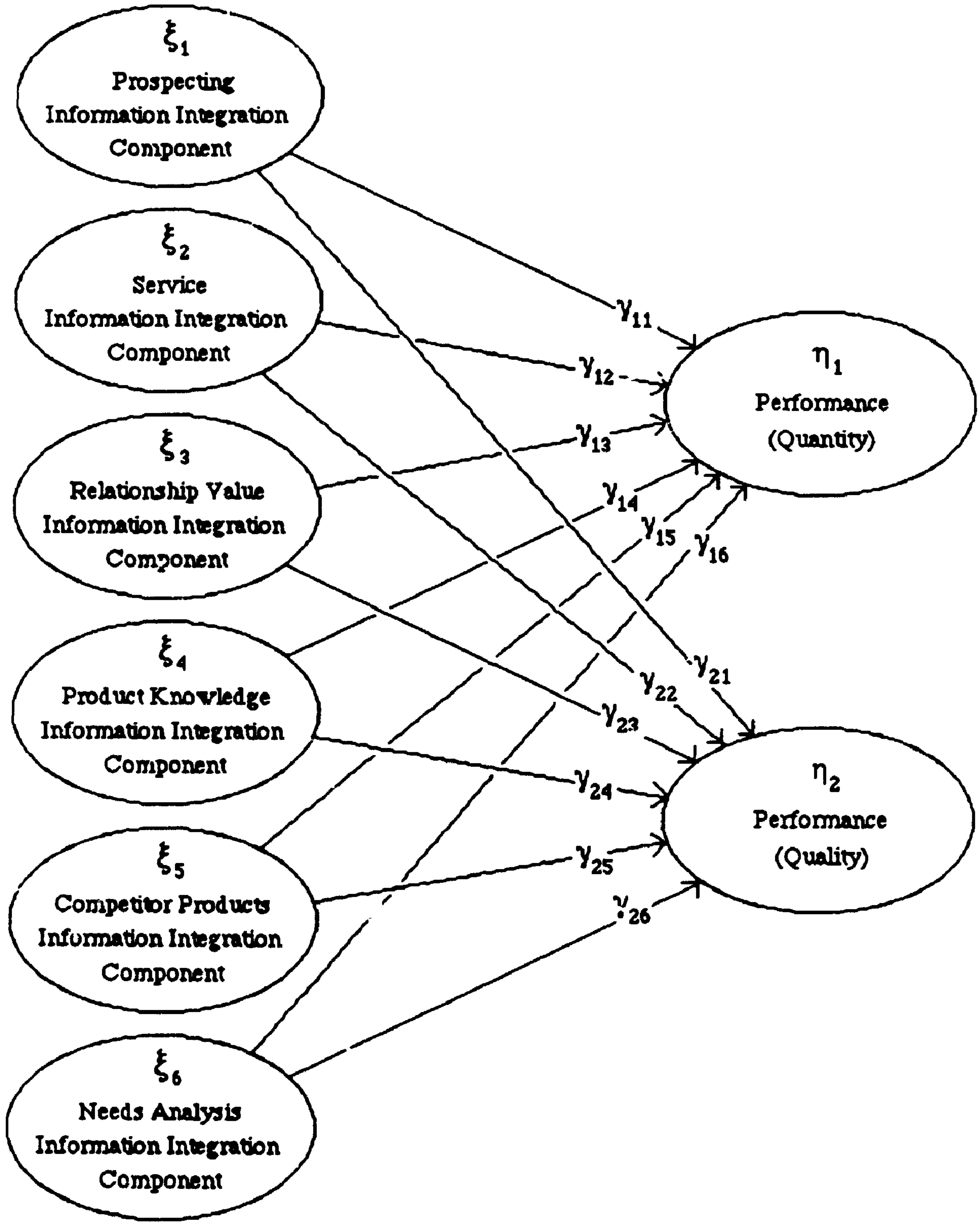
Model Specification Completion

On the basis of results from the two activities for the identification and validation of the set of CSFs, D was assigned a value of six and the job aspects were taken to be CSF labels. As a consequence, the specification of the model to be tested could be completed. Specific names were given to each of the D (= 6) independent constructs. Thus, the f_1-component of information integration became known as the Prospecting Component of Information Integration, the f_2-component of information integration was named the Service Component of Information Integration, and so on. Exhibit 4.5 illustrates all six information integration components in latent variable form within a structural model The twelve (2 x D) structural relationships to be tested are also shown in this exhibit.

Knowing the value for D permitted the set of structural equations to be completely determined. These were derived by setting D = 6 in Equations (3.11) and (3.12). The set of structural model hypotheses along with hypothesis statements and test parameters were derived from Exhibit 3.14 by setting D = 6 and substituting elements from {Prospecting, Service, ..., Needs Analysis} for corresponding elements of $\{f_1, \ldots, f_D\}$. The same substitutions were also made to the content of Exhibit 3.15 to produce a set of antecedent measurement model correspondence rules. In sum, D = 6 yielded 12 structural hypotheses and 54 antecedent construct correspondence rules.

EXHIBIT 4.5

Structural Model to be Tested



4.4 PROTOCOL DEVELOPMENT

The pre-test employed a trial protocol to obtain the data needed to calculate manifest values for the six independent constructs. Protocol execution took place in an interview with each of the 13 pretest subjects. The interview consisted of five different tasks arranged into a sequence of 20 activities. The first task involved an orientation to the research project and its purpose. This included an overview of the six job aspects, an assurance of confidentiality of responses, as well as a discussion of any questions or concerns raised by the subject. In the second task, a job aspect (e.g., 'Prospecting') was discussed in terms of how the subject operationally deals with that aspect. Third, a written list was prepared of all information sources used for the job aspect discussed in the previous step. Fourth, a set of nine information evaluation scales was completed on the information sources vis-a-vis their associated job aspect. Tasks two, three, and four were repeated for each of the remaining five CSFs. In the fifth and final task, subjects provided importance ratings for each of the six job aspects. (Results in this respect are presented in Exhibit 4.4.) Throughout the 20 activities, subjects completed a series of worksheets organized around the six job aspects. Subjects were encouraged to provide feedback on any or all aspects of protocol execution.

As the pre-test was carried out adjustments were made to various aspects of the trial protocol. Some of the initial interviews lasted almost three hours. Continuing with such a time consuming protocol was unacceptable. This would have resulted in excessive interference with the productivity of those on whom measurements were sought. Also, use of such a protocol on a large scale would not be feasible in terms of the time required to complete a sufficient number of interviews to adequately test the research hypotheses. Consequently, protocol changes were made as the pre-test was being done. The general procedure appeared appropriate in spite of its consisting of 20 activities; however, certain aspects of the worksheets and specific procedural details seemed to be the source of excessive time consumption.

Analysis of Pre-Test Protocol Operation

Three aspects of the protocol appeared to slow interview progress. The first and most significant of these was the identification of information sources. The requirement to identify *all* items in the group of information sources used for each aspect engaged subjects in excessive introspection about what was used. Also, as the list lengthened, seemingly unproductive discussion was held about whether something that had been identified would even be appropriately considered a source of information. Subjects appeared to feel that the researcher was desirous of obtaining a very long list of information sources and they seemed determined to deliver it. As information source identification came to light as a major time consumer, the interviewer probed subjects on what they considered to be the most important sources. Subjects may have listed as many as 12 sources; however, discussions revealed that only about two or three usually accounted for the vast majority of information that was actually used.

The second aspect impeding interview progress was the use of seven-point semantic differential scales to capture values assessing the information sources as a group in relation to their associated job aspects. Subjects often took some time to choose between two adjacent positions on a scale and sometimes asked if they could indicate a point between two positions. Rating the information sources as a group appeared to compound this problem. This arose because the intra-group variation (in the quality of the information sources used) required subjects to take the time to mentally balance sources of varying quality while simultaneously deciding how they weighted in importance.[7] The result of this process then had to be placed on the seven-point scale.

The third aspect appeared to be the general organization of the worksheets. These were supplied to the subject as separate worksheets while the session proceeded through its 20 activities. Since the same source was often used in more than one job aspect, subjects would frequently refer back to previously completed worksheets to recall information sources, often in an effort to be consistent in the nomenclature used for each source.[8] Another important point of organization was keeping the job aspects in view while their associated information sources were being evaluated. The initial form of the protocol worksheets clearly needed improvement in this respect.

Protocol Revision

As the pretest interviews were taking place, the protocol evolved through three versions in order to reduce the total time required for an interview. The final version of the protocol operated in a little over an hour. This was the result of its being revised in several significant respects:

(1) The identification of all information sources was no longer sought. Subjects were asked to list as many as they wanted to; however. a maximum of three information sources would be required for detailed evaluation. This revision was combined with a question on the portion that the three sources represented of all

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7 The reader should differentiate between this importance factor and the importance scores discussed previously. Here the concern is with the importance of an individual information source to task performance by the subject in respect of the job aspect for which it is being used. The importance scores previously discussed refer to the importance of the job aspect to the subject.

8 The consistency of nomenclature was not absolutely essential to generation of the manifest values needed for hypotheses testing; however, consistency in this respect dramatically improved the usefulness of the data to the participating organization.

the information sources used by the subject with respect to the job aspect being addressed. These figures were used to assess the extent of the loss caused by the three-source limitation.

(2) Limiting the number of information sources to three for each job aspect made it feasible to obtain measures for each individual source. This eliminated the need for subjects to think in terms of the entire group of information sources for the job aspect when providing a score. To further ease the mental burden, the revised protocol asked subjects to supply importance scores for each of the three information sources. This transferred the task of weighting the importance of the sources from the subject to the software used for data analysis.

(3) The seven-point semantic differential scales were abandoned in favour of graphic positioning scales anchored at seven locations. This minimized the response hesitancy observed when subjects pondered which of two adjacent points they would choose on the seven-point scale. While the use of graphic positioning dramatically increased the time and expense of capturing data, it appeared to considerably reduce the response time of subjects. More will be said on the use of graphic positioning in what follows.

(4) The series of worksheets was consolidated into (what came to be referred to as) a 'protocol booklet.' This booklet (partially shown in Appendix 4.2) consisted of separate and clearly marked sections for each job aspect. It was bound in such a way that pages were easily turned and job aspect sections are delineated with prominent tabs. A colour scheme was chosen for the booklet's cover and for its section tabs that created an attractive, professional appearance. A system of windows was used to minimize the amount of transcription required of subjects. These windows also kept the information sources identified by subjects in close

visual proximity to the job aspect for which the sources were used. The number of pages confronting the subject dramatically increased from about 20 to over 70. However, the improved clarity allowed subjects to proceed much more quickly and with an apparent reduction in frustration.

As a result of the revisions, the interview protocol became more focussed on the booklet. In fact, the booklet was ultimately structured as a guide for the entire interview. Instead of the interviewer supplying worksheets for scale completion at various points in the interview, the subject received the booklet as the interview began and used it as workbook to make lists and record responses throughout the whole session.

Protocol Booklet Structure

The protocol booklet was structured around the 20 activities included in an interview session. It was titled "Interview Guide and Questionnaire Booklet." Appendix 4.2 shows each of its 70 pages. The booklet contains eight sections: an introductory section, six job aspect sections, and a final section to obtain ratings of the relative importance of each job aspect.

Introductory Section: This section is made up of pages 1, 2, and 3 of the protocol booklet. The content of these pages was used to guide discussions on the purpose of the research, where and by whom the project was being operated, and what organizations were providing resources to support it. This section was also used to give an overview of the six job aspects and the organization of the booklet. The list of CSF explanations/clarifications (shown in Exhibit 4.2) was provided in this section as well. This list guided the interviewer's explanation of the job aspects. Blank lines were provided if subjects wished to add further points of explanation.

<u>Job Aspect Sections</u>: There are six of these, one for each aspect. Each of the six sections consists of eleven pages. Each page has the job aspect prominently displayed at the top. Every page in each section has a specific purpose:

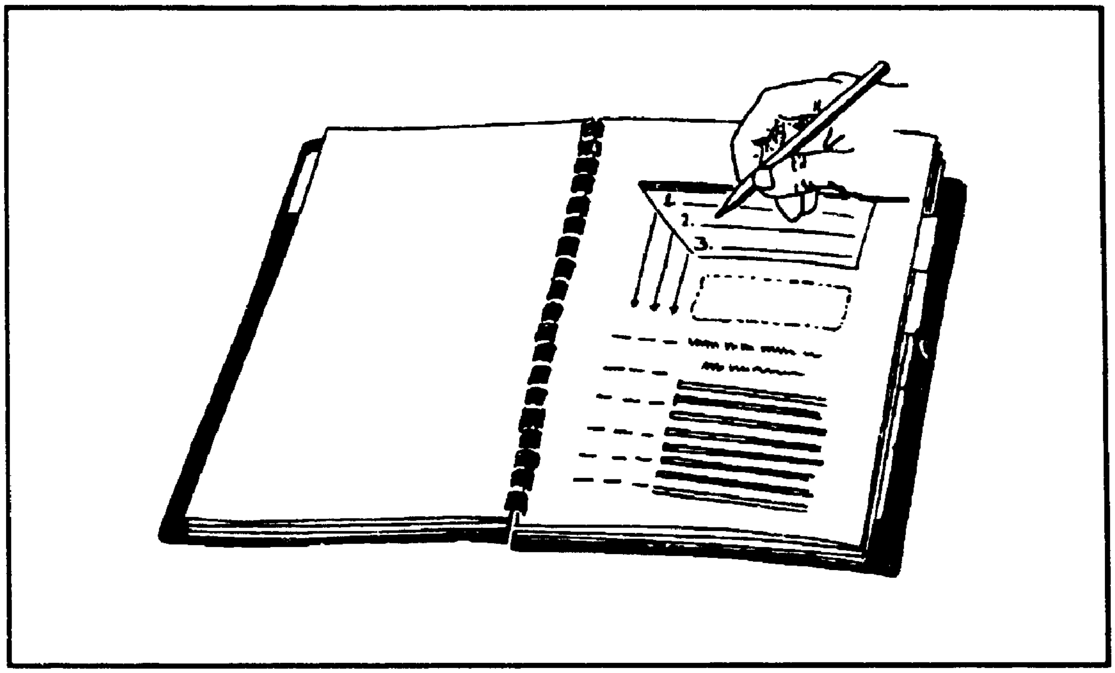
Page 1: This page provides a workspace for subjects to list the different information units used for tasks in respect of the job aspect being addressed. One of the six page 1's can be seen on page 4 of the protocol booklet shown in Appendix 4.2. The purpose of this page is to get subjects thinking about the information sources they use without being concerned about the importance of these sources or how they (the sources) will be evaluated. The term 'Information Units' appears on every 'page 1'. An 'Information Unit' refers to an identifiable and demarcatable information source that the subject actually uses for the job aspect in question.

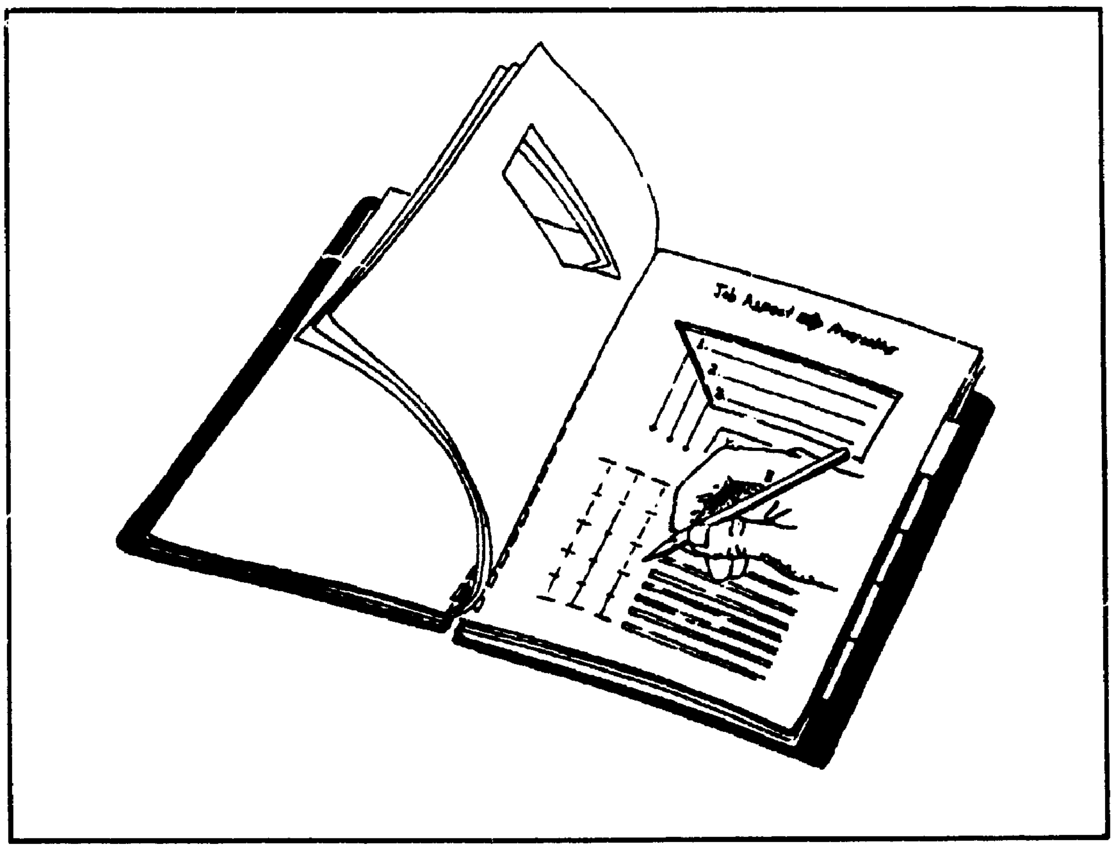
Page 1 corresponds to protocol booklet page number 4 (for Prospecting), number 14 (for Service), number 26 (for Relationship Value), number 37 (for Product Knowledge), number 48 (for Competitor Products), and number 59 (for Needs Analysis).

Page 2: When a subject turns to page 2, he/she is asked to select the three most importance information units listed on page 1. These three (or a lesser number if fewer than three have been listed on page 1) are transcribed to the window on page 2. When this is being done the subject is actually writing on the eleventh page of the section. This is because of a trapezoidal-shaped window cut through pages 2 through 10 which permits the subject's responses to be visually available to page 2. The same is true for pages 3 through 10. Exhibit 4.6 shows the window position and illustrates the role of the window in minimizing transcription and in keeping the information sources in close visual proximity to their associated job aspect.

EXHIBIT 4.6

Protocol Booklet Window Operation





The primary purpose of page 2 is capturing the relative importance of each of the (up-to-three) information units. A scale is provided for responses in this respect on page 2 just below the window. Exhibit 4.7 illustrates the manner in which subjects were instructed to use this scale to record the relative importance of the information units and to associate these responses with each source. This scale was designed to minimize a subject's tendency to list the information units in the window in order of their importance, something which became apparent as a time consumer in a previous version of the protocol. A second scale is also included on page 2. It sought responses about how often each unit is used for the job aspect at the top of the page. These responses were not used for hypotheses testing. This scale was included to enhance the value of the results to the participating organization.

Page 2 corresponds to protocol booklet page number 5 (for Prospecting), number 15 (for Service), number 27 (for Relationship Value), number 38 (for Product Knowledge), number 49 (for Competitor Products), and number 60 (for Needs Analysis).

EXHIBIT 4.7

Scale to Capture Values for the

Relative Importance of Information Units

($ui_{1,j}$, $ui_{2,j}$, and $ui_{3,j}$)

The most important information units that you use for this job aspect:

1. 'Information Unit 1'
2. 'Information Unit 2'
3. 'Information Unit 3'

Relative Importance of Information Units

Indicate the relative importance of each information unit listed above for this job aspect. Draw a vertical mark on the scale below and place the information unit number next to your mark.

1 3 2

NOT VERY IMPORTANT |---|---|---|---|---|---| **VERY IMPORTANT**

1 2 3 4 5 6 7

Page 3: The purpose of this page is capturing responses for the individual information units which (when combined with the importance responses from page 2) yield a subject's manifest scores for r_j. Recall from Chapter 3 that r_j is an indicator variable for a_j, the information product quality component of the latent variable, ξ_j. Exhibit 4.8 shows a sample 'page 3' for one of the job aspects. The (up-to-three) information units appear in the window just below their associated job aspect. Note that a graphic positioning rating scale is provided for each unit. Note also that the manifest variable being addressed is shown in the box just below the window containing the information units. On the 'page 3' shown in the exhibit, subjects were asked to rate the *reliability* of each *information unit* in the window with respect to the *job aspect* shown at the top of the page. Subjects responded by placing a horizontal mark on the scale corresponding to their rating of each unit. The scale is anchored at seven points.

Using 'page 3' and 'page 2' responses, the manifest value for r_j was determined by:

$$r_j = \frac{(ur_{1,j}\, ui_{1,j}) + (ur_{2,j}\, ui_{2,j}) + (ur_{3,j}\, ui_{3,j})}{(ui_{1,j} + ui_{1,j} + ui_{1,j})} \quad \ldots . \quad (4.1)$$

(with $r_j = 0$, when $ui_{1,j} = ui_{2,j} = ui_{3,j} = 0$)

where $ur_{1,j}$, $ur_{2,j}$, and $ur_{3,j}$ represent scores for information unit reliability. These scores were generated from the horizontal marks on the graphic positioning scales connected to information units 1, 2, and 3, respectively, for the j^{th} job aspect and $ui_{1,j}$, $ui_{2,j}$, and $ui_{3,j}$ represent the importance scores for each unit obtained from the scale on 'page 2.'

Page 3 corresponds to protocol booklet page number 6 (for Prospecting), number 16 (for Service), number 28 (for Relationship Value), number 39 (for Product Knowledge), number 50 (for Competitor Products), and number 61 (for Needs Analysis).

EXHIBIT 4.8

Scale to Capture Manifest Values for r_j

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

RELIABILITY
The consistency and dependability of the information.

The reliability of the information unit is . . .

- **COMPLETELY INADEQUATE for this job aspect.**
- . . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**
- . . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**
- . . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**
- . . . **GENERALLY ADEQUATE for this job aspect, some improvement is possible.**
- . . . **VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.**
- . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

Pages 4 through 10: These are similar in structure to page 3. Their purpose is capturing scores at the information unit level which will be used to determine values for the manifest variables t_j, l_j, s_j, c_j, w_j, u_j, v_j. These determinations employ equations that were constructed in the same manner as Equation (4.1). Page 4 captures scores for $ut_{1,j}$, $ut_{2,j}$, and $ut_{3,j}$ (unit timeliness) which were used to determine a value for t_j, the timeliness manifest for a_j. Page 5 captures scores for $ul_{1,j}$, $ul_{2,j}$, and $ul_{3,j}$ (unit relevancy) which were used to determine a value for l_j, the relevancy manifest for a_j. This continues to page 10 which captures scores for $uv_{1,j}$, $uv_{2,j}$, and $uv_{3,j}$ (unit volume) which were used to determine a value for v_j, the volume manifest for a_j.

Pages 4 through 10 correspond to protocol booklet pages numbered 7 through 13 (for Prospecting), numbered 18 through 24 (for Service), numbered 29 through 35 (for Relationship Value), numbered 40 through 46 (for Product Knowledge), numbered 51 through 57 (for Competitor Products), and number 62 through 68 (for Needs Analysis).

Page 11: This page has a twofold purpose: (1) it captures an indication of the portion which the (up-to-three) information units are of all the information used by the subject with respect to the job aspect being addressed, and (2) it captures a value for the ninth (and final) manifest, o_j, for the j^{th} job aspect. The scale used for the first of these is illustrated in Exhibit 4.9. Responses here supported an assessment of how restrictive the limitation of three information units is in relation to the entire information base utilized by a subject. Low values in this respect would cast doubt on the validity of all the results obtained through the protocol booklet.

EXHIBIT 4.9

Scale to Capture Extent of Information Usage Evaluated

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

Extent of Information Usage Evaluated

Indicate the portion which the information units listed above, TAKEN TOGETHER, are of all the information you actually use for this job aspect.

|---|---|---|---|---|---|---|---|---|---|

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If the portion is less than 80%, what are the other major units and the approximate portion that each represents?

	Information Unit	Additional %
1.	____________________	________
2.	____________________	________

The second scale on page 11 captures responses for o_j, the manifest f[illegible] overall information satisfaction. It is shown in Exhibit 4.10. Note that unlike the other manifests for a_j captured in the booklet, o_j refers to all th[illegible] inform[illegible]on used by a subject with respect to the job aspect being addressed, not just the information units listed in the window. As with the other p[illegible]ale, responses here are an

EXHIBIT 4.10

Scale to Capture Manifest Values for o_j

Overall Assessment

What is your overall assessment of the extent to which you are satisfied with ALL the information that you use for this aspect of your job?

	1	2	3	4	5	6	7	
SATISFIED	↑ extremely	↑ quite	↑ slightly	↑ neither or equally	↑ slightly	↑ quite	↑ extremely	DISSATISFIED

important validity check. Should the values for o_j not correlate highly with the other eight manifests (r_j, t_j, l_j, s_j, c_j, w_j, u_j, and v_j), the validity of the three-unit information source limitation as well the manipulations used to determine these manifests (e.g., Equation (4.1)) would be held in considerable doubt.

Page 11 corresponds to protocol booklet page number 14 (for Prospecting), number 25 (for Service), number 36 (for Relationship Value), number 47 (for Product Knowledge), number 58 (for Competitor Products), and number 69 (for Needs Analysis).

Relative Importance of Job Aspects: This, the final section (and final page) of the protocol booklet captures values for $\kappa_1, \ldots, \kappa_D$, the importance factors for each of $\xi_1, \ldots, \xi_D$. This part of the protocol was reviewed previously. (Note the discussions concerning Exhibits 4.3 and 4.4). This protocol section remained unchanged from that used in the pre-test.

Graphic Positioning Scales

The use of graphic positioning scales (GPS) is readily apparent throughout the protocol booklet. Both vertical and horizontal forms are used; 24 of the first form and four of the second are found in each of the six job aspect sections. GP-style scales were adopted to reduce the time needed by subjects to record their responses (Guilford 1954, Narayana 1977). They were employed as one of several modifications made to the original protocol to reduce the time required for an interview from several hours to around one hour. From observing subjects using the scales there is little doubt that the use of GPS contributed in a substantial way to the time reduction realized. While this study did not determine the extent of the time reduction, a study by Narayana (1977) found that GPS saved 43% in response time when compared with "traditional" seven-point scales.[9]

In addition to response time reduction, several other advantages arose from the use of GPS. The use of vertical GPS allowed for multiple anchors/cues along each scale. This is seen in Exhibit 4.8 where the scale is anchored at seven points along its length. This form of GPS also eases the task of providing for the rating of multiple objects (i.e., information units) on the same trait (e.g., the reliability of information units) before going on to another trait (e.g., the timeliness of information units), a practice which Guilford (1954) says is "commonly advised" and will help reduce any "halo effect." GPS can also accommodate multiple responses on the same scale. This capability was put to use when capturing scores for $ui_{1,j}$, $ui_{2,j}$, and $ui_{3,j}$, something which is demonstrated in Exhibit 4.7. From the viewpoint of the respondent, the use of GPS seemed not to present any major disadvantage; however, this was not the case when a respondent's marks had to be

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9 Narayana goes on to state: "The evidence suggests that with the use of the GPS, the researcher can shorten the questionnaire, increase the quality of data, save respondents' time, and save the researcher's time, money, and effort" [1977, p. 122].

transformed from paper-based responses to computer-based data.[10] As predicted by reviews on the use of GPS (Guilford 1954, Narayana 1977), this task proved to be quite burdensome.

4.5 DETERMINATION OF MANIFEST VALUES

When completed, the protocol booklet provides responses at the information unit level. These responses have to be transformed into values for the manifest variables for each of the six information integration constructs. As illustrated in Exhibit 4.11 this transformation involves several steps which take quantities from the information unit level through the information set level to the construct level. First, sets of scores at the information unit level (i.e., $\{ur_{1,j}, ur_{2,j}, ur_{3,j}\}$, $\{ut_{1,j}, ut_{2,j}, ut_{3,j}\}$, . . ., $\{uv_{1,j}, uv_{2,j}, uv_{3,j}\}$) are combined, in turn, with $\{ui_{1,j}, ui_{2,j}, ui_{3,j}\}$ using equations like Equation (4.1) to yield scores at the information set level for each of r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j. Recall from discussions in Chapter 3 that a_j represents the adequacy of the information set used with respect to the j^{th} job aspect. Thus r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j represent eight of the nine manifestations of a_j. The ninth manifest, o_j, was a response about the entire set of information utilized with respect to the j^{th} job aspect. (Therefore, o_j is not derived from responses about individual information units.) In the final step, the indicators are raised to the ξ_j-manifest level by applying κ_j to each element of $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$ to yield values for each element of $\{R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, O_j\}$. This latter set is that needed for hypotheses testing.

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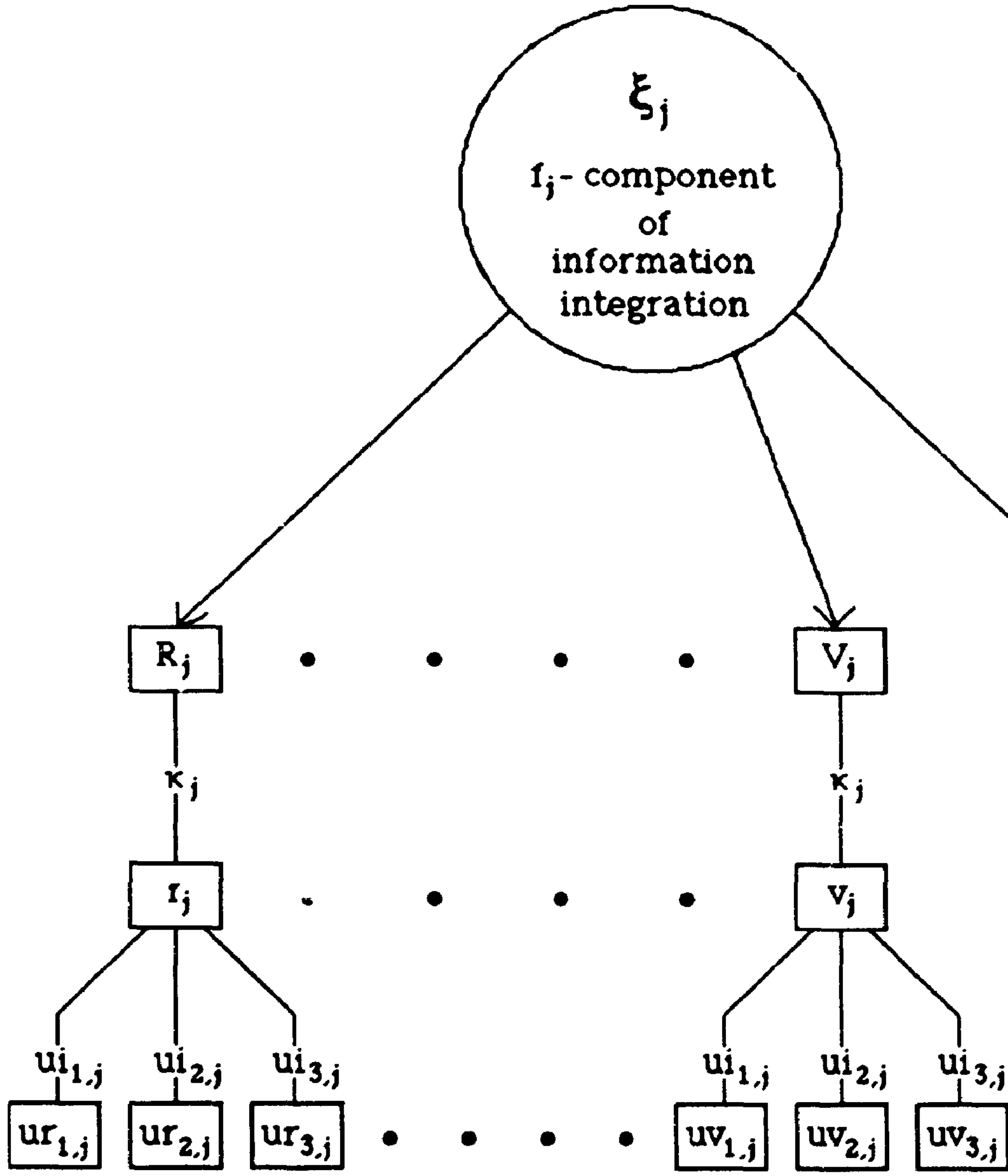
[10] This transformation was done in three steps: (1) the distance of the respondent's mark from the low end of each GPS was measured using an architect's ruler, (2) this distance was then converted to a point in an interval appropriate to the scale, and (3) the converted distance was keyed to a computer-readable medium for processing.

EXHIBIT 4.11

Transformation of Information Unit Scores to Construct Manifestations



Recall from Chapter 3 that $\xi_j = a_j \kappa_j$. The nine manifests (r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j) for a_j are scored in the interval [0, 6] while κ_j, the importance assigned to the j^{th} job aspect, is scored in the interval [0, 1]. This ensures that a zero-level of information integration (i.e., $\xi_j = 0$) results whenever either of three conditions exist: (1) the information set associated with the j^{th} job aspect is totally inadequate, (2) the individual uses no source of information for the job aspect in question, or (3) the job aspect is of no importance to the individual. All three conditions imply a zero-level of information integration but this zero-level can arise in different ways. The first two conditions result in zero-valued scores for each element of $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$ which imply a zero-value for a_j while the third condition implies a zero-value for κ_j.

4.6 PROTOCOL EXECUTION

Throughout the late Summer and Fall of 1990, interview sessions using the protocol booklet were held with 102 sales representatives (subjects) in 15 of the participating organization's 149 regional offices. The field work proceeded by selecting subjects from various performance levels and requesting their participation in an interview.[11] The specific sequence of events surrounding the execution of the interviews involved five activities: (1) the criteria for sales representative participation were developed and communicated to project coordinators at the organization's head office, (2) a regional office visitation schedule was prepared which set targets for the number of interviews to be done at each office, (3) a letter was sent from head office to the affected regional managers informing them about the project, introducing the researcher, requesting the participation of their sales representatives, and communicating the subject selection criteria, (4) anywhere from one-half to three days of interviews were held at each of the participating regional offices, and (5) a list was then submitted to head office to obtain performance measures for those with whom interviews had taken place. Thirteen of the 102 interviews were held with pre-test subjects. The sequence of activities surrounding the interviews with these

[11] It was communicated that participation was voluntary. To the researcher's knowledge only one sales representative refused to be interviewed.

individuals was generally the same as that for the final-test subjects, with the exception that communication with the regional managers was less formal.

Subject Selection

Three criteria were used to select the sales representatives to be interviewed: (1) he/she must have at least two years experience as a target group member with the organization, (2) his/her achievement must be measured by all four performance measures (P, I, M, and Q), and (3) subjects should be distributed over the various levels of achievement as evenly as possible. The first criterion helps ensure that a subject has enough experience to appreciate the requirements of the various CSF-related tasks and has been exposed to a variety of potentially useful information sources. (The implications of this criterion for causality are discussed in Chapter 3). The second criterion enables the data collected from an interview to qualify as a datum point for hypothesis testing. Extensive amounts of missing data would hamper the use of the PLS-based analysis methods that were used. The third selection criterion seeks to create variance in the performance constructs.

The third criterion arises from the study's concern with internal validity and lays the basis for dealing with this form of validity by establishing the variability of the performance constructs. With performance construct variability assured, the interview protocol could then be used to capture data on the information integration constructs. An analysis of these data tests the extent of concomitant variation between performance constructs and information integration constructs. Exhibit 4.12 shows the distribution of subjects in the final test with respect to their achievement classification. Figures in Exhibit 4.12 indicate that an even distribution was not entirely obtained; however, substantial representation from all achievement levels was realized. For comparison, the achievement classification distribution of all 1,521 members of the target group is also given in the Exhibit 4.12. An examination of both distributions indicate that those in the sample were distributed more

EXHIBIT 4.12

Distribution of Subject and Target Group Performance

Achievement Level	Number in Sample	Percent of Total Sample	Number in Target Group	Percent of Target Group
0	22	25 %	704	46 %
1	26	29	391	26
2	16	18	204	13
3	9	10	124	8
4	16	18	98	7
Total	89	100	1,521	100

evenly than those in the entire target group. Thus, the selection procedure appears to have done its job of establishing variability on the dependent constructs.

Field Procedures

The number of interviews planned for each regional office was developed with several factors in mind: (1) minimizing disruption to the overall productivity of a regional office (by the keeping the number interviewed to less than 1/3 of total office complement), (2) maximizing the impact on the personal productivity of each subject (by scheduling interviews early in the day)[12], and (3) minimizing travel time and the cost of the research (by selecting sites within several hours driving time of the researcher's office location). An overall objective amidst these constraints was obtaining at least 60 interviews. This number derives from the guidelines for PLS usage discussed in Chapter 3. In anticipation of losses (the extent of which could not be estimated), a field work plan for 100 interviews was prepared. This plan is shown in Appendix 4.3 (iii). The plan (along with other

[12] The late afternoon and evening hours are prime times for sales representatives to meet with customers.

previously mentioned descriptive and instructive information on the project) was communicated to the regional managers responsible for the office locations in which the interviews would take place.

Upon receipt of the communication from head office about the project (shown in Appendix 4.3 (i)), the regional manager or his/her designate made arrangements for the interviews. Subjects were selected (to the extent possible) based on the instructions in the head office communication, instructions that were essentially derived from the subject selection criteria discussed above. Subjects were given interview appointments in accordance with a suggested interview schedule (shown in Appendix 4.3 (ii)). This schedule allowed an hour or so for each interview and limited the total number of interviews to five per day.

The Interview

Much has been said about this already; however, several aspects of the interview have yet to be noted. One of the most important relates to the choice of an interview-based methodology. A review of the protocol booklet may leave the reader wondering why a survey-based approach could not be used, especially in view of the protocol's use of scales from instruments previously employed in surveys. Completion of scales was not the problem whose solution required face-to-face interaction to obtain the data needed. Instead, interaction was used to develop subject readiness to supply responses with respect to the six job aspects and to develop subject awareness of information usage vis-a-vis these aspects. During the interview, this interaction occurred most intensely at the beginning of each job aspect section where the list of information units is recorded (i.e., pages 4, 15, 26, 37, 48, and 59 of the protocol booklet in Appendix 4.2).

Subsequent to the interaction that took place as each new section began, subjects were generally able to independently provide responses. Some difficulty was often experienced in the first section as subjects were becoming familiar with the questions asked and the scales used. Much of this was accommodated by showing samples of completed scales.[13] It should also be said that the immediate availability of someone to answer questions about the booklet reduced subject frustration considerably. Another aspect of the interview was the opportunity to observe the operation of scales first hand, an important activity given the stage of the development of instrumentation for measuring information integration. Finally, the use of an interview permitted the collection of comments made by the subjects as various issues were discussed. These comments helped provide some insight into the nature of the variance in the manifest variables.

Performance Measures

Performance measures were disclosed for subjects after interviews with them had taken place. This was done to prevent the interviewer from knowing the level of performer being interviewed. This practice minimized any inferential threats that might arise from the interviewer's prior knowledge of a subject's performance.[14] The procedure to prevent prior knowledge operated in a straight forward manner. Prior to arriving at a site (regional office) the interviewer would not be told which of the sales representatives would be study subjects. Recall that subjects were selected for the study and scheduled for interviews by the regional manager on the basis of the criteria supplied by head office. No consultation with the researcher took place prior to the interviews with respect to subject

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13 These were provided for protocol booklet pages 5, 6, 13 and 14.

14 The notion that researchers "wittingly and unwittingly give subjects cues about how they are supposed to behave" is generally accepted [Kidder and Judd 1986, p. 97]. These authors refer to such cues as demand characteristics.

appropriateness.[15] Upon completion of interviews at the site, a list of those interviewed was submitted in head office. Performance measures were then retrieved and provided to the researcher by personnel authorized to obtain such data.

Maintenance of Confidentiality

The study would have appeared to subjects to be sponsored by management. Consequently, there is little doubt that subjects would have felt a certain amount of pressure to provide favourable information unit ratings. This situation presented a potential threat to the validity of the study's findings.[16] To mitigate this threat, procedures were employed to maintain the confidentiality of responses recorded in the protocol booklet and otherwise obtained in the interview.

At the start of each interview the subject was assured of complete confidentiality. Receiving such an assurance seemed not to be a concern with the vast majority of those selected for the study; however, there were some for whom this issue was important. For various reasons, these individuals did not want head office management to be able to associate their responses with them at an individual level. Because of subject selection by the regional manager as well as interview list submission to head office to obtain individual performance measures, management at several levels could easily identify those members of the target group who had been study subjects. Also, all data collected from subjects and otherwise obtained from the field work were turned over to the participating organization upon completion of the project. Subjects were told that this would be the case; however,

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15 There were communications between the regional manager and the interviewer prior to interviews for various administrative reasons: confirming schedules, changing schedules, etc.

16 The validity threat is similar in nature to what Cook and Campbell (1979) refer to as "evaluation apprehension" [p. 69]. These authors maintain that such a situation threatens "the construct validity of putative causes and effects."

they were informed that a procedure was in place to prevent management's identification of individuals by way of anything that was associated with interview responses.

The study met its confidentiality commitment to subjects and its submission commitment to the participating organization by adopting two policies: (1) individual-level data from the interviews were supplied to management without subject identifiers known to the organization, and (2) only aggregated data were supplied in instances where performance data and interview data were associated.[17] The first of these policies limited the use of the data to purposes not associated with individual evaluation. This seemed not to affect the value of data to management, since it sought to use the data "to streamline the information provided to sales representatives more effectively" [letter in Appendix 4.3 (i)]. The firm was already in the process of reviewing its information systems and saw the data from this project as a valuable but supplementary input to the review process. The second data submission policy permitted management to see the results of hypotheses testing in which both performance and interview data were associated; however, the aggregation of cases prevented identification of individual subjects.

4.7 SUMMARY

The centerpiece of the study's methodological approach is the protocol booklet shown in Appendix 4.3. Its final form emerged from developments in several areas: (1) the general research model proposed in Chapter 3, (2) the specific research model finalized in this chapter, (3) the lessons learned from pre-test execution of prior protocol versions, and (4) the adoption of graphic positioning scales. The confluence of these developments

[17] The reader should note that the set of performance measure values associated with a subject could easily be used as a key to link to that subject with his/her interview responses.

produced an instrument that was designed to capture as many as 264 responses from each individual during an interview time of around one hour. These responses define the data base necessary to generate values for the 54 manifest variables associated with the constructs of information integration.

The general research model posited in Chapter 3 provided the theoretical focus (i.e., ξ_j) for the protocol booklet. The two conceptual components of ξ_j, information adequacy (a_j) and CSF importance (κ_j) are the major themes around which the booklet is structured. In its development of a_j, Chapter 3 identified a set of information product traits (R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, and O_j) which provided the basis for the booklet's information unit rating scales. The specific research model finalized in this chapter determined the extent of the booklet (D = 6 job aspect sections) and provided objects of reference (i.e., labels for f_1 through f_D). The number of, and the names for, these object were needed to customize the protocol for use in the research setting. These were initially identified by a panel of senior managers and subsequently validated by thirteen pre-test subjects from the organization's 'target group.'

The lessons learned from pre-test activities were used to minimize the effort required of subjects. Asking for ratings on defined units of information (versus a group of units of varying quality) as well as asking for ratings on a limited number of units (versus as many units of the group as possible) considerably reduced the mental gymnastics demanded of subjects as they provided responses. Another outcome of the pre-test was the improved organization and presentation of the protocol booklet. The use of a system of information unit windows and the consolidation of individual worksheets into booklet form minimized response time and clarified the connection between response scale, information product trait, information units, and job aspect. Finally, the use of graphic positioning scales were employed in view of their potential to substantially reduce response time.

The primary goal of the field procedures was obtaining a sufficient number of completed protocol booklets to support model testing using PLS. Sixty was the minimum number required. One hundred and two were actually carried out: 13 of these were conducted in the study's pre-test phase while 89 formed the data base for the final test. The procedures operated in a top-down fashion with the participating organization issuing a communication from its head office to regional managers requesting their cooperation. This communication specified subject selection criteria and suggested an interview schedule. Up to five interviews per day were conducted at participating regional offices. Those interviewed had at least two years of experience with the organization and were evaluated using the four performance measures described in Chapter 3. These subjects were selected from various performance levels. To minimize interviewer bias, performance measures for each subject were only made available after completion of the interviews.

This chapter has taken the reader through the details of the methodological tasks that were required to fully specify the research model and subsequently construct the data collection protocol. Use of this protocol for interviews with specially selected subjects generated the data required for hypothesis testing and research model evaluation. The next two chapters report the results of this testing and evaluation.

CHAPTER 5

MEASUREMENT MODEL EVALUATION

Chapter 3 develops the conceptual aspects of the research model and couples it with a measurement component. Chapter 4 reports on the construction of the protocol and its associated instrumentation to capture measures for all the manifest variables for each hypothesized latent variable. This chapter evaluates the measurement component of the research model, a component which incorporates the manifest variables in association with their respective latent variables. Specifically, the chapter reports on an analysis of the 58 epistemic relationships linking the model's structural and measurement components. More generally, this chapter, like Chapter 6 following, is concerned with assessing the validity of the research model. The validity of the measurement component of the research model (i.e., the measurement or outer model) is the primary issue here while the validity of the structural component of the research model (i.e., the structural or inner model) is the primary issue in Chapter 6.

Valid measurements are critical to interpretation. A poor measurement model indicates a failure to adequately 'capture' the constructs that are hypothesized to exist. Such an outcome frustrates the interpretation of coefficients measuring the relationships between constructs. Consequently, the inner model of structural relationships should not be assessed until the outer model of measurement relationships provides evidence of adequately capturing the model's constructs. This suggests that any assessment of internal validity should be deferred until the measures associated with constructs display an adequate level of construct validity. Consequently, measurement model evaluation, the subject matter of this chapter, precedes structural model evaluation, the subject matter of the next chapter.

Chapter Overview

The ability of research operations to capture valid manifestations of the model's hypothesized constructs (i.e., construct validity) is the central issue in evaluating the research model's measurement components. The chapter begins by addressing the issue of construct validity through assessments of convergent and discriminant validity at both the construct level and the information integration manifest level. Various validity assessment formulations are discussed and applied to the data derived from the protocol booklet responses captured in the final test phase of the field work. These assessments take place within the context of the nomological net of latent and manifest variables provided by the PLS formulation of the structural model seen in Chapter 3.

The procedure, described in Chapter 4, for deriving the measurement model's information integration manifest values involved several levels of manipulation. These levels can be seen in Exhibit 4.11. Note, in particular, the two levels beneath the level containing the information integration manifests: (1) the 'information unit' level and (2) the 'information set' level. The chapter also deals with validity assessments at each of these two levels. This is done to assess whether the high degree of convergent and discriminant validity observed at the information integration manifest level arises as a consequence of the ability of research operations to capture valid reflections of the constructs or whether such validity outcomes are artifacts of the manipulations used to determine manifest values. Variables defined at the 'unit' and 'set' levels do not enjoy the context of a nomological network within which PLS-based validity assessments can take place. Consequently, more traditional validity assessment techniques were used. The chapter reports on the application of these techniques.

5.1 VALIDITY ISSUES

An evaluation of the research model begins with a review of the outer model shown in Exhibit 3.12. This component of the research model consists of 58 epistemic relationships linking as many manifest variables with eight constructs. Selected descriptive statistics on each of the 58 manifests are provided in Appendix 5.1. Measurement evaluation involves assessing the extent to which each set of manifests reflects its underlying construct. Specifically, for the antecedent variables, an evaluation seeks to assess the extent to which $\{R_1, T_1, L_1, S_1, C_1, A_1, U_1, V_1, O_1\}$ measures ξ_1, and the extent to which $\{R_2, T_2, L_2, S_2, C_2, A_2, U_2, V_2, O_2\}$ measures ξ_2, and so through to ξ_6. On the dependent side of the research model, our concern is with the extent to which {P, I, and M} measures η_1. With η_2 being captured by a single indicator, it is assumed to be perfectly measured by {Q}. In each case, the critical issue is whether an adequate level of construct validity has been achieved.

Construct validity refers "to the approximate validity with which we can make generalizations about higher-order constructs from research operations" [Cook and Campbell 1979, p. 38]. For the research model under investigation here, this is equivalent to assessing the validity with which we can generalize to each ξ_j from the operations that produced R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, and O_j (in the case of the antecedent constructs) and to each of η_1 and η_2 from the operations that produced P, I, M, and Q (in the case of the dependent constructs). Cook and Campbell go on to state that "assessing construct validity depends on two processes: first, testing for a *convergence* across *different* measures or manipulations of the same 'thing' and, second, testing for a *divergence* between measures and manipulations of related but conceptually distinct 'things'" [1979,

p. 61, emphasis in original]. This suggests that an assessment of construct validity can be decomposed into assessments of convergent validity and discriminant validity.

5.2 CONVERGENT VALIDITY

Assessing convergent validity involves a determination of the extent to which two or more methods of measuring the same construct produce measurements that are in agreement. Fornell, Tellis, and Zinkhan (1982) suggest that such measurement methods should be "maximally dissimilar" in order to provide a rigorous empirical test. However, these authors also state that having methods maximally different is an "ideal" and suggest that a set of differing questions forming a scale for a specific construct could constitute a set of 'dissimilar methods.' An application of this notion to this study's assessment of convergent validity would see each element of the set $\{R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, O_j\}$ regarded as a distinct 'method' attempting to capture ξ_j. The same could be said of $\{P, I, \text{and } M\}$ for η_1. The measures from each 'method' can be evaluated on the basis of the extent of their convergence, both individually and collectively, upon the construct they are intended to capture.

Several convergence evaluation formulations have been proposed for assessing convergent validity when employing structural modeling for analysis. Fornell and Larcker (1981) discuss three formulations that have found frequent use: (1) single measure reliability (item reliability), (2) construct reliability (internal consistency), and (3) average variance extracted. These formulations address convergence at different levels: the first at the measurement level and the second and third at the construct level. The first, item reliability, measures the convergence of each manifest on its associated construct. It is denoted by ρ_x and is defined as:

$$\rho_x = \frac{\lambda_x^2}{\lambda_x^2 + \mathrm{Var}(\varepsilon_x)} \qquad \ldots\ldots (5.1)$$

where λ_x is factor loading for manifest x on its construct. Adequate convergent validity in this respect would be observed when ρ_x is greater than 0.50. When this condition is satisfied, the amount of variance the manifest shares with its construct exceeds the manifest's error variance, $\mathrm{Var}(\varepsilon_x)$. Noting that the denominator is 1, Equation (5.1) can be written in a more simplified form that is often referred to as the communality of x:

$$\rho_x = \lambda_x^2 \qquad \ldots\ldots (5.2)$$

It is this, the communality, form of the item reliability equation that is used in the discussions that follow on the measurement-level convergent validity .

The second and third validity assessment formulations operate across all manifests to provide construct-level convergent validity assessments. The second, internal consistency (sometimes called composite reliability or construct reliability), extends the definition of item reliability to include all the manifests ($x_1, \ldots, x_m$) that are associated with a construct, ξ. This extension is seen from a comparison of Equation (5.1) with the following definition for construct reliability, ρ_ξ:

$$\rho_\xi = \frac{\left(\sum_{i=1}^{m} \lambda_{x_i}\right)^2}{\left(\sum_{i=1}^{m} \lambda_{x_i}\right)^2 + \sum_{i=1}^{m} \mathrm{Var}(\varepsilon_i)} \qquad \ldots\ldots (5.3)$$

As with ρ_x, adequate convergence validity is observed when ρ_ξ is greater than 0.50.

The third convergence assessment indicator, average variance extracted, reflects the amount of the variance that is captured by the construct in relation to the amount of error variance. Values of average variance extracted for a construct, ξ, having manifest variables, $x_1, \ldots, x_m$, are given by:

$$\rho_{AVE} = \frac{\sum_{i=1}^{m} \lambda_{x_i}^2}{\sum_{i=1}^{m} \lambda_{x_i}^2 + \sum_{i=1}^{m} \mathrm{Var}(\varepsilon_i)}$$

This equation indicates the portion of total variance that the manifests share with their construct. By noting that the denominator is simply m, the number of manifests, ρ_{AVE} can be written in a form that more readily evidences its name as an average of the variance attributed to the construct underlying the m manifests:

$$\rho_{AVE} = \frac{\sum_{i=1}^{m} \lambda_{x_i}^2}{m} \qquad \ldots\ldots (5.4)$$

As with ρ_ξ, adequate convergence validity is observed when ρ_{AVE} is greater than 0.50[1]. When this condition is not satisfied, the variance due to measurement error exceeds the variance captured by the c·nstruct. Whenever this is the case, little confidence can be placed in both the validity of the individual manifests as well as the validity of the construct (Fornell and Larcker 1981).

1 It should be noted that ρ_{AVE} is more conservative than ρ_ξ. It has been reported that the latter could produce values suggestive of adequate convergent validity even through more than 50% of the variance is error variance (Fornell and Larcker 1981)

Measurement-Level Convergent Validity

The factor loadings from the PLS analysis of the model's 58 manifests provide the basis for an assessment of convergent validity using item reliabilities determined by Equation (5.2). These loadings were also identified as the test statistics for the epistemic relationships given in Chapter 3 (see Exhibits 3.15 and 3.16). Recall that Chapter 3 identified four sets of measurement model validity conditions:

$$(1)\ \lambda_{X_j} \leq 0.7, \text{ for } j = 1, \ldots, D \text{ while } X = R, \ldots, O \qquad \ldots. (5.5)$$

$$(2)\ \lambda_{X_j} \leq \text{ all } \lambda^*_{X_{j'}}, \text{ for } j = 1, \ldots, D \text{ while } X = R, \ldots, O \qquad \ldots. (5.6)$$

$$(3)\ \lambda_P, \lambda_I, \text{ and } \lambda_M \leq 0.7, \text{ and} \qquad \ldots. (5.7)$$

$$(4)\ \lambda_P \leq \text{ all } \lambda^*_P, \lambda_I \leq \text{ all } \lambda^*_I, \text{ and } \lambda_M \leq \text{ all } \lambda^*_M. \qquad \ldots. (5.8)$$

In addition to testing epistemic relationships, Equations (5.5) and (5.7) also provide a test of item reliabilities which assess convergent validity at the measurement level. Equations (5.6) and (5.8) are also epistemic relationship tests; however, these equations address the issue of discriminant validity, the topic of a subsequent section. Equations (5.5) and (5.7) effectively test whether the variance that a manifest shares with its associated construct is greater than the variance due to error. This is equivalent to testing for $\rho_x > 0.5$. In other words, a test of the validity conditions in Equations (5.5) and (5.7) is also a test of the item reliabilities.

Exhibit 5.1 reports the factor loadings estimated by PLS. All λ-estimates exceed 0.7. The lowest, at 0.788, is the loading for the 'Achievement' manifest, M, on the 'Performance - Quality' construct, η_1. Exhibit 5.2 reports the item reliabilities derived from the loadings using Equation (5.2). All ρ_x values exceed 0.50. These results are indicative of adequate convergent validity and supportive of all the 58 epistemic relationships (seen in Exhibits 3.15 and 3.16). Both direction and level are as hypothesized. In fact, the figures in Exhibit 5.1 are indicative of a high level of redundancy in the measurement instrument. While some level of redundancy is desirable, the levels observed here probably indicate that greater efficiency can be obtained through a reduction in the size and scope of data collection instrumentation. Apart from efficiency concerns, the observed loadings appear strongly suggestive of adequate measurement model convergence.

Construct-Level Convergent Validity

From Equations (5.3) and (5.4) we have two statistics for assessing convergent validity at the construct level: (1) composite reliability (ρ_ξ) and (2) average variance extracted (ρ_{AVE}). These are shown in Exhibit 5.2 along with the communality and residual variance figures used in their determination. All values for both composite reliability and average variance extracted exceed 0.5. This is indicative of good convergent validity. The high values for ρ_ξ indicate that each set of manifests displays a high level of reliability (internal consistency) *as a group*. High values for ρ_{AVE} indicate that the amount of variance that is captured by the construct substantially exceeds the amount of variance due to measurement error. These results support the research model assertion that each construct is the most important causal agent in the set of correspondence relationships connecting it with its manifests.

EXHIBIT 5.1

Measurement Model - Factor Pattern Matrix

(Loadings x 10^3)

		ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	η_1	η_2
Prospecting									
Reliability	R_1	973							
Timeliness	T_1	975							
Relevancy	L_1	978							
Confidence in Systems	S_1	963							
Completeness	C_1	966							
Accuracy	A_1	976							
Currency	U_1	970							
Volume	V_1	924							
Overall Satisfaction	O_1	962							
Service									
Reliability	R_2		977						
Timeliness	T_2		955						
Relevancy	L_2		985						
Confidence in Systems	S_2		974						
Completeness	C_2		972						
Accuracy	A_2		986						
Currency	U_2		972						
Volume	V_2		969						
Overall Satisfaction	O_2		959						
Relationship Value									
Reliability	R_3			996					
Timeliness	T_3			995					
Relevancy	L_3			997					
Confidence in Systems	S_3			995					
Completeness	C_3			998					
Accuracy	A_3			992					
Currency	U_3			994					
Volume	V_3			994					
Overall Satisfaction	O_3			994					
Product Knowledge									
Reliability	R_4				989				
Timeliness	T_4				809				
Relevancy	L_4				988				
Confidence in Systems	S_4				989				
Completeness	C_4				989				
Accuracy	A_4				989				
Currency	U_4				989				
Volume	V_4				984				
Overall Satisfaction	O_4				982				

Exhibit 5.1 continues on the following page.

EXHIBIT 5.1 (Continued)

Measurement Model - Factor Pattern Matrix
(Loadings x 10^3)

		ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	η_1	η_2
Competitor Products									
Reliability	R_5					975			
Timeliness	T_5					972			
Relevancy	L_5					986			
Confidence in Systems	S_5					976			
Completeness	C_5					978			
Accuracy	A_5					975			
Currency	U_5					974			
Volume	V_5					975			
Overall Satisfaction	O_5					904			
Needs Analysis									
Reliability	R_6						985		
Timeliness	T_6						990		
Relevancy	L_6						988		
Confidence in Systems	S_6						988		
Completeness	C_6						985		
Accuracy	A_6						995		
Currency	U_6						991		
Volume	V_6						982		
Overall Satisfaction	O_6						984		
Performance - Quantity									
Units	P							968	
Value	I							959	
Achievement	M							788	
Performance - Quality									
Quality	Q								1000

EXHIBIT 5.2

Construct-Level Convergent Validity
(Values x 10^3)

		λ_x^2	$Var(\varepsilon_x)$	ρ_ξ	ρ_{AVE}
Prospecting					
Reliability	R_1	947	53	934	932
Timeliness	T_1	950	50		
Relevancy	L_1	956	44		
Confidence in Systems	S_1	928	72		
Completeness	C_1	933	67		
Accuracy	A_1	953	47		
Currency	U_1	940	60		
Volume	V_1	853	147		
Overall Satisfaction	O_1	925	75		
Service					
Reliability	R_2	954	46	947	945
Timeliness	T_2	912	88		
Relevancy	L_2	970	30		
Confidence in Systems	S_2	948	52		
Completeness	C_2	945	55		
Accuracy	A_2	972	28		
Currency	U_2	945	55		
Volume	V_2	940	60		
Overall Satisfaction	O_2	921	79		
Relationship Value					
Reliability	R_3	992	8	990	990
Timeliness	T_3	991	9		
Relevancy	L_3	993	7		
Confidence in Systems	S_3	989	11		
Completeness	C_3	995	5		
Accuracy	A_3	984	16		
Currency	U_3	988	12		
Volume	V_3	988	12		
Overall Satisfaction	O_3	987	13		
Product Knowledge					
Reliability	R_4	978	22	941	940
Timeliness	T_4	654	346		
Relevancy	L_4	977	23		
Confidence in Systems	S_4	978	22		
Completeness	C_4	979	21		
Accuracy	A_4	978	22		
Currency	U_4	979	21		
Volume	V_4	969	31		
Overall Satisfaction	O_4	965	35		

Exhibit 5.2 continues on the next page.

EXHIBIT 5.2 (Continued)

Construct-Level Convergent Validity
(Values x 10^3)

		λ_x^2	$Var(\varepsilon_x)$	ρ_ξ	ρ_{AVE}
Competitior Products					
Reliability	R_5	950	50	940	938
Timeliness	T_5	945	55		
Relevancy	L_5	972	28		
Confidence in Systems	S_5	952	48		
Completeness	C_5	957	43		
Accuracy	A_5	952	48		
Currency	U_5	949	51		
Volume	V_5	950	50		
Overall Satisfaction	O_5	817	183		
Needs Analysis					
Reliability	R_6	969	31	975	975
Timeliness	T_6	980	20		
Relevancy	L_6	976	24		
Confidence in Systems	S_6	977	23		
Completeness	C_6	970	30		
Accuracy	A_6	990	10		
Currency	U_6	981	19		
Volume	V_6	965	35		
Overall Satisfaction	O_6	968	32		
Performance - Quantity					
Units	P	937	63	839	826
Value	I	920	80		
Achievement	M	621	379		

5.3 DISCRIMINANT VALIDITY

Moving from the concern with convergence, the next construct validity assessment task addresses the "divergence between measures and manipulations of related but conceptually distinct 'things'" (Cook and Campbell 1979). Grant (1988) notes that discriminant validity is an important concern when examining causal relationships. Poor discriminant validity frustrates attempts to distinguish whether two constructs are causes and effects of one another or the two are actually the same construct. As with convergent validity, discriminant validity is also assessed at two levels: the measurement level and the construct level. Referring to the measurement level, Barclay, Duxbury, and Higgins (1991) propose that adequate discriminant validity is evidenced when no manifest loads more highly on another construct than it does on the construct it intends to reflect. Referring to the construct level, Fornell et al. (1982) describe discriminant validity as the degree to which a construct differs from other constructs.

Measurement-Level Discriminant Validity

At the measurement level, discriminant validity can be examined by comparing the loading between each manifest and its construct with all the loadings between the same manifest and all other constructs. This discriminant validity condition is embodied in Equations (5.6) and (5.8). We have:

$$(1)\ \lambda_{X_j} \le \text{all } \lambda^*_{X_j},\ \text{for } j = 1, \ldots, D \text{ while } X = R, \ldots, O \qquad \ldots\ (5.6)$$

$$(2)\ \lambda_P \le \text{all } \lambda^*_P,\ \lambda_I \le \text{all } \lambda^*_I, \text{ and } \lambda_M \le \text{all } \lambda^*_M. \qquad \ldots\ (5.8)$$

where λ_{X_j} is the loading of manifest, X (X = R, . . ., O) on the jth information integration construct (j = 1, . . ., 6) and any λ^* represents the cross-loading for each manifest on all constructs except the construct with which it is associated. λ_P, λ_I, and λ_M represent loadings for measures of the dependent construct while λ_P^*, λ_I^*, and λ_M^* are the cross-loadings for each measure on all constructs except η_1. (The absence of λ_Q was discussed in Chapter 3.)

Exhibit 5.3 presents the factor structure matrix generated by the PLS algorithm. It shows the loadings and cross-loadings for the 58 manifests of the measurement model. The boxed values indicate the loadings for hypothesized manifest-construct relationships. All other values in the exhibit represent loadings for unhypothesized manifest-construct relationships (i.e., cross-loadings). A comparison of the loading and the seven cross-loadings for each manifest reveals that the values satisfy the conditions for measurement-level discriminant validity in all 58 cases.

EXHIBIT 5.3

Measurement Model - Factor Structure Matrix

(Loadings x 10^3)

	ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	η_1	η_2
R_1	973	-283	-255	-483	-106	-314	-113	-97
T_1	975	-236	-291	-496	-122	-320	-103	-44
L_1	978	-258	-271	-479	-124	-311	-125	-75
S_1	963	-311	-247	-439	-71	-265	-121	-67
C_1	966	-264	-239	-440	-132	-265	-155	-57
A_1	976	-249	-289	-475	-135	-311	-152	-63
U_1	970	-222	-247	-464	-113	-295	-118	-32
V_1	924	-225	-225	-419	-52	-247	-101	36
O_1	962	-300	-265	-499	-134	-343	-123	-28
R_2	-270	977	46	-126	-135	-168	220	138
T_2	-221	955	-136	-129	-156	-155	317	141
L_2	-272	985	9	-114	-154	-188	268	149
S_2	-275	974	40	-102	-132	-176	286	144
C_2	-259	972	48	-113	-159	-138	213	132
A_2	-268	986	12	-97	-139	-176	266	147
U_2	-275	972	18	-114	-129	-167	297	154
V_2	-251	969	33	-127	-146	-145	245	156
O_2	-293	959	65	-120	-113	-166	209	180
R_3	-266	7	996	240	7	-7	-26	50
T_3	-264	2	995	230	18	23	-32	53
L_3	-260	12	997	219	32	11	-32	59
S_3	-282	-13	995	249	27	18	-36	59
C_3	-272	20	998	217	19	14	-33	48
A_3	-262	26	992	194	26	3	-21	56
U_3	-272	4	994	239	41	25	-44	34
V_3	-257	21	994	191	13	31	-19	43
O_3	-270	29	994	187	19	-1	-31	49
R_4	-465	-129	217	989	92	-12	-54	50
T_4	-357	-82	169	809	84	133	-42	17
L_4	-465	-117	185	988	80	-6	-68	52
S_4	-484	-126	246	989	102	-7	-84	54
C_4	-480	-120	249	989	113	15	-27	57
A_4	-490	-116	218	989	94	-18	-47	41
U_4	-484	-108	211	989	112	18	-28	56
V_4	-479	-120	192	984	128	-6	6	85
O_4	-491	-110	223	982	128	-19	-31	67

Exhibit 5.3 continues on the next page.

EXHIBIT 5.3 (Continued)

Measurement Model - Factor Structure Matrix

(Loadings x 10^3)

	ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	η_1	η_2
R_5	- 121	- 168	9	156	975	- 23	98	142
T_5	- 73	- 116	6	11	972	25	80	123
L_5	- 114	- 138	6	89	986	5	78	92
S_5	- 131	- 167	22	158	976	- 30	81	137
C_5	- 143	- 162	14	172	978	- 28	72	120
A_5	- 55	- 132	- 12	36	975	6	78	110
U_5	- 116	- 183	54	164	974	- 40	91	107
V_5	- 103	- 111	47	48	975	53	121	100
O_5	- 150	- 86	46	79	904	38	136	112
R_6	- 285	- 160	- 22	- 11	15	985	- 69	- 270
T_6	- 312	- 159	24	4	10	990	- 68	- 272
L_6	- 298	- 161	- 3	- 6	- 15	988	- 71	- 277
S_6	- 297	- 177	11	22	14	988	- 85	- 306
C_6	- 313	- 164	30	28	- 3	985	- 46	- 267
A_6	- 306	- 164	28	11	1	995	- 66	- 282
U_6	- 296	- 175	13	0	- 17	991	-53	- 252
V_6	- 295	- 166	20	- 21	16	982	- 55	- 253
O_6	- 339	- 181	13	5	- 15	984	- 49	- 248
P	- 148	306	- 87	- 74	85	- 59	968	333
I	- 107	250	- 21	- 25	92	- 93	959	297
M	- 85	94	131	6	108	18	788	389
Q	- 55	153	51	56	121	- 274	350	1000

Construct-Level Discriminant Validity

Assessing the extent of divergence between constructs relies on how this divergence is reflected in the manifests (as a group) for each construct. Fornell, Tellis, and Zinkhan (1982) propose that adequate construct-level discriminant validity arises when the variance shared between a construct and any other construct is lower than the variance shared between that construct and its measures. Construct-to-construct shared variance is determined by the square of the correlation between the two constructs. Construct-to-manifests shared variance corresponds to average variance extracted. Letting π_{jk} represent the correlation between the j^{th} and k^{th} constructs and $\rho_{AVE(j)}$ represent the average variance extracted for the j^{th} construct, the condition for construct-level discriminant validity for the j^{th} construct can be formally stated as:

$$\pi_{jk}^2 < \rho_{AVE\,(j)}, \text{ for } k = 1, \ldots, 8 \text{ where } j \neq k \quad \ldots . \ (5.9)$$

Values for π_{jk} can be determined from the factor scores generated by PLS for each construct. Figures for $\rho_{AVE(j)}$ can be determined using Equation (5.4) and were seen previously in Exhibit 5.2.

Exhibit 5.4 shows the matrix of observed values for variance shared between and within constructs. The diagonal elements are the average variances extracted for each construct, $\rho_{AVE(j)}$. The off-diagonal elements are the shared variances between constructs, π_{jk}-squared. For all constructs, the condition for discriminant validity stated in Equation (5.9) is satisfied since each average variance extracted exceeds both the row and column values for shared variance. In fact, the comparative levels are indicative of a fairly high level of discriminant validity.

EXHIBIT 5.4

Construct-Level Discriminant Validity

Shared Variance Between and Within Constructs

		ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	η_1	η_2
Prospecting	ξ_1	0.93							
Service	ξ_2	0.07	0.95						
Relationship Value	ξ_3	0.07	0.00	0.99					
Product Knowledge	ξ_4	0.23	0.01	0.05	0.94				
Competitor Products	ξ_5	0.01	0.02	0.00	0.01	0.94			
Needs Analysis	ξ_6	0.10	0.03	0.00	0.00	0.00	0.98		
Performance - Quantity	η_1	0.02	0.07	0.00	0.00	0.00	0.00	0.83	
Performance - Quality	η_2	0.00	0.02	0.00	0.00	0.02	0.08	0.12	1.000

5.4 INFORMATION UNITS AND INFORMATION SETS

From Exhibit 4.11, it can be seen that there are four levels where values associated with the antecedent constructs of information integration are either captured or derived:

(1) the information unit level where subjects provided values for $\{ur_{1,j}, ur_{2,j}, ur_{3,j}\}$, $\{ut_{1,j}, ut_{2,j}, ut_{3,j}\}$, . . . $\{uv_{1,j}, uv_{2,j}, uv_{3,j}\}$ for $j=1, \ldots, D$ (= 6),

(2) the information set level where (with the exception of o_j) the manifest values for a_j are derived by applying $\{ui_{1,j}, ui_{2,j}, ui_{3,j}\}$ to the information unit values in (1) using equations like Equation (4.1) to determine values for each of r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j; the values for o_j were provided by subjects,

(3) the information integration manifest level where κ_j is applied to each element of $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$ to yield values for each element of $\{R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, O_j\}$, and

(4) the information integration construct level where PLS generates factor scores for each ξ_j by deriving a principal component from the values of R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, and O_j.

The third and fourth levels have been the subject of validity discussions thus far. An assessment of validity at the first and second levels is also important. It is at these levels that the raw data used to form higher level variables are captured. However, unlik ,e third and fourth levels, the first two levels do not enjoy the the context of a structural model as a general framework for validity assessment. Consequently, more traditional approaches to validity evaluation had to be employed.

5.5 INFORMATION UNITS: VALIDITY ASSESSMENT

In the course of the interviews, it was explained to subjects that an information unit is any identifiable source of information. They were asked to (1) identify information units for each of six job aspects, (2) to select up to three of these units for detailed evaluation, and (3) to rate each unit on a scale consisting of eight items: Reliability, Timeliness, Relevancy, Confidence in Systems, Completeness, Accuracy, Currency, and Volume. Taking the Currency scale item as an example, each subject was asked to rate the currency of an information unit vis-a-vis the job aspect for which that information unit is used. The information unit so rated had been selected by the subject from a list of job aspect information units. This list had been previously developed by the subject in the course of discussions about the various sources of information used for the job aspect in question. Procedural details in these respects are reported in Chapter 4. This activity produced a set of data for 18 eight-item scales at the information unit level: three information units for each of six job aspects. An important concern is the validity of these operations in obtaining values that are ultimately translated into manifest values for the research model's antecedent constructs. In particular, the impact of the limitation on the number of information units rated and the performance of the rating scales utilized require assessment vis-a-vis validity considerations.

Information Unit Identification

Exhibit 5.5 provides a list of the five information units most frequently placed by subjects in the evaluation windows of the protocol booklet and then rated on the eight-item scale. A separate top-five list is shown for each of the six job aspects. The final column in Exhibit 5.5 indicates the portion of subjects that selected each information unit. A complete listing of all the information units evaluated by subjects is provided for each of the six job aspects in Appendix 5.2.

Some examples will help interpret what has been shown in Exhibit 5.5. For instance, the information unit 'Customer Information Records' (a computer-generated internal company report) was included in the three most important 'Prospecting' information sources for 82% of subjects. Similarly, the information unit 'InfoPac' (a internal company publication) was included in the three most important 'Product Knowledge' information sources for 51% of subjects. The information unit 'Client Policies' (a competitor's policy shown to the sales representative by a client or prospective client) was included in the three most important 'Competitor Products' information sources for 42% of subjects. The same unit can appear under several different job aspects. For example, the information unit 'Customer Information Records' is used by 82% of subjects for 'Prospecting', 74% of subjects for 'Service', and 29% of subjects for 'Client Needs Analysis.' The informatio

EXHIBIT 5.5

Most Frequently Referenced Information Units

Job Aspect	Code	Information Units Used	Portion (%)
Prospecting	14	Customer Information Records	82
	10	Personal File of Leads and Referrals	78
	19	Newspapers, Public Press, Etc.	15
	41	Rep's Planning Guide	13
	18	City Directory	12
Service	14	Customer Information Records	74
	70	CSA Terminal Use: Client Records	52
	17	Service Memos from Head Office	22
	41	Rep's Planning Guide	22
	11	Personal File of Follow-Ups	11
Relationship Value	44	Freedom 55 Advertising	25
	49	Pace	10
	91	Various Formal Internal Communications	10
	19	Newspapers, Public Press, Etc.	9
	95	Various Informal Sources - External	7
Product Knowledge	15	InfoPac	51
	39	New Product Information Kits	51
	63	Rate Book	29
	90	Various Informal Sources: Managers, Reps	21
	30	Staff Meetings/Materials on New Products	21
Competitor Products	25	Client Polices	42
	90	Various Informal Sources: Managers, Reps	24
	5	Various Formal Product Comparisons	16
	75	A. L. Williams Kit	16
	15	InfoPac	8
Needs Analysis	65	Self-Developed Needs Analysis Methods	63
	14	Customer Information Records	29
	80	Personal Financial Security Assessment	24
	87	Family Security Service	10
	85	Gateway - Ledger Statements	9

unit 'InfoPac' was used as a important source of 'Product Knowledge' for 51% of subjects and as an important information source on 'Competitor Products' for 8% of subjects.

Information Unit Codification

Unit codes also appear in Exhibit 5.5. Appendix 5.3 provides a complete listing of the codes used to classify information units. A considerable variety of sources were forthcoming as information units: computer-based, manual, internal, external, public, private, published, unpublished, formal, informal. There was no attempt to restrict the definition of an information unit other than it had to be some information source external to the individual that was actually used with respect to the job aspect in question. Personal knowledge and experience were not considered information sources.

The codification of units was done to enable information unit evaluations across subjects. This enhanced the value of the study's output to the participating organization. The identification of individual units was only useful to the research to the extent that it facilitated obtaining subject responses. Information unit responses were subsequently collapsed into information set scores using definitions similar to that given in Equation (4.1). The research model developed in Chapter 3 does not incorporate a concept of 'information unit.' Instead it uses the notion of an information *set*. The notion of an information *unit* is essentially a convenience for obtaining the values needed to determine scores for an information *set*.

Information Unit Validity Evaluation

Two important validity issues should be addressed with respect to the information unit data that are used to determine information set scores: (1) the extent of total information usage actually represented by the units evaluated, and (2) the reliability of the eighteen scales. Should the extent of the information evaluated be low in relation to the total set of information actually used for a job aspect, then the scores generated from the information unit ratings would be poor estimates of the true scores for entire information set for the job aspect in question. Such a result would be indicative of poor convergent validity. In addition, poor scale reliability would also be indicative of poor convergent validity. Poor convergent validity at the information unit jeopardizes convergent validity at the information set level as well as convergent validity at the two higher levels.

Extent of Information Usage Captured

The task here is one of assessing the impact of the three-unit limitation on the number of information sources evaluated by subjects. This involved checking the assumption that the entire information set used for any of the six job aspects can be reasonably obtained from no more than three distinct sources. This assumption seemed to hold reasonably well on the basis of what was observed during the pre-test. However, the sample used in the pre-test was small and was not selected with an assessment of the three-unit limitation in mind. A more complete data base for assessment only became available on completion of the final test.

Exhibit 5.6 provides results from the final test. Columns 2 and 3 were determined on the basis of subject responses given in the workspace for information unit identification provided at the beginning of each protocol booklet job aspect section. (Note pages 4, 14, 26, 37, 48, and 59 in Appendix 4.2 and the discussion of 'page 1' in Chapter 4.) Column 2 provides the mean value and the range for the number of information units identified for each job aspect. This column indicates that the average number of information units being used for 'Prospecting' is 3.2 and that the number of units identified in this respect ranges from no units used to a maximum of eight units used. In the case of 'Product Knowledge' the number identified averaged 2.9 and ranged from one unit used to a maximum of six units used. 'Prospecting' has the highest average number of units while 'Service' has the largest range of units. 'Relationship Value' shows the lowest average number of units used and it ties with 'Product Knowledge' for the smallest range of units used.

EXHIBIT 5.6

Information Set Extent Assessment

Job Aspect	Information Units Identified: Mean (Range)	Information Units Identified: Three Or-Less (%)	Units Rated	Units Absent	Information Extent of Units Rated: Extent Mean	Information Extent of Units Rated: Standard Deviation
Prospecting	3.2 (0 - 8)	58	2.6 (0 - 3)	2	86.7	6.9
Service	2.9 (0 - 11)	74	2.4 (0 - 3)	2	89.6	5.4
Relationship Value	1.2 (0 - 5)	93	1.1 (0 - 3)	44	84.7	11.3
Product Knowledge	2.9 (1- 6)	75	2.6 (1 - 3)	0	88.3	6.6
Competitor Products	2.0 (0 - 6)	85	1.8 (0 - 3)	23	86.1	8.2
Needs Analysis	2.2 (0 - 10)	88	2.0 (0 - 3)	1	90.4	6.2
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7

Column (3) of Exhibit 5.6 provides the percentage of subjects who identified a total number of three units or less. This ranges from 58% of subjects in the case of 'Prospecting' to 93% of subjects in the case of 'Relationship Value.' The reader should keep in mind that the figures in Column (3) refer to the number of distinct sources used and not the extent to which the sources constitute the entire information set actually used. Only when the 'three-or-less' figure is high can it be said that the three-unit limitation did not severely limit a consideration of the complete information set utilized for a job aspect. This seems to be the case for three of the job aspects: 'Relationship Value', 'Competitor

Products', and 'Needs Analysis.' When the 'three-or-less' number is low, the assessment is inconclusive since a knowledge is needed of the extent to which the three units contribute to the complete information set. (Data about information extent are provided in Columns (6) and (7) of Exhibit 5.6. These columns will be discussed in what follows.)

After subjects identified the list of information units, they were asked to select the three units which were most important in providing them with the information needed for the job aspect in question. As described in Chapter 4, these units were transcribed to the protocol booklet window in preparation for scale completion on each unit. Column (4) of Exhibit 5.6 provides the mean values and the ranges for the number of units placed in the window and subsequently rated. The high end of all ranges is 3, an artifact of the procedure since the protocol booklet window has room for only three. Range figures indicate that 'Product Knowledge' was the only job aspect with at least one information unit identified for all subjects. 'Prospecting' and 'Product Knowledge' show the highest average number of units rated. Mean values in this column are not dramatically different from those in Column (2). This suggests that the three-unit limitation may not severely impact the scores; however, the extent to which the units that were rated contributes to the entire job aspect information set remains to be determined.

Column (5) of Exhibit 5.6 shows the number of subjects for whom no information units were identified. Maintaining 'Product Knowledge' was the only job aspect that was information-based for all subjects. Two subjects used no information source for 'Prospecting.' The same number employed no information source for 'Service.' For 23 subjects, obtaining a knowledge of 'Competitor Products' was not an activity that made use of information and the same was the case for 44 subjects with respect to recognizing 'Relationship Value.' For the latter two job aspects, the portions of the sample displaying extremely low levels of information utilization were substantial: 26% for 'Competitor

Products' and 44% for 'Relationship Value'. Keeping in mind that information integration is a reflection of information utilization, these outcomes correspond to a low level of information integration for a high portion of the sample for these job aspects. Operationally, an absence of information units for a job aspect results in the assignment of zero values to all the manifest variables for that job aspect's information integration component. Consequently, given the large number of zero-valued manifests for 'Competitor Products' and 'Relationship Value', the distribution of information integration scores for these two aspects cannot be expected to be normal, a factor favouring the use of PLS as the primary analysis technique at the information integration manifest level.

Comments noted during the interviews help provide some insight into the lack of information intensity observed for some of the job aspects. On the topic of 'Relationship Value' subjects were heard to say:

> "I like to say that I work for London Life but there's no specific information that I use here. Actually I don't have time for using information this way."
>
> "I've been in the business twenty years and I still race to come to work every morning but there's no specific information that I use."
>
> "I really do value London Life, I wouldn't work for any other insurance company but there's no specific piece of information I use to evaluate it."
>
> "I think of London Life as being a family company, a Canadian company. Hard information is just not important to me personally."
>
> "After twenty years I know it's a stable reliable company but I don't use any particular information to assess the value of my association."
>
> "It's important to me to be associated with London Life but not important to be reminded of it."

On the topic of maintaining a knowledge of 'Competitor Products' subjects stated:

> "I don't worry about competitors' products. Sometimes I get knocked off by one but it doesn't happen often enough for me to bother with actively using any source of information."

> "There's nothing specific I use just my knowledge gained over a period of time, especially from experience in replacement situations. I like the idea of the Exchange[2] but I haven't been able to use it yet, but it's needed and I intend to use it."
>
> "I started a file of information on competitors' product when I began but I never used it."
>
> "If you're a decent rep, you don't have to worry a lot about competitor's products."

These comments do not necessarily reflect the unimportance of the underlying job aspect but merely that, for these subjects, an information dimension of the job aspect is virtually non-existent. Consequently, in such cases, the low mean values in Columns (2) and (3) of Exhibit 5.6 for "Relationship Value' and 'Competitor Products' are not surprising. A substantial portion of subjects use no information units and this represents the full extent of their information set for each of these two aspects. This accounts for the high value in Column (3) for 'Relationship Value,' indicating that the three-unit limitation on information units accommodated all the units identified for 93% of subjects.

At the end of each job aspect section of the protocol booklet, subjects were asked to indicate the portion that the rated information units represent of all the information they actually use with respect to the job aspect being reviewed. In other words they were asked to estimate, E_j, the extent of information usage evaluated for the j^{th} job asp , where:

$$E_j = \frac{\text{information in all the units shown } \textit{in} \text{ the window}}{\text{all information used for the job aspect shown } \textit{above} \text{ the window}}$$

The scale used to capture values for each E_j was discussed in Chapter 4 and can be seen in Exhibit 4.9 (and on pages 14, 25, 36, 47, 58 and 69 of the protocol booklet in Appendix 4.2). Columns (6) and (7) of Exhibit 5.6 provide the means and standard deviations,

2 The 'Exchange' is a phone link to a head office group specializing in the comparative analysis of competing products.

respectively, for each E_j. While there are no standards in such respects, the figures indicate that the information units rated represent substantially all the information constituting the information sets used by subjects with respect to each job aspect, at least in the opinion of those subjects.

In summary, the evidence that the three-unit limitation did not unduly restrict the protocol's ability to capture the complete information set employed for each job aspect is revealed in four ways:

(1) the average number of information units identified (column (2) of Exhibit 5.6) was in all cases less than 3.2 and for only one job aspect did it exceed 3.0,

(2) the average number of units identified is not substantially different from the average number of units rated; the largest difference (column (2) minus column (4)) across all six job aspects is 0.6 units,

(3) the average number of units identified for the less information-intensive job aspects is substantially less than three: 1.2 for job aspect 3 and 2.0 for job aspect 5, and

(4) when asked about the exter[illegible] information set coverage by the information units rated, subjects indicated that, on average, the units rated were essentially those constituting the complete job aspect information set.

These four outcomes provide considerable support for the assumption that the information set used for any job aspect is reasonably represented by no more than three distinct information sources. This support enhances the validity of operations at the information unit level.

Information Unit Scale Reliabilities

As a further step in validity assessment, reliabilities were calculated for each of the eighteen scales used to obtain information unit ratings. Recall that subjects provided values in an order corresponding to the order of the elements of the subsets of:

$$\{ \{ ur_{1,j}, ur_{2,j}, ur_{3,j} \}, \{ ut_{1,j}, ut_{2,j}, ut_{3,j} \}, \ldots, \{ uv_{1,j}, uv_{2,j}, uv_{3,j} \} \}, \text{ for } j = 1, \ldots, D.$$

This order can be observed on the pages of the protocol booklet in Appendix 4.2. For example, page 6 of the protocol booklet provides scales for ratings of 'Reliability' for each of the (up-to-three) information units and thereby captures values for $\{ur_{1,1}, ur_{2,1}, ur_{3,1}\}$; page 7 similarly provides for 'Timeliness' ratings and is designed to yield values for $\{ut_{1,1}, ut_{2,1}, ut_{3,1}\}$ and so on to page 13 where 'Volume' scales capture values for $\{uv_{1,1}, uv_{2,1}, uv_{3,1}\}$. This is repeated for the second job aspect beginning on page 17 of the protocol booklet, and so on for all six job aspects.

By reordering the elements of the set given above, items can be collected together to form a scale of eight items for each of the three information units within the six job aspects. These would be represented for the first job aspect by:

$\{ur_{1,1}, ut_{1,1}, \ldots, uv_{1,1}\}$ for the first information unit,

$\{ur_{2,1}, ut_{2,1}, \ldots, uv_{2,1}\}$ for the second unit,

$\{ur_{3,1}, ut_{3,1}, \ldots, uv_{3,1}\}$ for the third unit,

and so on to the sixth job aspect, where:

$\{ur_{1,6}, ut_{1,6}, \ldots, uv_{1,6}\}$ is the scale the first information unit,

$\{ur_{2,6}, ut_{2,6}, \ldots, uv_{2,6}\}$ is the scale the second unit, and

$\{ur_{3,6}, ut_{3,6}, \ldots, uv_{3,6}\}$ is the scale the third unit.

This results in eighteen scales for rating information units where each scale consists of eight items: Reliability, Timeliness, Relevancy, Confidence in Systems, Completeness, Accuracy, Currency , and Volume.

A traditional approach to scale evaluation involves a determination of its reliability coefficient. This coefficient measures the extent of measurement error in the scale. A high level of error, indicated by a low reliability coefficient, is indicative of poor convergent validity. A high coefficient value is a necessary consequence of good convergent validity (but not a sufficient condition for it). A frequently used coefficient in this respect is Cronbach's α (Nunnally 1978). Exhibit 5.7 shows α-values for each of the 18 scales. Note the differing n's across these scales. Only datum points with subject-supplied ratings were used for the reliability calculation. Datum points taking zero values because no information unit was identified were not included in the calculation, doing so would have the effect of increasing the α-values shown in Exhibit 5.7. Zero-valued datum points arise as a consequence of subjects rating fewer than three information units.

EXHIBIT 5.7

Reliability Coefficients for Inforr · · ·. Scales

(Cronbach's α's)

Job Aspect	First Information Unit Scale	Second Information Unit Scale	Third Information Unit Scale
Prospecting	0.88 (n = 87)	0.94 (n = 82)	0.94 (n = 59)
Service	0.91 (n = 87)	0.91 (n = 76)	0.94 (n = 51)
Relationship Value	0.95 (n = 45)	0.95 (n = 33)	0.94 (n = 21)
Product Knowledge	0.89 (n = 89)	0.91 (n = 83)	0.93 (n = 56)
Competitor Products	0.92 (n = 66)	0.91 (n = 55)	0.95 (n = 36)
Needs Analysis	0.92 (n = 88)	0.90 (n = 61)	0.95 (n = 27)

An examination of the α-values in Exhibit 5.7 reveals coefficient values that are high by accepted standards (Nunnally 1978, p. 245). This is indicative of good convergent validity; however, an important point should be kept in mind when u · g these results in an assessment of validity for the protocol employed for this study. The information units evaluated are, in general, not the same for each scale completion. There are many cases where they are the same. Exhibit 5.5 reveals some of these. The information unit 'Customer Information Records' appears for a high portion of subjects for job aspects 1, 2, and 6. The information unit 'InfoPac' also makes frequent appearances. However, in general, a different information unit is referenced during the completion of each of the 18 scales. This suggests that some caution should be exercised when taking the high α-values as an indication of high convergent validity. If any interpretation is to be placed on the observed values, it should probably refer *not* to the validity of the scales for evaluating specific information units *but instead* to the validity of the scales for evaluating the information set utilized for its respective job aspect. From this interpretive viewpoint, the high observed α-values would be consistent with those exhibited by a protocol that yields information set values with a high level of convergent validity.

Unit-Level Validity Assessment: A Summary

Two validity issues arose from research operations at the information unit level: (1) the extent to which values are obtained in respect of the complete job aspect information set, and (2) the performance of the scales used to capture the raw data that enters the determination of these values. The first of these was assessed by observing the convergence between the extent of information identified and the extent of information chosen for detailed evaluation. Figures (Exhibit 5.6) indicate a high level of convergence in this respect. This convergence was also corroborated by an assessment of the extent of information set coverage estimated by subjects. The second issue was addressed through the determination of reliability coefficients for each of the information unit evaluation scales. The observed coefficients (Exhibit 5.7) are indicative of high levels of convergent validity. These results suggest that the operations at the information unit level provide a valid foundation for the derivation of values at the information set level.

5.6 INFORMATION SETS: VALIDITY ASSESSMENT

Nine measures were obtained for each of the six information sets. These nine values attempt to capture, a_j, the adequacy of the information set used for the j^{th} job aspect. Recall that eight of the measures (r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j) are determined by applying the set of information unit importance scores, $\{ui_{1,j}, ui_{2,j}, ui_{3,j}\}$, to the eight sets of information unit evaluation scores, $\{ur_{1,j}, ur_{2,j}, ur_{3,j}\}$, $\{ut_{1,j}, ut_{2,j}, ut_{3,j}\}$, . . . $\{uv_{1,j}, uv_{2,j}, uv_{3,j}\}$ using the definitions:

$$r_j = \frac{(ur_{1,j}\, ui_{1,j}) + (ur_{2,j}\, ui_{2,j}) + (ur_{3,j}\, ui_{3,j})}{(ui_{1,j} + ui_{1,j} + ui_{1,j})} \quad \ldots . (5.10)$$

$$t_j = \frac{(ut_{1,j}\, ui_{1,j}) + (ut_{2,j}\, ui_{2,j}) + (ut_{3,j}\, ui_{3,j})}{(ui_{1,j} + ui_{1,j} + ui_{1,j})} \quad \ldots . (5.11)$$

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•

$$v_j = \frac{(uv_{1,j}\, ui_{1,j}) + (uv_{2,j}\, ui_{2,j}) + (uv_{3,j}\, ui_{3,j})}{(ui_{1,j} + ui_{1,j} + ui_{1,j})} \quad \ldots . (5.17)$$

The values for unit importance, $ui_{1,j}$, $ui_{2,j}$, $ui_{3,j}$, were captured on the graphic positioning scale shown in Exhibit 4.7. Descriptive statistics on these quantities are shown in Appendix 5.4. Values for the ninth manifest, o_j, were supplied directly by subjects on the scale shown in Exhibit 4.10. These operations produced a set of values for the elements of $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$ for each a_j.

Validity Assessment Approach

Validity assessment at the information set level is made more convenient if each a_j is treated as a latent variable. From this perspective, the issues of convergent and discriminant validity arise just as they did for the antecedent constructs of the research model. Accordingly, an assessment of validity at the information set level would be concerned with the extent to which the elements of $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$ converge on a_j and how each a_j and its manifests diverge from all other a_j's and their manifests. However, as was the case with variables at the information unit level, variables at information set level do not enjoy the context of a structural model for validity assessment. Consequently, more traditional approaches were employed.

In order to observe how each manifest is related to other manifests in the same 'a_j-measurement set' (convergence) and to observe how each manifest is related to other a_j's (divergence), a principal components analysis was performed on all the manifest variables defined at the information set level. Doing so involved the application of a more widely used approach than PLS; however, two problems should be noted with the extraction of principal components in the factor analytic tradition vis-a-vis the specifics of this research situation: (1) unlike principal component derivation in PLS, the extraction of components is not sensitive to theoretical considerations (and is said to be atheoretical) and (2) the ratio of cases to manifest variables (89:54 or 1.6:1) is low.

The first problem simply arises from the nature of the analytic technique (and is overcome by using second generation techniques such as PLS). This issue receives further attention in what follows. The second problem relates to the reliability with which extracted factors can be observed. Stevens (1986) warns that "factor analysis done on 30 or 40 item scales with N's around 100 should be treated with considerable caution, since the results are unlikely to replicate" [p. 345]. With what is in effect a 54-item scale applied to 89 subjects, the results of principal components should indeed be viewed cautiously.

The derivation of principal components in the factor analytic tradition is atheoretical in that factors are constructed (1) without reference to a nomological network of hypothesized relationships between constructs and (2) without a set of correspondence hypotheses which explicitly link each manifest with its intended construct. Consequently, with this approach there is no mechanism to associate a manifest or a set of manifests with a specific latent variable. The manifest becomes associated with other manifests and converges on a factor or factors on the basis of its correlations with those other manifests. This arises as a consequence of the factor analytic approach being driven solely by the structure of the correlations between the manifest variables. In comparison, a structural modeling approach such as PLS combines the structure of the correlations with theories about the constructs, their interrelationships, and how they should be measured.

Principal Components Analysis

Exhibit 5.8 shows the results of the principal components analysis on all the manifests for $a_1, a_2, \ldots, a_6$. A total of 54 variables entered the analysis. For consistency with the research model, the number of factors to be extracted was restricted to six.[3] No restrictions were placed on the association of the 54 variables (and none can be because of the atheoretical nature of the factor analytic approach). The figures shown in Exhibit 5.8 are the factor loadings after varimax rotation. Boxes have been placed around the loadings whose manifests were hypothesized to converge collectively.

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3 Without this restriction, seven factors were extracted; however, the seventh factor has an eigenvalue of 1.2 and its inclusion would raise the amount of variance extracted from 80.1% to 82.3%. All factors beyond the seventh have eigenvalues less than 1.0.

EXHIBIT 5.8

Factor Analytic Principal Components Using Information Set Manifests

(Loadings x 10^3)

	a_3-factor	a_5-factor	a_6-factor	a_2-factor	a_1-factor	a_4-factor
r_1	118	38	299	208	808	- 82
t_1	- 103	18	253	225	808	5
l_1	53	- 32	203	170	835	1
s_1	82	138	255	119	787	79
c_1	40	- 44	243	289	792	- 3
w_1	- 108	0	351	169	775	32
u_1	22	18	279	297	792	98
v_1	19	133	237	311	707	161
o_1	109	92	319	63	770	- 128
r_2	- 54	108	151	874	157	101
t_2	- 183	- 14	199	713	295	66
l_2	- 131	12	97	864	187	203
s_2	- 42	47	155	852	152	166
c_2	- 64	- 35	250	839	257	92
w_2	- 141	39	287	842	159	207
u_2	- 95	1	30	808	98	214
v_2	- 34	- 15	144	862	184	85
o_2	37	61	217	753	226	- 104
r_3	983	41	- 25	- 65	- 0	68
t_3	985	54	23	- 64	29	52
l_3	984	65	9	- 47	43	69
s_3	973	79	- 12	- 128	- 3	95
c_3	984	63	- 7	- 64	19	84
w_3	984	52	- 14	- 66	42	67
u_3	977	70	14	- 90	31	86
v_3	973	74	34	- 21	30	94
o_3	980	49	- 9	- 67	8	14
r_4	14	89	48	20	15	861
t_4	- 22	34	588	3	208	488
l_4	- 35	- 96	101	53	21	850
s_4	172	6	60	- 4	35	786
c_4	168	56	130	133	116	785
w_4	80	59	- 29	89	- 38	757
u_4	- 6	- 9	155	142	16	751
v_4	26	25	79	80	- 83	723
o_4	89	10	7	118	11	415

Exhibit 5.8 continues on the next page.

EXHIBIT 5.8 (Continued)

Factor Analytic Principal Components Using Information Set Manifests

(Loadings x 10^3)

	a_3-factor	a_5-factor	a_6-factor	a_2-factor	a_1-factor	a_4-factor
r_5	74	960	-27	-17	-26	67
t_5	27	944	132	28	52	9
l_5	1	951	25	56	42	45
s_5	77	962	-92	10	-8	29
c_5	49	944	-147	40	34	42
w_5	24	954	108	35	78	-14
u_5	110	941	-65	-44	-53	106
v_5	123	932	87	54	119	-10
o_5	51	873	149	35	56	-87
r_6	-59	67	827	201	195	65
t_6	-11	9	799	115	331	113
l_6	-40	-5	839	146	285	87
s_6	6	49	799	137	282	131
c_6	4	20	816	182	171	17
w_6	82	13	879	197	240	101
u_6	8	-5	804	189	268	124
v_6	47	98	780	172	210	82
o_6	-6	-76	782	132	204	-56

An examination of the loadings shows that, with one exception, the manifests group themselves as hypothesized. In other words, each element of $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$ loads most highly on the same factor with which all the other elements of the set load most highly. The one exception is t_4 which loads more highly on the 'a_6-factor' than it does on the 'a_4-factor.' In addition, for all but two of the manifests (t_4 and o_4) the loading values exceed 0.7, indicating that the underlying factor accounts for in excess of 50% of the variance in each manifest. On the basis of these two outcomes, manifest-factor association and loading-levels in excess of 0.7, the manifests values for each a_j display reasonably strong convergent validity.

An assessment of discriminant validity relies on a comparison of loadings and cross-loadings. As was previously discussed, adequate levels of discriminant validity are evidenced when the loading of a manifest on its hypothesized factor exceeds the loadings of that manifest on all its unhypothesized factors. The atheoretical nature of principal component analysis (in a factor analytic context) does not provide a distinction between hypothesized and unhypothesized factors. This presents a problem in the assessment of discriminant validity. For purposes here, hypothesized factors were taken to be those indicated by the blocks of convergent measures evidenced in Exhibit 5.8. The reader will easily see the problem with this approach had these 'blocks of convergence' not emerged as clearly as is seen in Exhibit 5.8. By treating the blocks (shown as the boxed cells in Exhibit 5.8) as hypothesized factors, loadings can be distinguished from cross-loadings. An examination of these loadings and cross-loadings indicates that the conditions for discriminant validity are satisfied for all but one of the manifests (t_4).

Information Set Manifest Components

The loadings in Exhibit 5.8 for the 'a_3-factor' and the 'a_5-factor' are substantially above those in the other 'factor' blocks. This outcome led the researcher to investigate the correlational structure of the components of eight of the nine a_j-manifests. Recall that the ninth manifest, o_j, is captured directly from responses supplied in the protocol booklet while the other eight (r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j) are derived from combinations of protocol booklet responses. Equations (5.10) through (5.17) indicate the components for each of these eight manifests. Equation (5.10) shows r_j consisting of component sets $\{ui_{1,j}, ui_{2,j}, ui_{3,j}\}$ and $\{ur_{1,j}, ur_{2,j}, ur_{3,j}\}$; Equation (5.11) shows t_j consisting of $\{ui_{1,j}, ui_{2,j}, ui_{3,j}\}$ and $\{ut_{1,j}, ut_{2,j}, ut_{3,j}\}$ and so on through to Equation (5.17) which shows v_j consisting of $\{ui_{1,j}, ui_{2,j}, ui_{3,j}\}$ and $\{uv_{1,j}, uv_{2,j}, uv_{3,j}\}$. In each of these eight cases the second component set is unique to each manifest while the first set is common to all eight manifests.

From the UIS-related conceptual developments in Chapter 3, there is an expectation that the unique components will be correlated across all the manifests for each a_j, an expectation that is supported by the reliability coefficients shown in Exhibit 5.7. However, because $\{ui_{1,j}, ui_{2,j}, ui_{3,j}\}$ is common to all manifests, the observed convergence among 'a_j-factor' loadings could be attributable not to the expected association between unique component sets but instead to correlations between this common component set and the unique component sets. These correlations could result from the importance ratings of the information units ($ui_{1,j}$, $ui_{2,j}$, $ui_{3,j}$) dominating the information unit traits (i.e., reliability of units ($ur_{1,j}$, $ur_{2,j}$, $ur_{3,j}$), timeliness of units ($ut_{1,j}$, $ut_{2,j}$, $ut_{3,j}$), and so on) to such an extent that the high observed loadings should be largely attributed to the importance ratings and not primarily to the UIS-based measures used in the set of manifests for each a_j. Some correlation between unique and common components can be reasonably expected since individuals would likely place greater importance on higher quality sources. However, there is little to suggest that information unit importance should dominate to the extent that it substantially accounts for the convergence between measures in the same a_j-measurement set.

Exhibit 5.9 shows the correlations between the definitional components of the information set manifests for each a_j. The levels of correlation vary widely, from -0.16 for CORR($ui_{1,2}$, $us_{1,2}$) to 0.65 for CORR($ui_{1,3}$, $us_{1,3}$). The highest levels of correlation across all information unit traits were realized for $ui_{1,3}$ and $ui_{3,5}$. These are associated with the 'a_3-factor' and the 'a_5-factor,' respectively, and account to some extent for the higher observed convergence for the measures associated with these two 'factors.' Exhibit 5.10 summarizes the shared variance between the common and unique component sets for each

a_j-measurement set. Here, the dominance of $ui_{1,3}$ and $ui_{3,5}$ is more clearly seen, although the average levels of shared variance (at 0.295 and 0.226, respectively) do not indicate an excessive amount of communality between common and unique definitional components. Overall, the shared variance figures in Exhibit 5.10 indicate that the two components are generally independent.

One other condition associated with the a_3- and a_5-measurement sets will also contribute to higher loadings observed in these two cases. The number of non-zero information set scores for each of a_3 and a_5 was substantially below those for the other 'factors.' Column (5) of Exhibit 5.10 shows this number for each information unit across all job aspects. The reader will recall from discussions in Chapter 4 that zero-valued information set scores are assigned when, inter alia, the subject utilizes no information source for the job aspect in question. When this condition occurs, zero-values are recorded for both the unique and common components for each manifest of a_j. In general, the inclusion of these zero datum points with the non-zero datum points increases the correlation between the unique and common components for each of the eight manifests of a_j. A review of the figures in Column (5) shows that the number of zero-valued manifest sets is greatest for 'Relationship Value' and 'Competitor Products.' These correspond to the 'a_3-factor' and the 'a_5-factor' of Exhibit 5.8, respectively. As a consequence of this increased correlation, loadings for these two 'factors' should display heightened levels, a result consistent with the loading values shown in Exhibit 5.8.

EXHIBIT 5.9

Correlations Between Definitional Components of the Information Set Manifests

	ur_{kj}	ut_{kj}	ul_{kj}	us_{kj}	uc_{kj}	uw_{kj}	uu_{kj}	uv_{kj}	n
Prospecting:									
ui_{11}	0.29	0.09	0.10	0.13	0.15	0.34	0.25	0.11	87
ui_{21}	0.45	0.40	0.36	0.33	0.40	0.36	0.22	0.17	82
ui_{31}	0.36	0.33	0.29	0.23	0.27	0.30	0.23	0.21	59
Service:									
ui_{12}	0.07	0.02	0.08	- 0.16	- 0.03	- 0.09	0.07	0.07	87
ui_{22}	0.12	0.11	0.13	0.06	0.01	0.01	0.02	- 0.02	76
ui_{32}	0.22	0.17	0.18	0.30	0.53	0.31	0.37	0.59	51
Relationship Value:									
ui_{13}	0.62	0.63	0.51	0.65	0.54	0.49	0.44	0.41	45
ui_{23}	0.34	0.04	0.34	0.15	0.24	0.38	0.17	0.19	33
ui_{33}	0.20	0.38	0.45	0.40	0.46	0.52	0.48	0.17	21
Product Knowledge:									
ui_{14}	0.30	0.15	0.26	0.20	0.07	- 0.01	0.11	0.17	89
ui_{24}	0.17	0.18	0.24	0.22	0.12	0.22	0.20	0.09	83
ui_{34}	0.47	0.32	0.44	0.45	0.45	0.51	0.47	0.21	56
Competitor Products:									
ui_{15}	0.21	- 0.02	0.17	0.25	0.23	0.19	0.32	0.19	66
ui_{25}	0.13	- 0.10	0.09	0.08	0.13	- 0.01	0.19	- 0.10	55
ui_{35}	0.43	0.52	0.52	0.61	0.43	0.24	0.35	0.60	36
Needs Analysis:									
ui_{16}	0.16	0.20	0.14	0.11	0.23	- 0.01	0.09	0.19	88
ui_{26}	0.17	0.18	0.10	0.41	0.12	0.13	0.05	0.06	61
ui_{36}	0.40	0.30	0.40	0.33	0.10	0.38	0.23	0.36	27

EXHIBIT 5.10

Shared Variance Between Definitional Components of the Information Set Manifests

	Minimum r^2	Maximum r^2	Mean r^2	n
Prospecting:				
ui_{11}	0.008	0.118	0.042	87
ui_{21}	0.028	0.200	0.119	82
ui_{31}	0.045	0.127	0.079	59
Service:				
ui_{12}	0.000	0.025	0.007	87
ui_{22}	0.000	0.017	0.006	76
ui_{32}	0.028	0.347	0.133	51
Relationship Value:				
ui_{13}	0.166	0.425	0.295	45
ui_{23}	0.002	0.144	0.065	33
ui_{33}	0.029	0.270	0.161	21
Product Knowledge:				
ui_{14}	0.000	0.089	0.033	89
ui_{24}	0.008	0.056	0.034	83
ui_{34}	0.044	0.258	0.180	56
Competitor Products:				
ui_{15}	0.000	0.101	0.046	66
ui_{25}	0.000	0.035	0.013	55
ui_{35}	0.056	0.371	0.226	36
Needs Analysis:				
ui_{16}	0.000	0.053	0.024	88
ui_{26}	0.002	0.171	0.035	61
ui_{36}	0.010	0.163	0.108	27

The Ninth Information Set Manifest

The ninth manifest, o_j, is hypothesized to reflect the level of satisfaction with the entire information set utilized for the j^{th} job aspect. As mentioned in Chapter 4, its convergence with the other eight manifests (r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j) of a_j is another indication of the validity of capturing the traits of the entire information set by evaluating, at most, three distinct information units. Exhibit 5.11 shows the correlations between each o_j and the other eight manifests of a_j that are associated with o_j. With the exception of o_4, the correlations are generally high. The low correlations for o_4 indicate poor support for the validity of the three-unit limit in the case of 'Product Knowledge,' a result inconsistent with the validity assessment in this respect at the information unit level (note Exhibit 5.6 and its associated discussion). These low correlational levels account for the failure of o_4 to load highly on its hypothesized factor (see Exhibit 5.8). Correlations for o_3 and o_5 display the highest levels of convergence; however, as discussed above, these correlations are affected by the presence of high numbers of zero-valued manifest sets.

Set-Level Validity Assessment: A Summary

The primary validity issue here is the extent to which the nine manifests comprising the set $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$ capture a_j, the adequacy of the information set used for the j^{th} job aspect. The results of a principal component analysis on the 54 manifests for a_1 through a_6 indicate, with two exceptions, reasonably strong levels of convergent and discriminant validity. An analysis of the correlational structure of the components of eight of the nine manifests for a_1 through a_6 suggests that convergence occurs as hypothesized. In other words, the eight manifests converge primarily as a consequence of their validity as reflective indicators and not largely as a consequence of an inter-manifest correlation induced by the information unit importance rating common to these eight manifests. With

EXHIBIT 5.11

Correlations Between Each o_j and its Associated Information Set Manifests

(n = 89)

	r_j	t_j	l_j	s_j	c_j	w_j	u_j	v_j
o_1	0.71	0.67	0.69	0.66	0.64	0.66	0.69	0.64
o_2	0.68	0.65	0.61	0.74	0.71	0.73	0.48	0.67
o_3	0.97	0.97	0.97	0.97	0.97	0.98	0.96	0.95
o_4	0.34	0.13	0.30	0.38	0.38	0.10	0.23	0.39
o_5	0.80	0.82	0.82	0.79	0.77	0.84	0.77	0.84
o_6	0.64	0.65	0.67	0.61	0.65	0.69	0.67	0.67

one exception, the ninth manifest for each of a_1 through a_6 converges with its associated manifests. While these results are generally supportive of the validity of research operations at the information set level, they should be viewed with some caution. This caution arises from two concerns: (1) the low case to variable ratio which faced the extraction of principal components, and (2) the departure from normality and the inflated correlations arising from a high number of zero-valued manifests for two of the job aspects.

5.7 INFORMATION INTEGRATION MANIFESTS: DEFINITIONAL COMPONENTS

As attention is moved from the information set level to the information integration manifest level, a similar concern with importance ratings arises. Ratings at the information integration manifest level are those for the relative importance of the six job aspects (versus those at the information set level for the relative importance of the information units within a job aspect). As seen from Exhibit 4.11, the manifests of a_j are multiplied by κ_j to form the manifests for each ξ_j. These operations produce a set of information integration manifests given by:

$R_j = \kappa_j r_j$		(Reliability)
$T_j = \kappa_j t_j$		(Timeliness)
$L_j = \kappa_j l_j$		(Relevancy)
$S_j = \kappa_j s_j$		(Confidence in Systems)
$C_j = \kappa_j c_j$		(Completeness)
$A_j = \kappa_j w_j$		(Accuracy)
$U_j = \kappa_j u_j$		(Currency)
$V_j = \kappa_j v_j$		(Volume)
$O_j = \kappa_j o_j$		(Overall Satisfaction)

The issues of convergent and discriminant validity for these manifests were discussed earlier in the chapter. Considerable support was observed for both forms of validity. However, the previous assessment did not examine the definitional components of the elements of $\{R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, O_j\}$. Consequently, it is not known whether the observed convergence should be attributed to the validity of the manifests as reflective indicators of their underlying information integration component *or* whether the observed convergence results from correlations between κ_j and the elements of $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$. The latter could possibly result from a 'halo' effect whereby information unit traits are rated according to the importance of the job aspect with which these information units are associated.

Convergence of Definitional Components

Exhibit 5.12 shows the correlations between each κ_j and the associated set of manifests $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$ used to form $\{R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, O_j\}$.

EXHIBIT 5.12

Correlations Between κ_j and the Manifests for a_j

(n = 89)

		κ_1	κ_2	κ_3	κ_4	κ_5	κ_6
Reliability	r_j	0.15	- 0.10	0.15	0.06	0.22	- 0.14
Timeliness	t_j	0.03	0.01	0.16	- 0.21	0.20	- 0.10
Relevancy	l_j	0.20	0.02	0.15	0.05	0.24	- 0.02
Confidence in Systems	s_j	0.15	0.01	0.14	0.03	0.21	- 0.11
Completeness	c_j	0.08	0.05	0.17	0.01	0.28	- 0.05
Accuracy	w_j	0.14	0.03	0.19	0.09	0.20	- 0.08
Currency	u_j	0.02	- 0.03	0.16	0.16	0.26	- 0.11
Volume	v_j	0.09	- 0.15	0.19	0.15	0.24	- 0.10
Overall Satisfaction	o_j	0.05	- 0.03	0.19	- 0.08	0.18	- 0.01
Average Shared Variance		0.014	0.004	0.028	0.012	0.052	0.008

Generally, these correlations are low, none exceeds 0.28 and most are considerably less than 0.20. The figures in Exhibit 5.12 for the average variance shared by κ_j with each element of $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$ are low, all are less than 6%. This is an indication that the convergence of the elements of $\{R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, O_j\}$ cannot be substantially accounted for by the correlations between κ_j and the elements of $\{r_j, t_j, l_j, s_j, c_j, w_j, u_j, v_j, o_j\}$. This result lends support to the assertion that the elements of $\{R_j, T_j, L_j, S_j, C_j, A_j, U_j, V_j, O_j\}$ converge on ξ_j as a consequence of their validity as reflective indicators of the f_j-component of information integration.

Divergence of Definitional Components

The issue of divergence is also relevant at this measurement level. Because the κ's are multiplicative factors in each component of information integration ($\xi_j = a_j \kappa_j$), the level of independence of the independent constructs will be affected by correlation between the κ's. This is of particular concern here, because there will necessarily be some level of correlation between the κ's as a consequence of the restriction (seen and discussed in Chapter 3) that $\Sigma\kappa_j = 1$. Exhibit 5.13 shows the correlations between the κ's. With the exception of κ_1, the correlations are generally low. The correlations between κ_1 and the other κ's suggest the primary importance of its associated job aspect ('Prospecting'). These correlations are not low and they are all negative. This is probably indicative of how points were allocated when subjects were faced with the constant sum restriction: they allocated points to 'Prospecting' and distributed whatever was left across the remaining job aspects, a behavior that the researcher frequently observed as subjects provided responses in this respect.

The level of correlation between κ_1 and the other κ's did not manifest itself in the form of severe problems with discriminant validity for its associated construct, ξ_1. Referring again to Exhibits 5.3 and 5.4, the reader can see that adequate levels of discriminant validity for ξ_1 were realized despite the correlational situation with κ_1. However, an examination of the cross-loadings in Exhibit 5.3 will indicate how the correlations between κ_1 and the other κ's affected the divergence of ξ_1's manifests. All cross-loadings with other independent constructs are negative, a result attributable to the negative correlations between κ_1 and the other κ's (shown in Exhibit 5.13).

EXHIBIT 5.13

Job Aspect Importance - Intercorrelations

(n = 89)

		κ_1	κ_2	κ_3	κ_4	κ_5	κ_6
Prospecting	κ_1	1.00					
Service	κ_2	- 0.39	1.00				
Relationship Value	κ_3	- 0.45	0.06	1.00			
Product Knowledge	κ_4	- 0.55	- 0.13	0.21	1.00		
Competitor Products	κ_5	- 0.30	- 0.18	0.05	0.32	1.00	
Needs Analysis	κ_6	- 0.46	- 0.28	- 0.07	0.12	- 0.00	1.00

PLS Estimation Bias

One other point should be made with respect to the high loading values observed for the information integration manifests. PLS generally over-estimates λ's, with over-estimation being more pronounced when reflective indicator modes are used than when formative indicator modes are used (Dijkstra 1983). Since the only indicator mode used in the PLS representation of the research model is reflective, this bias toward over-estimation can be expected to contribute to the high λ values. To help assess the extent of this effect, a principal component analysis (in the factor analytic tradition) was performed using the 54 information integration manifests. As previously discussed, the results of extracting principal components in this manner must be cautiously interpreted in view of the atheoretical nature of the procedure and the low case-to-variable ratio. However, an extraction of these components will provide some indication of the extent of the over-estimation.

EXHIBIT 5.14

Principal Components Factor Loadings

(Loadings x 10^3)

		ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6
Reliability	R_j	862	955	983	947	965	972
Timeliness	T_j	871	936	984	826	976	974
Relevancy	L_j	877	957	987	952	983	972
Confidence in Systems	S_j	885	951	980	939	965	974
Completeness	C_j	893	959	987	948	967	970
Accuracy	A_j	875	967	984	940	978	980
Currency	U_j	901	947	982	950	963	974
Volume	V_j	890	954	987	942	977	967
Overall Information Satisfaction	O_j	828	934	985	933	898	957

Exhibit 5.14 shows the loadings generated from the principal components factor analysis. Exactly six factors with eigenvalues exceeding 1.0 were extracted. The six accounted for 95.7% of the total variance in the factor solution generated. A comparison of these loadings with those in Exhibit 5.1 shows the PLS-generated loadings to be higher, a result consistent with caveat of over-estimation. However, the non-PLS loadings are themselves quite high. This suggests that the high loading values are only partially accounted for by the computational behavior of PLS. This provides further support to the assertion that, to a very great degree, the loading values arise as a consequence of the validity of the manifests as reflective indicators of their underlying constructs and are, to a much lesser degree, artifacts of the procedure used to estimate them.

5.8 SUMMARY

The major analysis task addressed by this chapter is assessing the ability of research operations described in Chapter 4 to capture valid manifestations of the research model proposed in Chapter 3. In general, results indicate that these operations captured the model's constructs with adequate levels of validity. All 58 epistemic relationships were found to be valid reflections of their constructs. The strongest indications of validity were found in the measurement model for the antecedent constructs. This part of the research model consists of four definitional levels. The highest two levels (the construct level and the information integration manifest level) have the context of a nomological net within which PLS-based hypothesis testing and validity assessments took place. High levels of both discriminant and convergent validity were observed at both levels.

The remaining two definitional levels (the information unit level and the information set level) had their validity assessments take place using more traditional approaches (reliability coefficients and factor analytic principal components extraction). These levels did not have the nomological framework needed for PLS-based validity assessments. An important concern was the impact of the three-unit limitation on capturing valid manifestation of information set adequacy. Results indicate that this limitation was not an impediment in obtaining such manifestations. Analysis at these levels also indicates that the measures of validity obtained at higher definitional levels may be inflated to some extent by inter-correlation among definitional components. However, it appears that any accentuation of validity indicators is not excessive and that results are generally supportive of the ability of research operations to capture valid manifestations of the constructs of the research model. These findings made it possible to proceed to an evaluation of the structural component of the research model, the subject matter of Chapter 6, in which the hypothesized relationships among constructs are examined.

CHAPTER 6

STRUCTURAL MODEL EVALUATION

The results of the measurement model evaluation reported in Chapter 5 suggest that the structural model can be evaluated with an adequate level of interpretative confidence. Measurement model components appear to have adequately captured the research model's constructs. High levels of convergent and discriminant validity were observed at both the measurement level and the construct level. Consequently, the proposed research model displays a high level of construct validity, an outcome critical to undertaking an assessment of the validity of the hypothesized structural relationships between constructs. Poor construct validity confuses inner (or structural) relationships with outer (or measurement) relationships and makes an assessment of the validity of the structural relationships difficult. Good construct validity lets us proceed with a task central to this chapter, evaluating the significance and strength of the relationships between constructs.

Chapter Overview

This chapter begins with an examination of the validity of the set of Critical Success Factors (formally denoted in previous conceptual developments by $F \equiv \{f_1, f_2, \ldots, f_D\}$). The variability of the importance ratings for each factor as well as the completeness of the set of factors is examined. These factors are the fundamental basis on which the conceptual developments in Chapter 3 are founded and on which the detailed research protocol described in Chapter 4 is constructed. It is difficult to underestimate the importance of obtaining a valid set of CSFs. The existence of a CSF is hypothesized to bring into existence a corresponding construct of information integration and two structural relationships linking each information integration construct with the two dependent performance constructs. Consequently, the comprehensiveness of the structural model rests entirely on the completeness of $\{f_1, f_2, \ldots, f_D\}$ and the validity of each of its elements.

The chapter continues with an examination of the model's structural relationships. The primary issue addressed is that of statistical conclusion validity which assesses the extent of concomitant variation between constructs. This assessment takes the form of discussions on the generation and testing of the PLS path coefficients representing the structural relationships (seen previously in Exhibits 3.14 and 4.5). These coefficients are reviewed in the light of concerns about both statistical significance and managerial significance. The chapter concludes with a discussion of the match or 'fit' between the research model and the data obtained from research operations.

6.1 VALIDITY OF CRITICAL SUCCESS FACTORS

Recalling the conceptual developments in Chapter 3, κ_j was used to denote the importance of a CSF (or 'job aspect'). The observed values for κ_1 through κ_6 provide an indication of the validity of the CSFs (factors f_1 through f_6) that are used as the basis for the six information integration components. As reported in Chapter 4, these factors initially emerged during the CSF-identification sessions that were conducted with the group of senior executives. Exhibit 4.4 provides the results of an analysis on κ_1 through κ_6 based on data collected during the pre-test on 13 subjects that followed the identification sessions. The pre-test results provide support for the validity of the CSFs identified by the executive group. However, the small number of subjects used in the pre-test is an insufficient basis on which to adequately assess the validity of the CSFs. The 89 subjects participating in the final test provided an opportunity for an improved assessment of CSF validity.

The protocol booklet used in the final test contained the same constant-sum points distribution method for capturing κ_1 through κ_6 that was used in the pre-test. Recall from Chapter 4 that this method required subjects to allocate 100 points across the six CSFs in a way that reflects the importance to them of each CSF. This is consistent with the restriction discussed in Chapter 3 that $\Sigma\kappa_j = 1$. Recall also that subjects were given the opportunity to add other factors to the 'critical list' with the proviso that the number of points assigned to new factors must come at the expense of factors in the hypothesized (proposed) CSF list. The worksheet used for points allocation is seen on page 70 of the protocol booklet. (See Appendix 4.2.)

Job Aspect Importance Variability

Exhibit 6.1 shows descriptive statistics on the κ_j for each of the six job aspects. Considerable variation is seen both within and across the six aspects. 'Prospecting' displays both the highest mean value (37.2) for job aspect importance as well as the widest range (76.5). This aspect is followed in importance by 'Service' and 'Needs Analysis' with means of 21.0 and 19.2 and ranges of 71.0 and 68.0, respectively. The remaining three aspects ('Relationship Value', 'Product Knowledge', and 'Competitor Products') show substantially lower mean importance ratings (at 7.0, 10.6, and 5.0, respectively). A comparison of the maximum values for the three least importance job aspects with the minimum values for the three most important job aspects shows an overlap in distributions. Such results are indicative of substantial variation across subjects not only in the importance assigned to the six job aspects but also in their order of importance.

A Student-Newman-Keuls (SNK) range test was applied to the data for κ_1 through κ_6 to statistically test for differences in importance ratings. κ_1 ('Prospecting') and κ_4 ('Product Knowledge') were differentiated from all other κ's at the 5% level of

EXHIBIT 6.1

Job Aspect Importance - Descriptive Statistics

(n = 89)

Job Aspect	κ	Mean	Standard Deviation	Minimum	Maximum
Prospecting	κ_1	37.2	16.7	8.5	85.0
Service	κ_2	21.0	10.6	4.0	75.0
Relationship Value	κ_3	7.0	5.9	0.0	40.0
Product Knowledge	κ_4	10.6	6.6	0.0	33.0
Competitor Products	κ_5	5.0	4.6	0.0	20.0
Needs Analysis	κ_6	19.2	10.2	2.0	70.0
	Total	100.0			

significance. κ_2 ('Service') was differentiated from all other κ's except κ_6 ('Needs Analysis') at the 5% level while κ_3 ('Relationship Value') was differentiated from all other κ's except κ_5 ('Competitor Products') at the 5% level. This result confirms the notion that CSFs vary in importance. By combining the mean values of κ_1 through κ_6 with the results of the SNK range test, a four-level hierarchy of job aspect importance can be observed. At the first level in the importance hierarchy is 'Prospecting.' This is followed by the second level in which 'Service' and 'Needs Analysis' are equally important. 'Product Knowledge' occupies the third level in the importance hierarchy while 'Relationship Value' and 'Competitor Products' show equal importance at the fourth level.

CSF Set Completeness

For the most part, subjects in the final test agreed with those in the pre-test and with the group of senior executives that $\{f_1, \ldots, f_6\}$ constituted a complete set of CSFs.

However, there were some instances where subjects used a subset of $\{f_1, \ldots, f_6\}$ and other instances where factors not in $\{f_1, \ldots, f_6\}$ were identified. The job aspects 'Relationship Value' and 'Competitor Products' were associated with substantial numbers of zero-valued κ's. The zero κ-value shown in Exhibit 6.1 for 'Relationship Value' was supplied by seven subjects while that for 'Competitor Products' was supplied by 18 subjects. Only one subject assigned a zero-value to the κ for 'Product Knowledge.'[1] These results indicate that the set of CSFs at an individual level differs from the set of CSFs at the organizational level. In the case of these three factors, a subset of $\{f_1, \ldots, f_6\}$ is being employed. This presents no particular problem for the analyses undertaken here as long as the condition $\Sigma\kappa_j = 1$ is maintained with respect to the six hypothesized factors. In other words, the definitions proposed in Chapter 3 can be readily applied as long as no new CSFs are added. Those subjects responding with zero κ-values were simply assigned zero levels of information integration for the respective component, ξ_j, an action readily derived from the definition of an information integration component wherein $\xi_j = a_j\, \kappa_j$.

When subjects identified a set of CSFs which was not completely a subset of $\{f_1, \ldots, f_6\}$, adjustments were necessary prior to the application of definitions in order to include the case in question in the analyses reported throughout this chapter. Such an act of inclusion is only justified if the number of such cases is very low in comparison with the total number of cases and there is some rationale for the inclusion of these cases. Only three of the 89 final-test subjects availed of the invitation to add job aspects. This

1 Exhibits 5.6 and 5.7 indicate that all 89 subjects completed the information unit rating scales. Thus, the lone subject who supplied a zero value for the importance of 'Product Knowledge' did so after identifying and rating at least one information unit in respect of this job aspect. This set of subject responses implies $a_4 \neq 0$ and $\kappa_4 = 0$. Since $\xi_4 = a_4\, \kappa_4$, the level of information integration for this subject with respect to the f_4-information integration component is zero.

represents less than 3.4% of those interviewed. These three subjects also allocated points to the additional factors they identified while maintaining the condition $\Sigma\kappa$'s = 1 across both the additional and hypothesized factors. Consequently, the condition $\Sigma\kappa_j = 1$ was not maintained with respect to $\{f_1, \ldots, f_6\}$. One subject allocated 40 points (from the total of 100) to the additional factors; a second allocated 15 points; and a third allocated 10.

Some thought was given to the elimination of these three cases. However, in view of the small sample size and the relatively high cost of acquiring each datum point, it was decided to retain the three cases. It should also be said that the several hundred other variables constituting a datum point and needing no extraordinary adjustment would each be provided with three more values if these cases were not removed. Thus, considerable information would be lost had the three cases been removed. To include these cases in the analysis, the points allocated to the hypothesized CSFs were adjusted proportionately such that $\Sigma\kappa_j = 1$ and the additional factors identified were ignored. A review of these additional factors suggested that little would be lost to the identification of a CSF set of greater validity as a consequence of their exclusion. As well, the impact of the adjustments on the mean values of κ_1 through κ_6 was negligible. The figures shown in Exhibits 5.12, 5.13 and 6.1 are those after the adjustments in this respect have taken place.

In summary, the evidence here is supportive of the validity of the set of Critical Success Factors. This was the same set initially identified by a group of senior managers and validated, in a preliminary way, by subjects in the pre-test. While many of the 89 final-test subjects identified fewer than six factors, only three subjects suggested more factors and all subjects placed at least some importance on a subset consisting of three of the CSFs: {'Prospecting', 'Service', and 'Needs Analysis'}. The complete set of six CSFs appears to be on the critical list for the majority of subjects. Additionally, the results shown in Exhibit 6.1 in combination with the SNK range test on κ_1 through κ_6 support the notion that CSFs varies in importance.

6.2 EVALUATION OF STRUCTURAL RELATIONSHIPS

The structural (or inner) model consists of the hypothesized relationships between constructs. These relationships were developed in Chapter 3 and are shown diagrammatically in Exhibit 3.12 and algebraically in Equations (3.11) and (3.12). These equations hypothesize that the independent constructs (ξ_1 through ξ_D) and the dependent constructs (η_1 and η_2) are linearly related by path coefficients (γ_{11} through γ_{2D}) as follows:

$$\eta_1 = \gamma_{11}\xi_1 + \ldots + \gamma_{1j}\xi_j + \ldots + \gamma_{1D}\xi_D + \zeta_1. \quad . \quad . \quad . \quad (3.11)$$

$$\eta_2 = \gamma_{21}\xi_1 + \ldots + \gamma_{2j}\xi_j + \ldots + \gamma_{2D}\xi_D + \zeta_2. \quad . \quad . \quad . \quad (3.12)$$

Exhibit 3.14 provides a summary of the (D x 2) research hypotheses for the structural model implied by these equations and indicates the null hypothesis to be used to test each structural relationship. Recall that D was determined to be six. Consequently, twelve (= D x 2) structural relationships required testing.

Validity Issues

The primary validity issue to be addressed when examining the structural model is internal validity. This form of validity "refers to the approximate validity with which we infer that a relationship between two variables is causal or that the absence of a relationship implies the absence of cause" [Cook and Campbell 1979, p. 37]. The issue of causality was explored in Chapter 3 with respect to the conditions of this investigation. The arguments surrounding this issue will not be repeated here, except to note that the covariation between presumed cause and effect is a necessary (but not sufficient) condition for internal validity. Establishing this covariation on the basis of statistical evidence, something Cook and Campbell (1979) refer to as statistical conclusion validity, is the primary concern at this stage in testing the research model. Assessing statistical conclusion validity was based on testing the null hypotheses involving the structural model's path coefficients (i.e., the γ's seen in Exhibit 3.14 and in Equations (3.11) and (3.12)).

Another validity issue relevant to structural model evaluation is that of nomological validity, an issue not unrelated to internal validity. Nomological validity refers to the degree to which predictions of the constructs in the model are verified (Fornell, Tellis, and Zinkhan 1982). The model's explanatory power lies at the core of this validity issue. More specifically, the main concern here is the extent to which variance in the endogenous constructs, η_1 and η_2, is explained by variance in the exogenous constructs, ξ_1 through ξ_6. The amount of variance explained is indicated by values for R^2, the coefficient of multiple correlation.

Path Coefficient Estimates

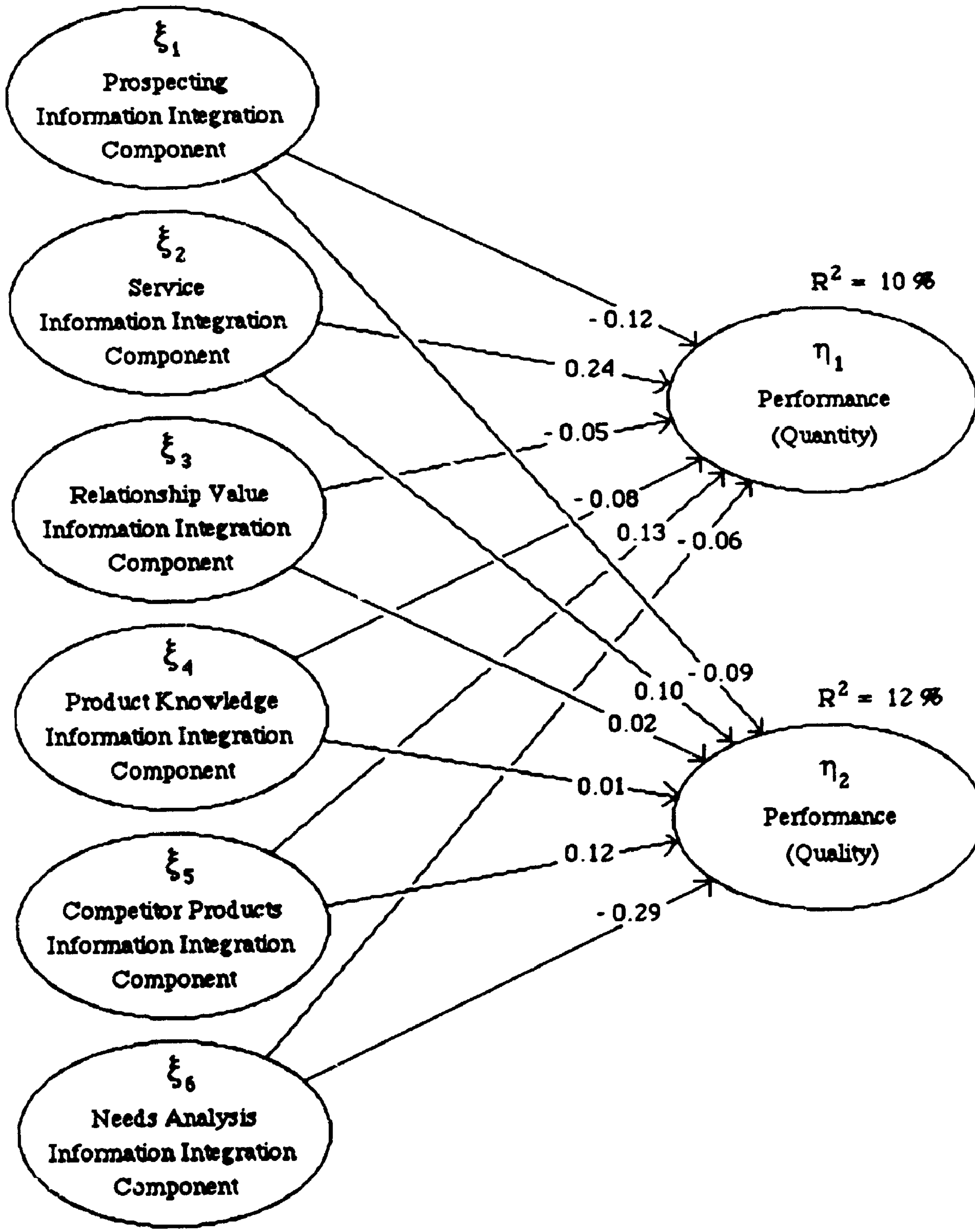
A path coefficient is a standardized regression coefficient (Pedhazur 1982, p. 628); accordingly, it represents the fraction by which the standard deviation of the dependent variable is changed as a consequence of a change of one standard deviation in the independent variable while holding the remaining variables constant (Pedhazur 1982, pages 53 and 247). Exhibit 6.2 shows the twelve path coefficients (γ_{11} through γ_{2D}) estimated by PLS. These coefficients range from - 0.29 (for γ_{26}) to 0.24 (for γ_{12}). Of the total of 12 path coefficients representing the 12 structural relationships in the research model, six are negative. Four of the six causal relationships hypothesized to impact η_1 are negative while only two of the six impacting η_2 are negative. Finding negative relationships between information usage and performance is of considerable theoretical interest. However, before discussing the implications in this respect, the path coefficients should be examined in the context of guidelines for both statistical significance and managerial significance (or meaningfulness). Doing so is critical to assessing both statistical conclusion validity and internal validity. These examinations of significance take place in the section that follows.

Variance Explained

Exhibit 6.2 also shows the R^2-values for each of the dependent constructs, indicating the portion of variance in the dependent construct that is associated with the variance in the antecedent constructs. With figures of 10% and 12%, the R^2-values could be indicative of poor nomological validity. However, these values are reasonably consistent with previous research on the antecedents of salesperson performance. As mentioned in Chapter 3, the Churchill, Ford, Hartley and Walker (1985) meta-analysis of 116 studies on such antecedents found an average R^2-value of less than than 4% across 1653 single associations. Given that both η_1 and η_2 each have six antecedents, their R^2-values (at 10% and 12%, respectively) are not out of line with the findings reported by Churchill et al. This suggests that, while these values may be indicative of low nomological validity, they are probably nomologically appropriate given the limited range of variables in the research model's nomological net. R^2-values much higher than those observed would be difficult to explain when a nomological net containing six information-related latents is compared with a nomological net consisting of all the variables, personal, organizational, competitive and otherwise, that could possibly contribute to the R^2-values for individual performance.

EXHIBIT 6.2

Structural Relationship Estimates



6.3 SIGNIFICANCE OF PARAMETER ESTIMATES

Two significance issues need to be addressed: statistical significance and managerial significance. Addressing the first significance issue was challenged by the distribution-free nature of PLS. A resort to Tukey's Jackknife procedure was needed to provide a distributional context for hypothesis testing. This procedure and its application are discussed below. Addressing the second significance issue was challenged by the lack of standard guidelines about path coefficient magnitudes and managerial significance.

Managerial Significance

Pedhazur (1982) deals with the lack of guidelines for managerial significance in his discussion on a "criterion of meaningfulness" for path coefficients:

> [M]eaningfulness is a judgmental criterion, which depends, among other things, on the specific area being studied, economic considerations, and the consequences of decisions made on the basis of the obtained results. In the absence of guidelines many researchers select a criterion for the deletion of paths arbitrarily -- say, all [path coefficients with magnitudes] < .05 are deleted [p. 617].

The area of investigation pursued here, both in terms of previous research and in terms of the specific research setting, can certainly be characterized by an "absence of guidelines" in this respect. If, "arbitrarily", .05 can be taken as a guideline, then two path coefficients, γ_{23} and γ_{24}, are managerially insignificant and at least two others, γ_{13} and γ_{16}, appear only marginally significant. It may be possible in the context of the participating organization to place a value on 'a standard deviation of performance' and consequently establish a path coefficient guideline and would be useful to the managers of that organization. Determining such an organization-specific guideline was not a primary concern of this research. A guideline for the managerial significance of path coefficients capturing the effect of information usage on performance *generally* would be of interest; however, none appear to be available and establishing such a guideline is beyond the scope of this study.

Statistical Significance

The problem of hypothesis testing in the distribution-free context of PLS was addressed through the application of Tukey's Jackknife to assess statistical significance. Jackknifing proceeds by splitting a sample into H arbitrary subsets of equal size and then forming 'new' samples by omitting each subset in turn. A PLS analysis of each of the H samples produces a set of parameter estimates, p_i^{est}, $i = 1, \ldots, H$. If we denote the value of a PLS analysis on all cases in the original sample by p_{all}^{est}, "pseudovalues" can be generated for each p_i^{est}, using:

$$P(p_i^{est}) = (H)\, p_{all}^{est} - (H - 1)\, p_i^{est} \qquad \ldots . (6.1)^2$$

Tukey (1958) asserts that these pseudovalues have approximate independent normal distributions. The mean of the pseudovalues can be regarded as a sample mean. This mean is referred to as the jackknife estimator of p_{all}^{est} and is denoted by $J(p_{all}^{est})$. The standard deviation, S, of the pseudovalues can be regarded as a sample standard deviation. The derivation of these estimates combined with the plausibility of the existence of their associated distribution permit the jackknifed parameter estimate, $J(p_{all}^{est})$, to be tested in relation to some other parameter level, p, using the following t-statistic (with H-1 degrees of freedom):

$$\frac{J(p_{all}^{est}) - p}{S / \sqrt{H}} \qquad \ldots . (6.2)^3$$

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[2] The development of Equation (6.1) is outlined in Fenwick (1979).

[3] Gray and Schucany (1972) adjust Equation (6.2) by the factor $\sqrt{(H - 1)/(2H - 1)}$ to account for possible interdependence between the pseudovalues. In general, this

The path coefficients were tested by setting p = 0 in Equation (6.2), doing so corresponds to null hypotheses in which $\gamma_{qj} = 0$ (q = 1, 2 and j = 1, . . ., 6). The number of cases in each jackknife subset was 1; consequently, 89 sub-samples were formed resulting in 89 pseudovalues being generated. These operations resulted in t-statistics for each path coefficient with H - 1 = 88 degrees of freedom.

Exhibit 6.3 provides the results of testing the path coefficients using the Jackknife procedure. Ten of the twelve path coefficients are statistically different from zero at $\alpha = 1\%$. The two path coefficients that were statistically insignificant are the same two that are managerially insignificant. Exhibit 6.3 also summarizes the correspondence between parameters, null hypotheses, inter-construct paths, and conceptual model hypotheses. Note that each conceptual model hypothesis is associated with at least one path coefficient that is both statistically and managerially significant. Equivalently, each antecedent construct for information integration is connected to a dependent performance construct by at least one significant path coefficient.

6.4 DISCUSSION OF PATH COEFFICIENTS

Exhibit 6.3 presents three structural model results that deserve particular attention: (1) path coefficients that are low and statistically insignificant, (2) path coefficients that are low yet statistically significant, and (3) path coefficients that are both statistically and managerially significant but are reversed in sign from the hypothesized direction. Four path coefficients (γ_{12}, γ_{22}, γ_{15} and γ_{25}) do not fall into any of these three classifications. They are all both managerially and statistically significant in a positive (hypothesized) direction. Results in these four cases are indicative of relationships that are consistent with

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adjustment results in conservative t-values. The values used to test the path coefficients in Exhibit 6.3 were t-values with this conservative adjustment.

EXHIBIT 6.3

Structural Model - Test Results

Conceptual Model Hypothesis	PLS Path Representation	Null Hypothesis	Parameter Estimate
$a_1\ \kappa_1 \rightarrow p$	$\xi_1 \rightarrow \eta_1$	$\gamma_{11} = 0$	- 0.12**
	$\xi_1 \rightarrow \eta_2$	$\gamma_{21} = 0$	- 0.09**
$a_2\ \kappa_2 \rightarrow p$	$\xi_2 \rightarrow \eta_1$	$\gamma_{12} = 0$	0.24**
	$\xi_2 \rightarrow \eta_2$	$\gamma_{22} = 0$	0.10**
$a_3\ \kappa_3 \rightarrow p$	$\xi_3 \rightarrow \eta_1$	$\gamma_{13} = 0$	- 0.05**
	$\xi_3 \rightarrow \eta_2$	$\gamma_{23} = 0$	0.02
$a_4\ \kappa_4 \rightarrow p$	$\xi_4 \rightarrow \eta_1$	$\gamma_{14} = 0$	- 0.08**
	$\xi_4 \rightarrow \eta_2$	$\gamma_{24} = 0$	0.01
$a_5\ \kappa_5 \rightarrow p$	$\xi_5 \rightarrow \eta_1$	$\gamma_{15} = 0$	0.13**
	$\xi_5 \rightarrow \eta_2$	$\gamma_{25} = 0$	0.12**
$a_6\ \kappa_6 \rightarrow p$	$\xi_6 \rightarrow \eta_1$	$\gamma_{16} = 0$	- 0.06**
	$\xi_6 \rightarrow \eta_2$	$\gamma_{26} = 0$	- 0.29**

** Coefficient is significant at $\alpha = 1\%$; * coefficient is significant at $\alpha = 5\%$.

conventional wisdom about the use of information and its relationship to organization-related individual performance. The remaining eight are not consistent with such wisdom.

Low and Statistically Insignificant Path Coefficients

Two of the twelve structural relationships are statistically indistinguishable from zero, γ_{23} and γ_{24}. As discussed previously, these also carry values that are of questionable managerial significance. Theoretically, this is an interesting finding since it indicates that certain CSFs may not be information-based antecedents of certain kinds of organization-related individual performance. Of the CSFs making up $\{f_1, \ldots, f_6\}$, it appears that information usage with respect to both f_3 ('Relationship Value') and f_4 ('Product Knowledge') is unrelated to η_2 ('Performance - Quality'); in words more specifically referencing the organizational setting for the study, these components of information integration do not significantly affect the level of policy persistency achieved by individual sales representatives.

Significant Path Coefficients of Questionable Managerial Significance

Small coefficients, when applied to an information integration component applicable to a large target group, could predict performance changes of substantial managerial significance. There are four statistically significant path coefficients (γ_{13}, γ_{14}, γ_{16} and γ_{21}) whose values (shown in Exhibit 6.3) would probably be considered low. When these coefficients are applied to the target group's 1,521 members, the predicted impacts on total organizational performance may not be managerially insignificant.[4] Such an impact would no doubt be of heightened managerial interest due to the negative coefficients that, in this case, would be used in their determination. However, the confidence that can be placed in these coefficients is diminished by the presence of multicollinearity between the independent constructs of the model. As seen from Exhibit 6.4, there are non-zero correlations between many of the constructs. While these correlational levels are not excessively high, especially for data obtained under field (as opposed to lab) conditions, they are high enough, vis-a-vis the magnitudes of γ_{13}, γ_{14}, γ_{16} and γ_{21}, to cause some concern. Pedhazur (1982) comments on the potential impact of this outcome:

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4 It should be said that the validity of such a conclusion rests upon an ability to generalize to the entire target group from the sample used to generate the coefficients. Previous discussions indicate that considerable caution must be exercised in this respect.

> [M]ulticollinearity leads to imprecise, and sometimes surprising estimates ... For example, high multicollinearity may lead to counterintuitive results: a regression coefficient may have a negative sign when the variable with which it is associated is expected to have a positive effect [p. 245].

Such counterintuitive results appear in this group of path coefficients. While these values may indeed reflect reality, the presence of multicollinearity clouds our ability to draw firm conclusions.

Significant Negative Path Coefficients

Two of the research model's twelve path coefficients are both statistically significant and bear a negative sign, γ_{11} and γ_{26}. The magnitudes of these coefficients (at 0.12 and 0.29) are at levels that would likely be considered managerially significant. The observation of negative path coefficients is counter-intuitive to our general presumptions about information usage and performance. Several possible alternative explanations were considered when attempting to account for such an outcome. The first of these was motivated by the UIS-basis used to construct the research model's measurement component. The UIS-derived measures utilized by subjects to evaluate their information sources may not have captured the increased levels of information integration associated with increased performance levels. Instead, it could be said that the measures obtained are reflective of subjects' becoming increasingly more critical of the information sources they use as they achieve higher performance levels. However, as seen in Exhibit 6.3 two of the antecedent constructs, ξ_2 and ξ_3, are associated with path coefficients that are both positive in sign and statistically significant. This result casts considerable doubt on any rival hypotheses based on the notion that an increased propensity for information source criticism is associated with increased performance.

EXHIBIT 6.4

Intercorrelations Among Independent Constructs

(n = 89)

		ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6
Prospecting	ξ_1	1.00					
Service	ξ_2	- 0.27	1.00				
Relationship Value	ξ_3	- 0.27	0.01	1.00			
Product Knowledge	ξ_4	- 0.48	- 0.12	0.22	1.00		
Competitor Products	ξ_5	- 0.12	- 0.14	0.02	0.11	1.00	
Needs Analysis	ξ_6	- 0.31	- 0.17	0.01	0.00	0.00	1.00

Another alternative explanation which also arises from the use of UIS-derived measurements is one in which individuals become more critical of their information sources as their performance levels increase but only with respect to the most important CSFs. This assertion is motivated by the negative path coefficients observed for the 'Prospecting' component of information integration. However, here again, the results provide little support. Recall from discussions on the definitional components of the manifests for information integration that a hierarchy of CSF importance emerged from the data. This four-level hierarchy placed 'Prospecting' by itself at the highest level, 'Service' and 'Needs Analysis' together at the second level, 'Product Knowledge' by itself at the third level, and 'Relationship Value' and 'Competitor Products' together at the fourth level. A comparison of the path coefficients in Exhibit 6.3 with the placement of factors in the hierarchy suggests no obvious relationship between factor importance and the sign of the path coefficients. Negative path coefficients are observed at both the very top and the very bottom of the hierarchy. Also, the two levels containing more than one factor show a mix of path coefficient signs. Consequently, the notion that there might be a propensity to negatively rate information sources based on their importance seems unsupported.

Other rival hypotheses are possible (and Chapter 7 engages in further discussion in these respects). However, as with those considered above, the conditions of the study make it difficult to either strongly support or conclusively falsify them. The presence of multicollinearity among the independent constructs adds to this difficulty. Consequently, an extensive discussion of their implications is, at best, speculative. On the basis of the results obtained here, evidence is seen for the existence of constructs of information integration as antecedents of organization-related individual performance; however, the relationships may not all be positive nor are they all statistically significant. These findings suggest that conventional wisdom about the relationship between information usage is, at worst, generally incorrect or, at best, overly simplistic. However, it is difficult, in view of these results and the single-organization setting for the study, to be more specific about the nature of the impact of information use on performance.

6.5 RESEARCH MODEL FIT

The low levels of variance explained in the dependent constructs motivates an examination of the extent to which the research model captures the variation in the obtained data. This extent is called model 'fit.' Low R^2-values may be acceptable in situations where little variation remains to be explained; in other words, in situations where there is a good 'fit' between the model and the data. Generally, a good fit occurs when residual variation is low. Various PLS residual covariance matrices can be examined to assess model fit. Lohmoller (1989) suggests the examination of three residual covariance matrices: (1) the outer residual covariance matrix, (2) the inner residual covariance matrix, and (3) the matrix of inner and outer residual covariances. The first covariance matrix addresses the fit of the outer (or measurement) model, the second matrix addresses the fit of the inner (or structural model), while the third provides an assessment of overall model fit.

Beginning with overall model fit, Exhibit 6.5 provides the matrix of inner and outer residual covariances. An examination of the elements of this matrix shows that the element with the largest absolute value is 0.156 (the covariance between the residual for ξ_2 and that for M, the third manifest of η_1). Most elements have values less than 0.050. The values for the covariances of the manifest residuals with the residuals of their respective constructs are all zero. This is merely a definitional result of principal component factor extraction. Another definitional result generating zero values is the single manifest attached to η_2. A sole manifest has, by definition, zero residual; consequently, its covariance with any other residual is zero, a result seen on the last line of Exhibit 6.5.

The figures in Exhibit 6.5 indicate that the inner and outer residual covariance values are generally low. Lohmoller (1989) holds that "the fit of the total model can be judged as satisfactory . . . if the covariance of inner and outer residuals is low enough." Lohmoller stops short of proposing standards for "low enough" and to the author's knowledge no standards in this respect have emerged from any other source. The root-mean-square (RMS) value for the matrix of inner and outer residual covariance values shown in Exhibit 6.5 is 0.025. In the absence of an accepted convention in this respect, this result is taken to be indicative of a good overall fit between the research model and the data obtained from the study's participants.

EXHIBIT 6.5

Matrix of Inner and Outer Residual Covariances

(Values x 10^3)

	ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	η_1	η_2
R_1	0	-18	7	-14	8	-14	16	-47
T_1	0	29	-29	-25	-8	-20	14	2
L_1	0	-8	-8	-7	-10	-10	0	-24
S_1	0	-49	12	26	41	31	15	-6
C_1	0	-1	20	26	-19	33	-21	7
A_1	0	17	-26	-3	-20	-10	-28	-11
U_1	0	41	14	5	0	4	0	17
V_1	0	26	24	27	56	38	12	87
O_1	0	-38	-6	-35	-21	-47	9	18
R_2	-5	0	35	-9	6	-3	-43	-14
T_2	38	0	-147	-15	-18	7	58	6
L_2	-5	0	-3	3	-11	-21	3	-7
S_2	-11	0	29	14	9	-11	23	-12
C_2	5	0	37	3	-18	27	-42	-8
A_2	0	0	1	20	3	-9	1	-7
U_2	-10	0	7	1	12	-3	33	1
V_2	12	0	22	-12	-6	19	-12	16
O_2	-32	0	54	-6	26	-3	-55	25
R_3	2	-5	0	21	-16	-20	8	-4
T_3	3	-10	0	10	-4	10	4	7
L_3	8	0	0	-1	9	-2	-2	7
S_3	-14	-24	0	30	4	5	1	10
C_3	-4	9	0	-3	-4	2	-4	-3
A_3	4	15	0	-25	3	-10	3	1
U_3	-5	-7	0	19	19	12	-13	-16
V_3	11	9	0	-28	-9	18	10	-1
O_3	-3	17	0	-32	-3	-13	-7	-7
R_4	13	-11	1	0	-13	-16	-4	-7
T_4	34	15	-9	0	-1	129	4	11
L_4	12	1	-33	0	-25	-10	-20	-2
S_4	-6	-9	28	0	-3	-11	-36	-5
C_4	-2	-2	31	0	8	11	20	3
A_4	-13	1	0	0	-11	-22	-3	-20
U_4	-7	10	-7	0	7	14	14	3
V_4	-3	-3	-25	0	24	-10	47	25
O_4	-16	7	6	0	24	-23	7	0

Exhibit 6.5 continues on the next page.

EXHIBIT 6.5 (Continued)

Matrix of Inner and Outer Residual Covariances
(Values x 10^{3})

	ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	η_1	η_2
R_5	-7	-27	-13	53	0	-25	11	19
T_5	41	-27	-16	-92	0	24	-23	15
L_5	1	25	-17	-15	0	3	-21	-26
S_5	-17	4	0	55	0	-31	-8	11
C_5	-29	-26	-9	68	0	-29	-19	-7
A_5	59	-20	-35	-67	0	4	-19	-1
U_5	-2	9	31	61	0	-41	10	-19
V_5	11	-42	24	-56	0	51	21	-5
O_5	-44	30	25	-17	0	37	34	4
R_6	18	7	-35	-15	14	0	-10	0
T_6	-7	9	11	0	9	0	-8	-3
L_6	6	7	-15	-10	-16	0	-8	-4
S_6	8	-9	-2	18	13	0	-19	-35
C_6	-10	3	18	24	-4	0	19	2
A_6	0	4	15	7	-1	0	-2	-10
U_6	9	-7	0	-4	-19	0	15	24
V_6	8	0	8	-25	15	0	6	15
O_6	-36	-14	1	1	-16	0	15	21
P	-21	46	-58	-30	-9	3	-17	-9
I	19	-9	8	19	-1	-32	4	-45
M	19	-118	156	43	31	69	42	139
Q	0	0	0	0	0	0	0	0

To assess the fit of the inner model, Lohmoller (1989) suggests an examination of the inner residual covariance matrix. This matrix is shown in Exhibit 6.6. Of particular concern here is the residual covariance between the endogenous variables, η_1 and η_2. Exhibit 5.19 shows a value of 0.28 for this covariance. Lohmoller asserts that "the fit of the inner model can be judged satisfactory . . . if no single residual covariance between endogenous variables is higher than a path coefficient." Comparing 0.28 with the path coefficients in Exhibit 6.3 we see that the magnitude of this covariance exceeds that of all

EXHIBIT 6.6

Matrix of Inner Residual Covariances

		ξ_1	ξ_2	ξ_3	ξ_4	ξ_5	ξ_6	η_1	η_2
Prospecting	ξ_1	1.00							
Service	ξ_2	-0.27	1.00						
Relationship Value	ξ_3	-0.27	0.01	1.00					
Product Knowledge	ξ_4	-0.48	-0.12	0.22	1.00				
Competitor Products	ξ_5	-0.12	-0.14	0.02	0.11	1.00			
Needs Analysis	ξ_6	-0.31	-0.17	0.01	0.04	0.01	1.00		
Performance - Quantity	η_1	0.00	0.00	0.00	0.00	0.00	0.00	0.90	
Performance - Quality	η_2	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.89

path coefficients with only one exception, $\gamma_{26} = -0.29$. This result is indicative of a poor fit between the inner (structural) component of the research model and the data.

Finally, the matrix of outer residual covariance values can be used to assess the fit of the outer (measurement) model. This matrix is shown in Appendix 6.1. An examination of its individual elements will show that the covariance with the largest magnitude is -0.082 (the covariance between the residual for T_4, the 'Timeliness' manifest of ξ_4, and the residual for S_5, the 'Confidence in Systems' manifest of ξ_5). Most of the outer residual covariance matrix elements have a magnitude less than 0.01 and the RMS across all matrix elements is 0.009. Lohmoller (1989) indicates that "the fit of the outer model can be judged to be satisfactory . . . if the [the outer] residual covariances are low enough." As was mentioned with respect to the matrix of inner and outer residual covariances, there appears to be no standard for "low enough." In the absence of an accepted convention the RMS value of 0.009 is taken as evidence of a good fit between the data collected in final test and the outer (measurement) component of the research model.

In summary, the outer residual covariance matrix indicates that the measurement component of the research model a good fit with the obtained data. Simultaneously, the inner residual covariance matrix indicates that the structural model displays a low degree of model-data fit. However, the inner and outer residual covariance matrix indicates that, overall, the research model is a good fit to the data forthcoming from the study's subjects.

Research Model Revisions

It is possible that other PLS formulations of the research model might yield better fits and stronger parameter estimates. Changes in indicator modes would produce different formulations. A desirable finding according to Fornell and Bookstein (1982) is one in which different indicator modes result in parameter estimates that are effectively the same. They state that "if the results correspond, there is no problem. If they differ, a compromise might be worked out using the factor structures of the blocks separately; otherwise, a decision as to the overriding concern must be made" [p. 442]. This implies two recourses whenever parameter estimates and levels of model fit differ substantially from mode to mode: (1) the manifest indicator directions can be changed on selected constructs or (2) a choice of computational objective must be made.

The latter course was that taken, for reasons discussed in Chapter 3. The first course was not feasible for two reasons. First, each of the six information integration constructs employed the same 'information product' scale to capture manifest values. Consequently, the use of indicators that would be formative in one instance and reflective in another has little basis for justification. Also, because the same items are used in each scale, dropping an item (e.g., 'Timeliness') from the scale for one construct implies that the same ('Timeliness') item must be dropped from the scales for the other five constructs as well. At the same time, the conditions of the study are such that our ability to drop scale items is limited, this leads us to the second reason for not changing indicator directions. The number of datum points available for analysis was not large enough to allow for a hold-out sample to test any model changes. Revising the research model without subsequent testing runs the risk of arriving at results for which the data collected play a role of greater importance than theoretical considerations. In view of the small sample size, the risk of 'data driven' conclusions was great. Consequently, the research model was not revised in the pursuit of theory trimming or for the purpose of achieving greater levels of model fit or stronger parameter estimates.

6.6 SUMMARY

Results obtained for the structural model were generally not consistent with conventional notions about the relationship between information usage and organization-related individual performance. Twelve relationships were hypothesized between the six antecedent constructs of information integration and the two dependent constructs for performance. Ten of these relationships yielded path coefficients that were statistically significant; however, only four have path directions consistent with prevalent presumptions about such relationships. Although four of the six negative path coefficients may be of questionable managerial significance and their values are clouded to some extent by the presence of multicollinearity, these results indicate that the relationship between information usage and performance may be more complex than that posited by conventional wisdom.

Two other major issues were addressed in the chapter: the validity of the set of CSFs and the fit of the model with the data collected in the field. The validity of the set of CSFs, identified by the participating organization's executive group and validated in the pre-test, received further support among the 89 subjects used to test the research model. Most subjects used exactly the same set that was identified for the organization. All subjects used a subset of these factors and only three subjects identified factors that were not in the hypothesized set. The fit of the research model was assessed through an examination of root-mean-square residual covariance values. These values generally indicate that the fit between the research model and the obtained data is good.

CHAPTER 7

CONCLUSIONS, IMPLICATIONS, LIMITATIONS
AND
FUTURE RESEARCH DIRECTIONS

This study is positioned at the early stages in an anticipated stream of research to investigate the presumption of a positive causal relationship between information usage and performance at both individual and organizational levels. To further conceptual development and lay the foundation for empirical testing, the work was primarily concerned with the antecedent part of the presumed relationship, information usage. To facilitate hypothesis testing, a research setting was chosen in which measures of individual performance were available and where such measures are directly related to organizational performance. This combination of conceptual development on the antecedent side and observational convenience on the dependent side was felt to be appropriate given the early stage of empirical work and theoretical development in this area. Under these conditions, the observation of results consistent with null hypotheses would provide strong evidence in support of the falsification of conventional wisdom about the presumed positive causal relationship between the use of information and performance. The results obtained were not consistent with null hypotheses; at the same time, these results were also not consistent with conventional wisdom. Instead, a more complex relationship between information usage and performance is suggested.

Two major research challenges arose as the investigation sought to develop and test theory about information usage by individuals in an organizational setting: (1) identifying a conceptual basis for information relevant to performance, and (2) measuring the extent to which such performance-relevant information is utilized. To address the first research challenge, the concept of Critical Success Factors was used as the basis for relevancy and was coupled with the notion of associated information sets to form the concept of information integration. It was posited that each distinct CSF, in combination with its respective information set, gives rise to a distinct component of integration and that each of these components is an antecedent of performance. To address the second research challenge, 'information product' scales were adapted from those developed in the stream of research on User Information Satisfaction (UIS) and used to capture manifestations of the various organization-specific forms of information integration. These scales produced results indicative of strong levels of construct validity, an important result given the study's preoccupation with antecedent constructs and their associated manifests. This finding is also significant in that it provides a bridge between two important areas of Information Systems research: the stream of research on CSFs and the stream of research on UIS.

7.1 SUMMARY OF RESEARCH EXECUTION

Five areas of literature were reviewed: (1) general concepts of integration in organizations, (2) concepts of information systems integration, (3) empirical research on information systems integration, (4) empirical research on information systems usage and performance, and (5) information-based determinants of organizationally related individual performance. Four major tenets were derived from these areas of the literature to provide a conceptual foundation for the development of a model to guide the research: (1) integration is an organizational state (and not a process), (2) information integration reflects the state of information usage without reference to the technology of information delivery, (3) a finite number of important factors or key tasks are critical to performance at both individual and organizational levels, and (4) relationships exist between information integration and performance at these same levels. The first tenet permits a distinction between information systems integration (a state) and information systems development (a process), the latter being regarded as the means to change the former. The second tenet recognizes that the information base utilized in organizational work extends beyond the information delivered by computer-based technology. The third tenet provides a basis for information relevancy in specific organization contexts while the fourth embodies the essential hypothesis which this study set out to test.

Using these four tenets, a research model was formulated which hypothesized that information integration at the organizational level, Ω, is an antecedent to organizational performance, P, as:

$$\Omega = \frac{\sum_{i=1}^{N} \sum_{j=1}^{D} a_{ij} \kappa_{ij}}{N} \rightarrow P$$

where a_{ij} represents the adequacy of the information set used by the i^{th} organizational member with respect to the j^{th} critical factor. N represents the number of organizational members and D represents the number of critical factors in $\{f_1, \ldots, f_D\}$. κ_{ij} represents the importance of the j^{th} critical factor to the i^{th} organizational member.

A definition of information integration at the individual level, ω, was extracted from that for Ω and posited to be an antecedent of individual performance, p, as:

$$\omega = \sum_{j=1}^{D} a_j \kappa_j \rightarrow p$$

Each of ω's components was then treated as a research hypothesis in which a_j, the adequacy of the information set utilized for the j^{th} critical factor, in multiplicative combination with κ_j, the importance of the j^{th} critical factor, is held to be an antecedent of individual performance. In other terms:

$$a_1\kappa_1 \rightarrow p \quad \cdots \quad a_j\kappa_j \rightarrow p \quad \cdots \quad a_D\kappa_D \rightarrow p$$

Operationalizing the model required a means of capturing three groups of data: (1) manifestations of information set adequacy (a_j), (2) critical factor importance (κ_j), and (3) manifestations of individual performance (p). The first operationalization drew upon the research in UIS; the second employed a constant-sum points distribution to obtain measures of critical factor importance; while the third drew upon the participating organization's archives to obtain manifestations of performance. An analysis of these manifests in the light of validity considerations led to the emergence of two performance factors. The research model was consequently revised for testing in the specific organizational context whereby its dependent side took the form of two performance constructs.

The number, D, and nomenclature, $\{f_1, \ldots, f_D\}$, of a set of Critical Success Factors is unique to an organization. Consequently, a complete specification of the research model and its attendant hypotheses only became known after an initial phase of field work at the participating organization. In a series of working sessions with a group of senior managers the set of critical factors emerged. Six factors were identified. These were subsequently validated in a pre-test of the study's methodology. After the factors were identified and validated, the research model was specified in its final testable form as a set of structural equations representing the relationships between the constructs for information integration and those for performance as well as the relationships between the constructs and their associated manifests. Because the conditions of the investigation could reasonably satisfy its conditions for application, the method of Partial Least Squares (PLS) was the structural analysis technique employed. This method provided the means to evaluate research model's outer (construct-to-manifest) relationships and, in combination with Tukey's Jackknife, test its inner (construct-to-construct) relationships.

The research model was tested on 89 subjects who were members of a group that is critical to the performance of the organization that agreed to participate in the research. This criticality maximized the convergence between $\{f_1, \ldots, f_D\}$ for each individual and that for the organization. The subjects were sales representatives from a division consisting of over 1500 such individuals in an insurance firm whose employees totalled in excess of 5600 at the time of the study. The 89 subjects were located in 12 different regional offices geographically disbursed throughout Southwestern Ontario. They were selected in a way that ensured variability in individual performance levels.

Each subject participated in a highly structured interview involving extensive scale completion about the subject's use of information vis-a-vis each of the six critical factors. Responses were recorded by subjects in a specially designed 'protocol booklet' which guided each interview and presented a sequence of worksheets to identify and evaluate the information set used for each factor. Protocol booklet responses were subsequently transformed into values for the 54 UIS-based manifests for the six CSF-based components of information integration. Following the interviews, four performance measures on each subject were retrieved from the participating organization's archive files. These activities produced a set of 58 manifest values for each subject. These values formed the dataset used to evaluate the 58 epistemic relationships linking constructs with manifests and to test the 12 structural relationships linking the six CSF-based constructs for information integration with the two constructs for individual performance.

7.2 MAJOR FINDINGS

This investigation found a relationship between the CSF-based components of information integration and performance. It found strong indications of the validity of these components at both the measurement level and the construct level. The criticality of the set of CSFs was confirmed. The study also revealed that the entire information set utilized by individual vis-a-vis a specific CSF is composed of a small number of distinct information sources. These findings are elaborated upon and discussed in what follows.

Hypothesis Tests

Ten of the 12 structural relationships bear PLS path coefficients that Tukey's Jackknife found to be statistically significant. Six of the statistically significant path coefficients bear signs that oppose the direction presumed by 'conventional wisdom' about the relationship between information use and performance. Four of these six have magnitudes of questionable managerial significance; however, this result suggests that the relationship between information use and performance is more complex than the simple positive linear causal relationship that it is often assumed to be. This outcome may also account for the observation of weak associations in previous research in this respect. Positive and negative components may be 'netting out' at lower levels of abstraction.

Validity Assessment

The measurement model displays strong indications of construct validity. This is especially the case for convergent and discriminant validity of the manifests and the constructs on the antecedent side of the research model. All 54 antecedent manifests load on their respective constructs at levels exceeding 0.80 and all cross-loadings with other constructs have magnitudes less than 0.50. The average variance extracted for each of the six antecedent constructs exceeds 0.90 and the highest level of shared variance between any two antecedent constructs is 0.23. These measures of validity were affected to some extent by inter-correlations between quantities used to form manifest values and by PLS's tendency to over-estimate loadings. However, various analyses suggest that the validity figures obtained were not, to a great extent, artifacts of the procedures used to obtain them; instead, the results are indicative of the validity of research operations to capture valid manifestations of the six constructs of information integration. Results obtained for the antecedents are also suggestive of a high level of redundancy in the manifests used for each construct. Most antecedent manifests loaded at levels exceeding 0.96. While this outcome is indicative of desirable levels of instrument reliability, it also suggests that measurement activities can be made more efficient through a reduction in the length of data collection instrumentation.

The measurement components of the dependent constructs also display adequate levels of construct validity. The three manifests of the performance factor with multiple indicators all load at levels exceeding 0.78 and cross-loadings are all less than 0.39, results indicative of adequate levels of discriminant and convergent validity at the manifest level. At the construct level, average variance extracted exceeds 0.82 and the levels of shared variance are all 0.12 or less, results which are also consistent with adequate levels of convergent and discriminant validity.

Concomitant Variation

One of the primary objectives of the research was observing the covariation of information integration with performance. The extent to which this was achieved is indicated by R^2-values of 10% and 12% for each of the two performance constructs. While these values could be considered evidence of poor nomological validity, two factors suggest that they are probably nomologically appropriate: (1) the observed R^2-values are reasonably consistent with those obtained in previous research on the contribution to individual performance of the various determinants of that performance, and (2) the research model's residual covariances are low.

With respect to the first factor, previous research suggests that an average value of around 4% is the level to which the variation in salesperson performance is accounted for by any single determinant. With six predictors, the research model's R^2-values of 10% and 12% are not out of line with this finding. Even without the 4% reference value it would be difficult to support values much higher than those observed given the extensive number of factors that are posited to determine individual performance. The second factor supporting the nomological appropriateness of the observed R^2-values indicates that the research model recovers a substantial portion of the covariance in the obtained data. Consequently, the incorporation of further variables would add little to the ability of the model to account for the variability in individual performance.

CSF Criticality

The study found variability with respect to the CSFs in two ways: (1) their relative importance varies, and (2) the strength of the relationship between their associated information integration components and performance varies. With respect to relative importance, the six factors clustered into four levels of relative importance. Beyond the specific organizational context in which the research took place, it is not important to know which factors clustered together. However, this result is important in that it suggests that some factors are more critical than others and that there may exist a hierarchy of factor criticality, notions which may benefit further theoretical development.

All of the CSF-based components of information integration are connected by at least one statistically significant path coefficient. While this supports the criticality of each element of $\{f_1, \ldots, f_D\}$, low and/or non-significant path coefficients should not be taken as evidence of the unimportance of a particular element of $\{f_1, \ldots, f_D\}$. All that can be said in such a circumstance is that the factor seems not to be an information-based factor and its support from an information provision viewpoint is not critical. It may, however, still be a factor critical to performance. Several of the CSF-based components are connected by paths with low coefficients. This suggests that information set variability with respect to the CSFs that underlie these components has little effect on performance variability. It does not suggest that these CSFs lack criticality.

Performance Factor Impacts

The variability in the strength and direction of the path coefficients suggests that different performance factors are impacted in different ways by different components of information integration. Only two of the antecedent constructs of information integration affect the two dependent performance constructs through relationships that are all positive. Two other antecedent constructs affect the performance constructs through relationships that are all negative. The two remaining antecedents affect one performance constructs through relationships that are negative and the other through relationships that are positive (but statistically insignificant). Also, as mentioned previously, the magnitudes of the path coefficients indicate that the relationships vary considerably in strength. These magnitude and direction outcomes suggest that the nature of the relationship between information integration and performance differs by performance factor. Certain CSFs appear to be more informationally critical to certain performance factors than to others.

Information Set Composition

In delineating the concept of information integration, the notion was developed that each CSF is associated with a specific set of information. This presented the methodological problem of identifying and evaluating the various information sources that make up this set. From pre-test activities it appeared that the information set utilized by an individual was composed of three or fewer distinct information sources. Based on this observation, the final protocol was developed based on an assumption that any information set could be validly represented by three or fewer sources. Since only 13 subjects were included in the pre-test, further evidence was needed that this assumption is reasonable. Consequently, the protocol used in the final test was designed with provisions to capture data that were used to assess the extent to which the assumption holds. These data indicate that the assumption whereby the information set associated with any CSF is essentially represented by three or fewer distinct information sources is a reasonable one. This finding is an important one for the construction of any instrumentation which identifies and evaluates an individual's 'information set.'

7.3 IMPLICATIONS FOR MANAGEMENT

From a managerial viewpoint, the most important finding of this investigation is the existence of negative relationships between information integration and individual performance. An implication of this finding is that making a critical activity more information-intensive may not be the route to enhanced performance or increased productivity. Complicating matters is the finding that relationships are not consistent in both direction and magnitude across the various components of information integration. This implies that any enhancement of an individual's information set, to be effective, must be done with a knowledge of the relationship between the information set vis-a-vis its underlying CSF and the specific performance factor whose variability we wish to influence. Further complication arises from the observation that the same information source can be included in the information set for different information integration components which in turn have different relationship directions with performance. Consequently, the enhancement of an information source may have a bimodal influence on performance with positive influences operating through some information integration components and negative influences operating through others.

This bimodal effect on performance was illustrated rather dramatically in the (insurance firm) organizational setting used for the research. The firm makes Customer Information Records (CIRs) available to its sales representatives. These records provide data on the firm's existing customers and appear to be highly valued by the sales representatives. The delivery of CIRs is the object of a considerable expenditure in computer-based information systems resources by the firm. This study found that CIRs are included in the information sets of a majority of the study's subjects for two CSFs: 'Prospecting' and 'Service to Existing Clients.' Consequently, the UIS-based evaluations of the CIRs vis-a-vis 'Prospecting' were taken as manifestations of the Prospecting Component of Information Integration and, simultaneously, similar CIR evaluations vis-a-vis 'Service to Existing Clients' were taken as manifestations of the Service Component of Information Integration. The study also found a *negative* relationship between the Prospecting Component of Information Integration and the two performance variables while the relationship between the Service Component of Information Integration and these same performance variables was found to be *positive*. The implication of this is that any CIR enhancement which improves the evaluation of the CIRs vis-a-vis these two CSFs will *positively* influence performance through the Service Component of Information Integration and *negatively* influence performance through the Prospecting Component of Information Integration.

This highlights the importance of knowing as precisely as possible the nature of the relationships between the antecedent information integration constructs and the dependent performance constructs. In a situation like the one described above, the firm may still wish to enhance the quality of an information source that is included in the information set of two opposing information integration components. In such a circumstance, a knowledge of the relationships could be used to assess the extent of any net gain. In other situations, a knowledge of the relationships would indicate where information set enhancement could selectively influence specific kinds of performance. In general, a knowledge of the direction and magnitude of the relationships would be an important input to any process seeking to more productively direct investments in information systems resources.

Two other facets of the research have significant implications for the management of organizations: (1) the use of a 'management-friendly' theoretical basis for the concept of information integration, and (2) the development of procedures and instrumentation which could be applied in an 'information integration audit.' The first of these addresses the confusion that seems to exist in practitioner circles about the exact nature of the integration of information systems with respect to a specific organizational context. Previous research indicates that managers easily relate to the concept of critical success factors. Since this concept is central to the notion of information integration, it can be used as a basis from which managers can develop a sense of what the integration of information systems means in relation to the strategic and competitive circumstances of their organizations.

The second facet, the development of instrumentation that is potentially applicable to information integration auditing, could support organizations in tracking the relationship between information usage and selected kinds of performance as the organization engages in both strategic and tactical actions. During times of significant change the set of CSFs will become composed of different elements (i. e., $F \equiv \{f_1, \ldots, f_D\} \rightarrow F'$). Different information integration-performance relationships arise when F' information integration components replace those of F. Consequently, an organization can experience information *dis*integration when systems remain unchanged or even when investments in information resources are taking place. Information integration audits utilizing appropriate variations on the instrumentation developed for this investigation could detect disintegration and provide the knowledge base to more appropriately direct information resource investments.

Investments in information resources are often directed toward the development, maintenance, and operation of an organization's applications portfolio. The possibility that some information integration-performance relationships are either weak or negative should enter decisions about the selection of the applications that form this portfolio. Extensive investments directed at systems to deliver information that enhances the information set associated with a integration component that has a negative relationship with a key performance factor would be counterproductive. The negative relationships observed between the Prospecting Information Integration Component and the two performance factors make it difficult to justify the expenditure of the firm's resources to enhance the information sets associated with 'Prospecting.' This is a counter-intuitive conclusion, especially in the industrial setting in which the research was conducted -- one would think it would be only 'common sense' for a company in the insurance business to direct its information resources toward 'Prospecting' for clients. In fact, the research found that, of the six CSFs identified, 'Prospecting' is by far the most important CSF for the firm under observation. However, the negative relationships associated with 'Prospecting' imply that it should not be a major concern when developing the applications portfolio for this firm.

In addition to such strategic and tactical concerns, the instrumentation may be also be applicable to organizational activities that are more operational in nature. Measuring the productivity and effectiveness of information systems resources and evaluating information technologies are operational activities to which the procedures and instrumentation of this research could be applied. A periodically performed information integration audit could provide measures of the level of information integration over time. The effectiveness of information resources could be evaluated on the extent to which targeted values for information integration are achieved. The efficiency, or productivity, of these resources could be conceptualized and measured in terms of the changes realized in the level of information integration per unit expenditure. In a similar way, the potential effectiveness and efficiency of new information technologies could be evaluated using data on the extent to which these technologies enhance the information sets associated with selected components of information integration.

7.4 IMPLICATIONS FOR RESEARCHERS

While the implications for management stem largely from findings associated with the inner (or structural relations) component of the research model, those for researchers extend to findings associated with the measurement component of the research model. These latter findings indicate that CSFs in association with individual information sets give rise to information integration constructs and that these constructs can be captured using UIS-derived measures. This connection between CSF theory and the work on UIS is an important finding for researchers. It supplements the instrumentation available to those working in the CSF stream of research and enriches the theoretical context for those working in the UIS stream of research. Also, since the research builds upon existing concepts and measurement in information systems research, it responds to the call for the "cumulative tradition" needed to advance information systems area as a academic discipline (Keen 1980).

Both the theoretical development and the methodological approach used in this investigation involve important aspects not seen in previous information systems research. The concept of integration based on CSF-specific information sets is introduced and the use of a interview guide (the protocol booklet) to capture construct manifestations during subject-interviewer interactions is a substantial variation on the 'traditional' structured interview approach. While the association of CSFs and specific collections of information is not new, the use of this association as a basis for formalizing a technology-free concept of information integration seems unprecedented. Also, having subjects complete scales in the course of an interview is not new; however, the comprehensive nature of the protocol booklet represents a considerable departure from both the 'traditional' questionnaire booklet and intermittent scale completion during an interview. The protocol booklet allowed several hundred responses to be captured from each subject during an interview lasting, on average, a little over an hour.

An important outcome for researchers is the high level of construct validity realized from the research operations embodied in the study's methodological approach. The protocol booklet was the centerpiece in these operations; however, its structure and development was firmly tied to the theoretical framework of the research model. Consequently, the levels of validity observed here provide considerable support for the existence of the proposed constructs and for the appropriateness of the measurement methods employed in the investigation. As will be discussed later in this chapter, further investigation is clearly needed. The high validity figures suggest that the procedures and instrumentation developed for this investigation have considerable potential to form the basis for methodological approaches taken in further research.

While the theoretical and empirical aspects of information integration construct development and measurement are probably the main area of concern for academics at this stage in the research, there are also important lessons from findings associated with the research model's structural relationships. The observation of negative relationships was unexpected and not in accordance with conventional wisdom. This has important implications for theoretical development in a wide range of academic pursuits in information systems research. Much throughout the field seems to rest on the assumption of a positive causal relationship between information use and performance. While this study, by reason of its limitations, should not be taken as a firm refutation of this assumption, its findings suggest that the relationship is far more complex than that embodied in such an assumption.

Chapter 6 speculated that the observation of negative relationships might arise from factors associated with the UIS-based evaluation of an individual's information set. Two hypotheses in this respect were suggested: the first posited that there existed an increased propensity to be negative about information sets as performance increased while the second posited that this increased propensity to be negative only arises with respect to the most important CSFs. The conditions of the study were such that these two hypotheses could not be conclusively rejected; however, the evidence (seen in Chapter 6) does not support either hypothesis. Moving away from the evaluative behavior of individuals (and even further from a basis of data from which support may or may not be shown), other rival hypotheses may be generated from a consideration of the nature of the individual's relationship with the organization as well as from the (generally accepted) tendency of individuals to seek information when faced with uncertainty.

To speculate how individual-organizational relationships might account for the mix of negative and positive relationships, consider an organizational setting in which individuals have little autonomy and exercise minimal discretion over the information sources they use. An organization in this situation may have enough power relative to that of its organizational members to effectively control the content of information sets. On the other hand, in organizational settings where individuals operate in a highly autonomous manner and can select the information sources they use, there is probably minimal organizational control over the content of information sets. The extent of information source selection will vary in each of these two situations, with the latter allowing for a generally greater selection of information sources than the former. This would result in information sets that would be generally different in each organizational context. Consequently, different relationships between information integration and performance might arise from differences in the relationship between individuals and their organizations vis-a-vis their information sets. Further, this relationship may vary at the CSF-level within the same organization. Certain CSFs may have information sets over which the organization has extensive control while other CSFs may have information sets over which the organization has relatively little control.

How could this variability in information sets account for the mix of negative and positive relationships observed between information integration and performance? Goodhue et al. (1992) in a discussion on "strategic data planning" seem to suggest a mechanism by which these observations might arise. They assert that approaches which "promote extensive data integration in decentralized organizations with unique local needs may not only be difficult, it may not be best for the organization" [p. 24]. Given the relatively high degree of autonomy of its sales representative and their wide geographic dispersion, an insurance firm could be considered a highly decentralized organization. Certain CSFs and their associated information sets may be identified with "unique local needs." Because of their focus on clients, the CSFs found in the research setting for 'Prospecting' and 'Needs Analysis' are essentially 'local' in their orientation. Consistent with the Goodhue et al. assertion, the negative relationships observed between information integration and performance suggest that increased integration is indeed not in the best interests of the organization.

The 'Service' CSF, which seemly would also have a client focus, was associated with a relationship that appears inconsistent with the Goodhue et al. assertion. However, from the researcher's time in the field, it appeared that 'Service' was seen by many sales representatives in terms of activities imposed by the firm's head office. 'Service' tasks often involved extensive paper work, time in the office, and other activities that kept the representatives *away* from clients. From this perspective, the observed relationship is not inconsistent with Goodhue et al. since many sales representatives appeared to perceive head office demands (i.e., centralized needs) and not client demands (i.e., local needs) as the focus of 'Service' tasks.

The 'Competitor Products' CSF also lacked a focus on "unique local needs." Many of the sales representatives who seemed to regard this as important also felt that the knowledge base in this respect (i.e., the information set) should b. supplied by the firm's head office. In other words, this integration component was not associated with unique local needs and there was some reliance on, and orientation to, centralized facilities to supply an appropriate information set. Thus, the observed positive relationship between the Competitor Products Component of Information Integration is also not inconsistent with the Goodhue et al. assertion. The remaining two information integration components ('Relationship Value' and 'Product Knowledge') exhibit a mix of relationships and do so at marginal levels of both managerial and statistical significance. Without more definitive results in these two cases, any discussion would be unduly speculative.

Uncertainty avoidance may be an important factor in explaining why negative relationships arise in decentralized organizational settings when organizational members deal with unique local needs. Those who perform at lower levels may seek to enhance their information sets to compensate for the lack of supervision inherent in decentralized circumstances. Increased supervision would likely be reflected in increased control and direction to individuals with the effect that uncertainty would be reduced about actions appropriate to performance improvement. On the other hand, decreased supervision would increase uncertainty and thereby motivate the search for information. So, as performance decreased, information set enhancement would take place, especially in organizational circumstances where the freedom exists to choose, replace, or even modify information sources. Information set enhancement vis-a-vis that set's respective CSF would be observed as an increase in the level of information integration. Consequently, decreases in performance could occur in association with increases in information integration, an occurrence that would be manifested as a negative relationship.

It should be noted that the uncertainty avoidance mechanism reverses the direction of causality or at least suggests that it is bidirectional. In either case, information set enhancement (i.e., systems development) is not clearly separated from information utilization with respect to a critical factor (i.e., information integration). This issue was raised in Chapter 3 where it was noted that the systems development and information integration were part of the same causal chain:

$$\Delta p \rightarrow \Delta \text{ (systems development behavior)} \rightarrow \Delta\omega \rightarrow \Delta p$$

It was also noted that systems development was outside the scope of this study. However, it is possible that systems development behavior as well as information utilization behavior could have been captured in the measurement of information integration. Given the autonomy of sales representatives in the decentralized circumstances of the research setting, much in the way of information set enhancement could be taking place which may not be clearly separated from information utilization. Evaluating the extent to which this takes place was not possible given the use of a single organization, one of the study's several limitations.

7.5 LIMITATIONS

Several aspects of this investigation place limits on what can be concluded from the findings. These include the formulation of a linear research model, the potential bias from using sales-oriented organizational members for CSF identification and validation, the non-random selection of subjects, the use of a single organization for model testing, and the mis-estimation of parameter values by the method of Partial Least Squares used for data analysis. While the limitations arising from these concerns do not critically invalidate the investigation's findings vis-a-vis its objectives, they do place significant restrictions on the extent to which these findings can be generalized.

The research model assumes linear relationships between the antecedent constructs of information integration and the dependent constructs for performance. However, there is little to suggest that such relationships are linear. While the residual covariance figures observed in this study suggest that the proposed research model is reasonably consistent with the observed data, these figures could also be consistent with other forms for the research model, both linear and non-linear. In view of the counter-intuitive finding of negative relationships between certain antecedent constructs and the dependent constructs, it is important to eliminate the possibility that these negative relationships are due to significant non-linear terms in the functional form of the relationships. Observing model-data 'fit' over a wider range of construct variation and functional relationship forms would increase the confidence that could be placed in the validity of the study's counter-intuitive findings.

Much is dependent on the validity of the set of CSFs. These were initially identified by a group of senior managers, validated by 13 organizational members in a pre-test of the study's data collection instrumentation and further validated by the 89 subjects in the final test of the research model. Since these three groups consisted almost entirely of members from the organization's sales divisions, considerable potential existed for a 'sales' viewpoint on what is critical and what is not. While this is probably not inappropriate given the nature of the organization in which the research was conducted and given the large portion of total organizational members who work in the firm's sales divisions, a sales viewpoint on factor criticality may diminish the validity of the CSF set for the entire organization. Consequently, caution should be exercised in concluding that the observed components of information integration are those for the entire organization.

Subjects were selected in manner that increased the probability of observing the relationship between information integration and performance. Specifically, they were selected in a way that maximized measurable variation on the dependent constructs for performance. Subsequently, field activities sought to capture manifestations of the antecedent constructs for information integration for these same subjects. These procedures are not consistent with random selection of the study's subjects. Consequently, limitations are placed on the extent to which results can be generalized to other members in the target group (the firm's sales division participating in the research), to the entire organization, and to other organizations and industrial settings. To the extent that all the members of the target group had the same probability of being selected for the study, we can generalize the results of the study to the target group. However, subjects were not selected in a way that equalized their probability of being interviewed. Consequently, any generalization from the group used for the study to entire target group must be cautiously made. With respect to the entire organization or other organizations, the basis for generalization is even further diminished.

Anderson and Gerbing (1988) note that "PLS estimates will be asymptotically correct only under the joint conditions of consistency (sample size becomes large) and consistency at large (the number of indicators per latent variable becomes large). They go on to state that "in practice, the correlations between the latent variables will tend to be underestimated, whereas the correlations of the observed measures with their respective latent variables will tend to be overestimated." Dijkstra (1983) states that this overestimation will be more pronounced when reflective construct-manifest correspondence relationships are assumed.

The conditions of the study and the form of the research model are such that mis-estimation by PLS in both these forms should be anticipated. The small sample size obtained for the study and the limited number of indicators per latent variable in the research model will reduce "consistency" whereby inter-construct correlations were underestimated and construct-manifest correlations were overestimated. The exclusive use of reflective construct-manifest relationships further accentuates the latter. These algorithmic actions by PLS may account to some extent for very low path coefficients and dramatically high factor loadings that were observed. At the same time, such mis-estimation places limits on our confidence in the parameter estimates generated by PLS and suggests that the relationships between performance and the various components of information integration may actually be stronger than the study's results suggest.

The research model's general conceptual development was not dependent on any particular organizational or industrial setting. However, to achieve the level of specification required for model testing, a set of CSFs must be identified. Each CSF gives rise to a distinct component of information integration, an antecedent construct of the model. CSFs, both in number and in name, can only be known in the context of a specific organization. In addition, the various types of organizationally-related individual performance can only be known in the context of a specific organization. Consequently, the research model can only be specified in its testable form with reference to a specific organization. While testing the model in specific organizational settings can be highly effective in falsifying the research model's general concepts, the results obtained in such settings are limited in the extent to which they can be used to support these general concepts. Testing in multiple organizational settings will mitigate this limitation; however, the study took place in a single organizational setting. Consequently, the extent to which the results can be considered supportive of the general model is limited.

7.6 DIRECTIONS FOR FURTHER RESEARCH

The most pressing need for further research arises from the negative relationships observed in this study. These counter-intuitive results, if true, could substantially affect the way we think about the role of information in enhancing performance and productivity at both individual and organizational levels. In view of the limitations of this investigation, much more needs to be done before it can be concluded that conventional wisdom in this respect has been firmly refuted. Supporting results should be sought under conditions which address, as a start, the limitations that faced this study. Replications in other organizational and industrial settings, study designs that allow testing for relationships having functional forms other than the linear ones assumed here, and methodological approaches that allow greater generalizability are among the areas in which further research could be productively undertaken. Should these activities confirm the existence of negative relationships, it is likely that further theoretical development will be necessary in explaining these relationships as well as further empirical work to validate any counter-intuitive causal directions emerging from such developments.

The most important limitation probably arises from the use of a single organization. Replications in other organizations by other investigators would be important in confirming the existence of negative relationships. Replications using organizations in circumstances more turbulent than those associated with the highly stable organization used for this investigation would be particularly useful. Circumstances of increased instability may result in an organization exhibiting stronger information integration-performance relationships as its members seek information as a means of reducing the uncertainty brought about by turbulent conditions. The emergence of negative relationships under such conditions would be an important finding, one that would provide considerable justification for the expenditure of further research resources in the development and testing of theory to explain such relationships.

Negative relationships are enigmatic in the context of a linear model since they imply that information removal is the route to enhancing performance over the entire range of that performance. There is much that does not 'make sense' about such an inference, especially as the variables involved take extreme values. This leads one to suspect that, in general, the relationships may exhibit non-linear characteristics wherein there are points of discontinuity or significant non-linear terms in the functional forms of the relationships. The revelation of discontinuities or non-linearities is more likely when study designs are 'more experimental' than the study design used here. An experimental design would facilitate the identification of functional forms by administering 'treatments' of the independent variable, information integration, and observing the functional behavior of the dependent variable, performance. Realizing effective designs in this respect is not a trivial matter, considerable simplification and ingenuity would be necessary in constituting both the 'information set' and the underlying CSF for each component. Much would need to be held constant. However, if the experiments are successful, the revealed function forms would add much to our knowledge. Experimental designs would also add to our confidence in the causal directions of the relationships.

In view of the stage of the research in this area, placing the emphasis of this investigation on internal validity is probably appropriate. Establishing both construct-

construct relationships and construct-manifest relationships provides an important starting point for future research, both in terms of theory development and instrument construction. However, the validity of the antecedent constructs of information integration could be more firmly established by the use of designs which establish the external validity, or generalizability, of the constructs. Results would have greater value if they can be generalized at least to the target group from which the subjects are drawn and, even better, to the entire organization in which the research takes place. Study designs involving random selection of subjects would support statements about the generalizability of the constructs and enhance our knowledge about the nature of the components of information integration. These designs could be similar to the one used here and employ essentially the same procedures and instrumentation, possibly incorporating the previously mentioned suggestions for improved efficiency.

7.7 CONCLUDING REMARKS

This investigation was initially motivated by the phenomenon of information systems integration. By noting the demands of certain organizations for obtaining strategic value from integrating selected information systems, the investigation positioned itself to contribute to an understanding of the strategic relevance of information systems integration. Drawing primarily upon the Lawrence and Lorsch notion of integration and the Bullen and Rockart notion of critical success factors (CSFs), the concept of information integration was developed. Multiple information integration components were posited to exist, one for each CSF, and each component was hypothesized to be an antecedent of performance, performance important to the continued survival of organization. It is the use of CSFs as a basis for information integration coupled with critical performance variables that makes this investigation of interest to those wishing to understand how the integration of information systems relates to the strategic concerns of an organization.

In addition to its conceptual developments linking CSFs with information usage, this study produced empirical evidence validating the concept of CSF-based information integration components. This seems an important finding for information systems researchers seeking to make their discipline relevant to strategic decision makers. Not only is such evidence supportive of a strong connection between information use and matters of strategic concern, it also heightens the importance to strategically-relevant information systems research of the set of CSFs as an interface between these areas. As Vitale, Ives, and Beath (1986) tells us, the use of critical success factors "circumvents the problem of direct involvement in the firm's strategic planning process." Results here validate the set of CSFs as a convenient boundary for information systems research whereby both theoretical development and empirical research can contribute to the "strategic planning process" without becoming paralyzed with the myriad of concerns inherent in that process. In addition to being a boundary for research, the set of CSFs also represents a critical interface between general management and information systems management, an interface characterized by the dynamic interchange of CSFs with delivered levels of information integration with respect to those CSFs. This investigation validated this interface, verified its importance, and developed instrumentation to measure the delivered levels of information integration.

It seems to be the nature of research to raise more questions than it answers. This research was no exception. Of the many questions raised, the most important at this point are probably those concerned with the observation of negative relationships between certain information integration components and performance. Are these relationships artifacts of the research operations used to capture construct manifestations? Are they idiosyncrasies of the specific organization studied? Are they indicative of more complex functional forms for the relationships linking antecedent and dependent variables? Are they evidence of more complex interactions for which a wider set of theoretical variables is needed? Or, are they reasonable approximations of what is actually true for many organizations? If so, conventional wisdom about the relationship between information use and performance is misguiding both academics and practitioners. Raising more questions is the nature of research, so too is not jumping to conclusions. Before conventional wisdom can be brought under greater suspicion, more research must be done.

APPENDIX 2.1

SELECTED LITERATURE
ON
INFORMATION TECHNOLOGY
AND
ORGANIZATIONAL STRATEGY

INFORMATION TECHNOLOGY AND ORGANIZATIONAL STRATEGY

The literature on the strategic use of information technology (IT) dates from the time when articles on the use of computer-based information systems (IS) in organizations first appeared. In 1961, Daniel began the tradition of presenting a framework for conceptualizing the role of information systems in providing, among other things, "competitive" information for "strategy formulation." The early 70's saw Zani (1970) and Gorry and Scott Morton (1971) put forth their notions of IS in the context of strategy, while the late 70's and the entire decade of the 80's witnessed a plethora of writings on conceptual frameworks and IT-strategic perspectives.

Literature Classification

Exhibit A presents a condensation of a selection of articles written throughout the period 1961-1989. A brief reference is provided (year/author(s)/title) along with the purpose of each article, its major findings/results, and the research methodology it utilized. The scope of the literature encompasses writings on both strategic information systems and systems for gaining competitive advantage; in fact, many writers make no attempt to distinguish these (Huff and Beattie's 1985 article is clearly an exception).

The articles appear to fall into three categories: (1) prescriptions on how information systems should be managed in support of an organization's strategic interests, (2) techniques for identifying opportunities for gaining competitive advantage through the deployment of information technology, and (3) theory building attempts. The delineations between these categories are not always clear. The Gorry and Scott Morton (1971) article illustrates this: they draw implications from their "Framework for Management Information Systems" for management of IS resources at operational, managerial, and strategic levels;

however, their objective to understand the evolution, benefits, and problems of MIS was also concerned with theory building.

Prescriptive Literature

This category might include Daniel (1961), Zani (1970), King (1978), Rockart (1979), McFarlan, McKenney, and Pyburn (1983), Parsons (1983b), Johnston and Carrico (1988), and Lederer and Mendelow (1988). Much of the earlier work here (Daniel, Zani, Rockart) is preoccupied with critical success factors (CSFs) as a basis for strategic IS management. Interestingly, the CSF theme in the IS literature is about to turn thirty. The articles given in Exhibit A follow this theme for the first twenty years of its history. (For work in this respect after 1980 see Exhibit 2.6) The preponderance of literature in this category seems concerned with the development of conceptual frameworks. (The few exceptions include Rockart 1979, Johnston and Carrico 1988, and Lederer and Mendelow 1988.) While not always made explicit, Anthony's (1965) classification of the levels of management is often an underlying concept.

Opportunity Identification

The category of articles which attempt to identify and discover opportunities for competitive advantage through the use of IT seems to contain the greatest variety of conceptual frameworks and the least amount of empirical work. Here we find all the work dated entirely in the past decade: Gerstein and Reisman 1982, Parsons 1983a, Benjamin, Rockart, Scott Morton, and Wyman 1984, Wiseman and MacMillan 1984, Rockart and Scott Morton 1984, McFarlan 1984, Ives and Learmonth 1984, Cash and Konsynski 1985, Rackoff, Wiseman, and Ullrich 1985, Porter and Millar 1985, Munro and Huff 1985, Barrett 1986, Reich and Huff 1988, and Johnston and Vitale 1988. All provide different frameworks for pursuing competitive advantage through IT deployment; only Reich and Huff (1988) provide an empirical basis for what is posited. Underlying much of the work in this category is Porter's framework of competitive forces and the value chain concept (Porter 1980 and 1985). While Porter's framework provides some potential for a reconciliation of the various conceptual frameworks, there is much shaky ground here. Porter's work, although widely accepted, has not been the subject of extensive empirical verification.

Theory Building

Articles concerned with theory building seem to appear infrequently. Treacy (1985) attempted to identify steps for building a "cumulative research tradition" in the area of IT and competitive advantage. Bakos and Treacy (1986) put forth a causal model of competitive advantage. These efforts were attempts to integrate many of the frameworks identified by other authors into a more comprehensive view. Both articles were conceptual pieces based on extensive literature reviews. Sabherwal and King (1987) used an "inductive" approach to develop a theory of the strategic use of information systems. By surveying literature on the applications of IT for competitive advantage, a theory (including a set of propositions) was formulated. Venkatraman and Zaheer (1989) conducted a field experiment on the role of "electronic integration" in providing "strategic benefits" to an organization. Their study and its results are discussed more extensively in the review of research on information integration and performance contained in Chapter 2.

EXHIBIT A

Information Technology and Organizational Strategy

Year / Author(s) / Title	Purpose	Results/Findings	Method(s)
61 Daniel: *Management Information Crisis.*	To identify relevant management information for planning and control.	A framework for objective setting and strategy formulation on the basis of competitive, environmental, and internal information focussed on "success factors."	Conceptual
70 Zani: *Blueprint for MIS.*	To identify the major determinants of MIS design.	A framework showing opportunities and risks, strategy, structure, decision-making, technology, and availability of information sources as MIS design determinants. "Key success variables" are central.	Conceptual
71 Gorry and S. Morton: *A Framework for MIS.*	To understand the evolution of MIS activities, benefits, and problems.	A framework based on Anthony's classification of managerial activities into operational, management, and strategic levels and Simon's classification of decisions.	Conceptual
78 King: *Strategic Planning for MIS.*	To describe an approach for linking the firm's "strategy set" to the MIS "strategy set."	A process deriving an MIS strategy from the firm's strategy given the interests of various constituencies: customers, the public, stockholders, government, creditors, employees, and management.	Conceptual
79 Rockart: *Chief Executives Define Their Own Data Needs.*	To describe the critical success factors method for identifying executive information requirements.	A framework linking information requirements to industry structure, competitive strategy, and environmental and temporal factors.	Interviews (n=4), Action research (n=1), and conceptual.
82 Gerstein and Reisman: *Creating Competitive Advantage with Computer Technology.*	To explore the strategic underutilization of DP technology.	A framework with two dimensions: (1) the extent of operational criticality and (2) the potential for competitive advantage.	Conceptual
83a Parsons: *Information Technology: A New Competitive Weapon.*	To assess the competitive impact of IT on a firm and develop a guide for integrating IS with strategy.	A framework, based on Porter's competitive forces, suggesting three levels of IT impact: the industry, the firm, and strategy.	Conceptual. Selected examples fill the grid.

Exhibit A continues on the next page.

EXHIBIT A (Continued)

Information Technology and Organizational Strategy

Year / Author(s) / Title	Purpose	Results/Findings	Method(s)
83b Parsons: *Fitting IST to the Corporate Needs: The Linking Strategy.*	To present a means of developing a conscious IT strategy consistent with the firm's needs.	Six Generic IT Strategies are identified: Centrally Planned, Leading Edge, Free Market, Monopoly, Scarce Resource, and Necessary Evil. Much is based on McFarlan, McKenney, and Pyburn's Strategic Grid.	Conceptual.
83 McFarlan, McKenney and Pyburn: *The Information Archipelago - Plotting a Course.*	To examine IS planning in the context of IT and corporate strategy.	Identified phases of technology assimilation. Developed the Strategic Grid classifying the IS environment along two dimensions: (1) the strategic impact of existing systems and (2) the strategic impact of the applications development portfolio.	Conceptual
84 Benjamin, Rockart, Scott Morton, and Wyman: *Information Technology: A Strategic Opportunity.*	To explore the "gap" between the opportunities created by IT and its effective utilization.	The Strategic Opportunities Framework with 2 dimensions: (1) the competitive marketplace and internal operations, and (2) significant structural change and traditional processes.	Conceptual. Selected examples fill the grid.
84 Wiseman and MacMillan: *Creating Competitive Weapons from Information Systems.*	To identify opportunities for gaining a competitive edge through IT .	The Option Generator with strategic targets (suppliers, customers, competitors) and strategic thrusts (cost differentiation and innovation as the major dimensions.	Conceptual. Selected examples are used.
84 Rockart and Scott Morton: *Implications of Changes in IT for Corporate Strategy.*	To provide a conceptual model for the "double linkage" of IT supporting business strategies and IT creating opportunities for new business strategies.	A model of technology impact based on the work of Chandler and by "particularizing" from work by Leavitt. Strategy and technology are seen as a "critical interaction."	Conceptual.
84 McFarlan: *IT Changes the Way You Compete.*	To provide a basis for identifying when IT represents a strategic resource.	Guiding questions based on Porter's competitive forces are posited. Can IST (1) build barriers to entry? (2) build in switching costs? (3) change the basis of competition? (4) change the balance of power with suppliers? and (5) generate new products?	Conceptual.

Exhibit A continues on the next page.

EXHIBIT A (Continued)

Information Technology and Organizational Strategy

Year / Author(s) / Title	Purpose	Results/Findings	Method(s)
84 Ives, Learmonth: *The Information System as a Competitive Weapon.*	To examine a firm's relationship with its customers and how it might be changed or enhanced by the strategic application of IST.	Developed the 13-stage Consumer Resource Life Cycle on which to map existing applications or identify new applications.	Conceptual. Multiple examples from "recent trade literature" and from a "survey" of IS executives.
85 Cash, Konsynski: *IS Redraws Competitive Boundaries.*	To examine inter-organizational systems (IOSs) and their competitive implications.	Identifies potential uses for IOSs in view of Porter's classification of competitive forces. Concludes that such systems can "radically" change the balance of power in buyer-supplier relationships.	Conceptual.
85 Rackoff, Wiseman and Ullrich: *IS for Competitive Advantage: Implementation of a Planning Process.*	To provide a means of discovering strategic information systems opportunities systematically.	This extends the strategic thrust dimension of Wiseman and MacMillan's (1984) Option Generator (to include growth and alliance).	Conceptual.
85 Porter and Millar: *How IT Gives You Competitive Advantage.*	To help general managers respond to the challenges of the information revolution.	Develops the Information Intensity Matrix which relates information in the value chain to the information content in the product to "illuminate" the differences in the intensity and role of information across industries.	Conceptual.
85 Treacy: *Toward a Cumulative Tradition on Research on IT as a Strategic Business Factor.*	To critically review the methodological basis of literature on IT and competitive advantage and to identify steps for building a cumulative research tradition.	Classifies the literature in 3 ways: (1) descriptions, (2) prescriptions, and (3) opportunity identification. Identifies 5 areas of improvement.	Conceptual. Literature reviews.
85 Munro and Huff: *IT and Corporate Strategy.*	To help senior managers discover and exploit competitive IT opportunities.	Juxtaposition of four frameworks: (1) the firm and its competitive environment, (2) the firm-customer link, (3) the value-added chain, and (4) the internal IT assessment and adoption forces.	Conceptual.

Exhibit A continues on the next page.

EXHIBIT A (Continued)

Information Technology and Organizational Strategy

Year / Author(s) / Title	Purpose	Results/Findings	Method(s)
85 Huff and Beattie. *Strategic Versus Competitive IS.*	To clarify the two concepts and provide frameworks for the development of both types.	SIS development framework based on success factors and performance indicators. CIS opportunity identification based on Porter's Value Chain and the Information Intensity Matrix.	Conceptual.
86 Bakos and Treacy: *IT and Corporate Strategy: A Research Perspective.*	To survey efforts to arrive at a framework and to integrate them into a more comprehensive view.	Posits a causal model of competitive advantage with 8 constructs: Search-related Costs, Unique Product Features, Switching Costs, Bargaining Power, Internal Efficiency, Interorganizational Efficiency, Comparative Efficiency, and Competitive Advantage.	Conceptual. Literature review.
87 Barrett: *Strategic Alternatives and IOS Implementations: An Overview.*	To clarify the relationship between strategic choices and potential IOS implementations.	Finds examples of IOSs to support the strategic alternatives identified by Rowe, Mason, and Dickel.	Conceptual. Examples.
87 Sabherwal & King: *Towards a Theory of the Strategic Use of Information Resources: An Inductive Approach.*	To develop a theory of the strategic use of information resources.	An "induced" theory for the strategic use of information systems including a set of propositions.	Survey of business articles (32 cases).
88 Reich and Huff: *Customer-Oriented Strategic Systems.*	To understand the factors influencing successful COSS development and implementation.	Identifies 5 factors driving development and 7 factors driving COSS adoption. Provides an "idea-to-competitive advantage" framework of recommendations.	Studied 11 COSSs in 9 large firms.
88 Johnston & Carrico: *Developing Capabilities to Use Information Strategically.*	To identify the factors that lead to the possibility of being able to use IT strategically.	Competitive advantage depends on the interaction between industry conditions and the internal capability to identify and exploit opportunities.	Interviews with 90 managers in 11 firms all in different industries.
88 Johnston & Vitale: *Creating Competitive Advantage with Interorganizational Information Systems.*	To guide the discovery of competitive advantage through the use of IOSs.	An Opportunity Search framework which considers business purpose, relationships/participations, information function, and improvement focus.	Conceptual.

Exhibit A continues on the next page.

EXHIBIT A (Continued)

Information Technology and Organizational Strategy

Year / Author(s) / Title	Purpose	Results/Findings	Method(s)
88 Lederer & Mendelow: *Convincing Top Management of the Strategic Potential of Information Systems.*	To identify the reasons why IS managers feel it is difficult to convince top management of the strategic impact of IS.	Six reasons are identified along with as many techniques or overcoming TM's reluctance to recognize impacts.	Interviews with 20 IS executives.
89 Venkatraman & Zaheer: *Electronic Integration and Strategic Advantage.*	To investigate the role of electronic integration in providing strategic benefits.	Differential performance is statistically different for efficiency measures but not for effectiveness measures.	Quasi-experimental design using 2 matched groups (treatment n = 85, control n = 75).

APPENDIX 4.1

INVITATIONAL INFORMATION PACKAGE

FOR

PROSPECTIVE PARTICIPATING ORGANIZATIONS

Information Integration Research Project
School of Business Administration
The University of Western Ontario

Critical Organizational Tasks

As organizations face increasingly more competitive and complex environments, the importance of well informed organizational members becomes more critical to organizational performance. Assessing market changes, evaluating new sources of financial capital, identifying innovative technology, and tracking competitor actions and reactions are just some of the information-intensive tasks that affect the formulation of appropriate organizational responses to complex and competitive conditions. A major factor in the successful performance of many of these critical tasks is the information used by organizational members. In spite of its importance, very little research has been done on the information utilized by such tasks and how its use impacts individual performance and, consequently, organizational performance.

The Research

This research project investigates the extent to which the information that is used by the members of an organization is integrated with critical tasks and how this integration impacts the performance of individuals. As a long term goal, our research seeks to understand the way in which such integration affects an organization's performance and its ability to gain and sustain strategic advantage; however, our initial research efforts are focussed on the relationship between information integration and the job-related performance of individuals within an organization.

Financial Support

The project is funded by a grant from the Natural Sciences and Engineering Research Council of Canada. Other than the time required by various individuals for meetings and questionnaire completion, no out-of-pocket expenses should be incurred by an organization in respect of its participation in this research.

.../2

The Procedure

The research proceeds in three stages:

(1) Identification of the critical tasks for a target group of employees. This will be done during initial meetings with senior executives. The target group will consist of individuals whose performance is closely connected to organizational performance (e.g., brokers in a stock brokerage firm, sales representatives in an insurance company or a real estate firm, etc.).

(2) A preliminary study of information utilization with respect to the critical tasks identified in Stage 1. This involves the completion of a questionnaire by about 30 individuals in the target group. Questionnaire completion is estimated to take between 30 and 40 minutes depending on the number of critical tasks.

(3) Completion of the questionnaire by all individuals in the target group. This questionnaire will essentially be the same as that used in Stage 2 but revised on the basis of findings from the preliminary study.

Benefits for Participating Organizations

Although the data collected and the analysis performed will be directed at our basic research questions, we feel that the results will be of interest to management. Essentially, what will be done is an evaluation of the organization's information systems, not just its computer-based systems but all the mechanisms by which members of the target group obtain information that is used to accomplish critical tasks. Analysis will involve the correlation of various aspects of information integration with performance measures. This will result in the generation of various quantities which indicate the areas in which the provision of information has the greatest effect on individual performance and productivity.

General Conditions for Participation

Participating organizations must be willing to provide the time of senior executives and individuals in the target group. These organizations must also be willing to provide data on individual performance. Procedures will be employed to protect the identity of those who complete questionnaires and for whom performance data are made available.

APPENDIX 4.2

THE PROTOCOL BOOKLET

Information Integration Research Project

Interview Guide
and
Questionnaire Booklet

Project Director

Jim Wyse

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The University of Western Ontario
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Acknowledgement

This project is financially supported by the Natural Sciences and Engineering Research Council of Canada.

Information Integration Research Project
School of Business Administration
The University of Western Ontario

London Life Representatives - Job Aspects

- ☐ 1. Prospecting.
- ☐ 2. Providing service to existing clients.
- ☐ 3. Recognizing the value of being associated with London Life.
- ☐ 4. Maintaining a knowledge of London Life's current products.
- ☐ 5. Obtaining a knowledge of competitors' products.
- ☐ 6. Analyzing the needs of clients.

The purpose of this interview is to assess the extent to which the information you use is 'integrated' with these 6 aspects of your job.

London Life Representatives - Job Aspect Clarifications

Prospecting:

- Locating leads.
- Getting an interview under favourable circumstances.
- Qualifying potential clients.
- Further development of existing clients.
- ______________________________
- ______________________________

Providing service to existing clients:

- Supplying requested information on presently held policies.
- Making existing clients aware of legislative changes, new products, options, etc.
- Building client relationships .... "London Life cares ..."
- Policy maintenance: changes re: beneficiary, bank, address, name, etc.
- ______________________________
- ______________________________

Recognizing the value of being associated with London Life:

- Assessing the advantages of staying/associating with London Life.
- Determining what London Life does for you and your client.
- ______________________________
- ______________________________

Maintaining a knowlege of London Life's current products:

- Maintaining an awareness of the features and benefits of current products.
- ______________________________
- ______________________________

Obtaining a knowledge of competitors' products:

- Maintaining an awareness of how London Life's products "stack up" against competing products.
- ______________________________
- ______________________________

Analyzing the needs of clients:

- Being familiar with government benefits (CPP, etc.).
- Determining dreams/goals.
- Matching problems and solutions.
- Assessing ability to pay.
- ______________________________
- ______________________________

Job Aspect ➡ *Prospecting*

Information units that you use for this job aspect:

A. ______________________________

B. ______________________________

C. ______________________________

D. ______________________________

E. ______________________________

F. ______________________________

G. ______________________________

H. ______________________________

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

Relative Importance of Information Units

Indicate the relative importance of each information unit listed above for this job aspect. Draw a vertical mark on the scale below and place the information unit number next to your mark.

NOT VERY IMPORTANT |---|---|---|---|---|---| VERY IMPORTANT

1 2 3 4 5 6 7

Frequency of Use

Indicate how often you actually use each information unit for this aspect of your job. Use vertical marks as was done above.

|---|---|---|---|---|

Daily Weekly Monthly Quarterly Yearly Less Often Than Yearly

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

RELIABILITY
The consistency and dependability of the information.

The reliability of the information unit is . . .

. . . COMPLETELY INADEQUATE for this job aspect.

. . . SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

. . . GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.

. . . GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.

. . . GENERALLY ADEQUATE for this job aspect, some improvement is possible.

. . . VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.

. . . PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

TIMELINESS
The availability of the information at a time suitable for its use.

The timeliness of the information unit is . . .

. . . COMPLETELY INADEQUATE for this job aspect.

. . . SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

. . . GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.

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. . . VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.

. . . PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

RELEVANCY
The degree to which the information corresponds to what is needed.

The relevancy of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

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. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

CONFIDENCE IN SYSTEMS
Your feeling of assurance or certainty about the means (systems, procedures) by which the information is developed and delivered.

The means of information unit delivery is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

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. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

COMPLETENESS
The comprehensiveness of the content of the information.

The completeness of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

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. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

ACCURACY
The correctness of the information.

The accuracy of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

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. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

CURRENCY
The age of the information.

The currency of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

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. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

VOLUME
The amount of information that is supplied to you.

The information unit's volume is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

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. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

☐ ☐ ☐ . . . **too much**
☐ ☐ ☐ . . . **too little**

Job Aspect ➡ *Prospecting*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

Extent of Information Usage Evaluated

Indicate the portion which the information units listed above, TAKEN TOGETHER, are of all the information you actually use for this job aspect.

| - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - |

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If the portion is less than 80%, what are the other major units and the approximate portion that each represents?

	Information Unit	Additional %
1.	______________________	________
2.	______________________	________

Overall Assessment

What is your overall assessment of the extent to which you are satisfied with ALL the information that you use for this aspect of your job?

	1	2	3	4	5	6	7	
SATISFIED	↑ extremely	↑ quite	↑ slightly	↑ neither or equally	↑ slightly	↑ quite	↑ extremely	DISSATISFIED

Job Aspect ➡ *Providing Service to Existing Clients*

Information units that you __use__ for this job aspect:

A. ______________________________

B. ______________________________

C. ______________________________

D. ______________________________

E. ______________________________

F. ______________________________

G. ______________________________

H. ______________________________

Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

Relative Importance of Information Units

Indicate the relative importance of each information unit listed above for this job aspect. Draw a vertical mark on the scale below and place the information unit number next to your mark.

NOT VERY IMPORTANT | - - - | - - - | - - - | - - - | - - - | - - - | VERY IMPORTANT

1 2 3 4 5 6 7

Frequency of Use

Indicate how often you actually use each information unit for this aspect of your job. Use vertical marks as was done above.

| - - - | - - - | - - - | - - - | - - - |

Daily Weekly Monthly Quarterly Yearly Less Often Than Yearly

Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

RELIABILITY
The consistency and dependability of the information.

The reliability of the information unit is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

. . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

. . . **GENERALLY ADEQUATE for this job aspect, some improvement is possible.**

. . . **VERY ADEQUATE for this job aspect, any improvement is probat unnecessary.**

. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

TIMELINESS
The availability of the information at a time suitable for its use.

The timeliness of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

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Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

RELEVANCY
The degree to which the information corresponds to what is needed.

The relevancy of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

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Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

CONFIDENCE IN SYSTEMS
Your feeling of assurance or certainty about the means (systems, procedures) by which the information is developed and delivered.

The means of information unit delivery is . . .

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. . . SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

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Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

COMPLETENESS
The comprehensiveness of the content of the information.

The completeness of the information unit is . . .

. . . COMPLETELY INADEQUATE for this job aspect.

. . . SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

. . . GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.

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. . . PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ______________________________________

2. ______________________________________

3. ______________________________________

ACCURACY
The correctness of the information.

The accuracy of the information unit is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

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Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ______________________________________

2. ______________________________________

3. ______________________________________

CURRENCY
The age of the information.

The currency of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

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. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

VOLUME
The amount of information that is supplied to you.

The information unit's volume is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

. . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

. . . **GENERALLY ADEQUATE for this job aspect, some improvement is possible.**

. . . **VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.**

. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

☐ ☐ ☐ . . . **too much**

☐ ☐ ☐ . . . **too little**

Job Aspect ➡ *Providing Service to Existing Clients*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

Extent of Information Usage Evaluated

Indicate the portion which the information units listed above, TAKEN TOGETHER, are of all the information you actually use for this job aspect.

|---|---|---|---|---|---|---|---|---|---|

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If the portion is less than 80%, what are the other major units and the approximate portion that each represents?

	Information Unit	Additional %
1.	______________________	________
2.	______________________	________

Overall Assessment

What is your overall assessment of the extent to which you are satisfied with ALL the information that you use for this aspect of your job?

	1	2	3	4	5	6	7	
SATISFIED	extremely	quite	slightly	neither or equally	slightly	quite	extremely	DISSATISFIED

Job Aspect ➡ *Recognizing the Value of Being Associated with London Life*

Information units that you <u>use</u> for this job aspect:

A. ____________________

B. ____________________

C. ____________________

D. ____________________

E. ____________________

F. ____________________

G. ____________________

H. ____________________

Job Aspect ➡ *Recognizing the Value of Being Associated with London Life*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

Relative Importance of Information Units

Indicate the relative importance of each information unit listed above for this job aspect. Draw a vertical mark on the scale below and place the information unit number next to your mark.

NOT VERY IMPORTANT | - - - | - - - | - - - | - - - | - - - | - - - | VERY IMPORTANT

1 2 3 4 5 6 7

Frequency of Use

Indicate how often you actually use each information unit for this aspect of your job. Use vertical marks as was done above.

| - - - | - - - | - - - | - - - | - - - |

Daily Weekly Monthly Quarterly Yearly Less Often Than Yearly

Job Aspect ➡ *Recognizing the Value of Being Associated with London Life*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

RELIABILITY
The consistency and dependability of the information.

The reliability of the information unit is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

. . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

. . . **GENERALLY ADEQUATE for this job aspect, some improvement is possible.**

. . . **VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.**

. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

Job Aspect ➡ ***Recognizing the Value of Being Associated with London Life***

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

TIMELINESS
The availability of the information at a time suitable for its use.

The timeliness of the information unit is . . .

. . . COMPLETELY INADEQUATE for this job aspect.

. . . SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

. . . GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.

. . . GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.

. . . GENERALLY ADEQUATE for this job aspect, some improvement is possible.

. . . VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.

. . . PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.

Job Aspect ➡ ***Recognizing the Value of Being Associated with London Life***

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

RELEVANCY
The degree to which the information corresponds to what is needed.

The relevancy of the information unit is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

. . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

. . . **GENERALLY ADEQUATE for this job aspect, some improvement is possible.**

. . . **VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.**

. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

Job Aspect ➡ *Recognizing the Value of Being Associated with London Life*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

CONFIDENCE IN SYSTEMS
Your feeling of assurance or certainty about the means (systems, procedures) by which the information is developed and delivered.

The means of information unit delivery is . . .

. . COMPLETELY INADEQUATE for this job aspect.

. . . SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

. . . GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.

. . . GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.

. . . GENERALLY ADEQUATE for this job aspect, some improvement is possible.

. . . VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.

. . . PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Recognizing the Value of Being Associated with London Life*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

COMPLETENESS
The comprehensiveness of the content of the information.

The completeness of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Recognizing the Value of Being Associated with London Life*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

ACCURACY
The correctness of the information.

The accuracy of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Recognizing the Value of Being Associated with London Life*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

CURRENCY
The age of the information.

The currency of the information unit is . . .

1	2	3	
-----	-----	-----	. . . **COMPLETELY INADEQUATE** for this job aspect.
-+-	-+-	-+-	. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.
-+-	-+-	-+-	. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.
-+-	-+-	-+-	. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.
-+-	-+-	-+-	. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.
-+-	-+-	-+-	. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.
-----	-----	-----	. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Recognizing the Value of Being Associated with London Life*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

VOLUME
The amount of information that is supplied to you.

The information unit's volume is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

☐ ☐ ☐ . . . too much
☐ ☐ ☐ . . . too little

Job Aspect ➡ *Recognizing the Value of Being Associated with London Life*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

Extent of Information Usage Evaluated

Indicate the portion which the information units listed above, TAKEN TOGETHER, are of all the information you actually use for this job aspect.

|---|---|---|---|---|---|---|---|---|---|

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If the portion is less than 80%, what are the other major units and the approximate portion that each represents?

	Information Unit	Additional %
1.	______________________	________
2.	______________________	________

Overall Assessment

What is your overall assessment of the extent to which you are satisfied with ALL the information that you use for this aspect of your job?

	1	2	3	4	5	6	7	
SATISFIED	↑ extremely	↑ quite	↑ slightly	↑ neither or equally	↑ slightly	↑ quite	↑ extremely	DISSATISFIED

Job Aspect ➡ *Maintaining a Knowledge of London Life's Current Products*

Information units that you <u>use</u> for this job aspect:

A. ______________________________

B. ______________________________

C. ______________________________

D. ______________________________

E. ______________________________

F. ______________________________

G. ______________________________

H. ______________________________

Job Aspect ➡ *Maintaining a Knowledge of London Life's Current Products*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

Relative Importance of Information Units

Indicate the relative importance of each information unit listed above for this job aspect. Draw a vertical mark on the scale below and place the information unit number next to your mark.

NOT VERY IMPORTANT |---|---|---|---|---|---| VERY IMPORTANT

1 2 3 4 5 6 7

Frequency of Use

Indicate how often you actually use each information unit for this aspect of your job. Use vertical marks as was done above.

|---|---|---|---|---|

Daily Weekly Monthly Quarterly Yearly Less Often Than Yearly

Job Aspect ➡ *Maintaining a Knowledge of London Life's Current Products*

The most important information units that you use for this job aspect:

1. ______________________________________

2. ______________________________________

3. ______________________________________

RELIABILITY
The consistency and dependability of the information.

The reliability of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Maintaining a Knowledge of London Life's Current Products*

The most important information units that you use for this job aspect:

1. ________________________________

2. ________________________________

3. ________________________________

TIMELINESS
The availability of the information at a time suitable for its use.

The timeliness of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspec ➡ *Maintaining a Knowledge of London Life's Current Products*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

RELEVANCY
The degree to which the information corresponds to what is needed.

The relevancy of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Maintaining a Knowledge of London Life's Current Products*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

CONFIDENCE IN SYSTEMS
Your feeling of assurance or certainty about the means (systems, procedures) by which the information is developed and delivered.

The means of information unit delivery is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

. . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

. . . **GENERALLY ADEQUATE for this job aspect, some improvement is possible.**

. . . **VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.**

. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

Job Aspect ➡ *Maintaining a Knowledge of London Life's Current Products*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

COMPLETENESS
The comprehensiveness of the content of the information.

The completeness of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ ***Maintaining a Knowledge of London Life's Current Products***

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

ACCURACY
The correctness of the information.

The accuracy of the information unit is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

. . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

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. . . **VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.**

. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

Job Aspect ➡ *Maintaining a Knowledge of London Life's Current Products*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

CURRENCY
The age of the information.

The currency of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Maintaining a Knowledge of London Life's Current Products*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

VOLUME
The amount of information that is supplied to you.

The information unit's volume is . . .

1	2	3	
-----	-----	-----	. . . **COMPLETELY INADEQUATE** for this job aspect.
-+-	-+-	-+-	. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.
-+-	-+-	-+-	. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.
-+-	-+-	-+-	. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.
-+-	-+-	-+-	. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.
-+-	-+-	-+-	. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.
-----	-----	-----	. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.
☐	☐	☐	. . . too much
☐	☐	☐	. . . too little

Job Aspect ➡ *Maintaining a Knowledge of London Life's Current Products*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

Extent of Information Usage Evaluated

Indicate the portion which the information units listed above, TAKEN TOGETHER, are of all the information you actually <u>use</u> for this job aspect.

|---|---|---|---|---|---|---|---|---|---|

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If the portion is less than 80%, what are the other major units and the approximate portion that each represents?

Information Unit	Additional %
1. ______________________	________
2. ______________________	________

Overall Assessment

What is your overall assessment of the extent to which you are satisfied with <u>ALL</u> the information that you use for this aspect of your job?

	1	2	3	4	5	6	7	
SATISFIED	extremely	quite	slightly	neither or equally	slightly	quite	extremely	DISSATISFIED

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

Information units that you <u>use</u> for this job aspect:

A. ______________________________

B. ______________________________

C. ______________________________

D. ______________________________

E. ______________________________

F. ______________________________

G. ______________________________

H. ______________________________

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

Relative Importance of Information Units

Indicate the relative importance of each information unit listed above for this job aspect. Draw a vertical mark on the scale below and place the information unit number next to your mark.

NOT VERY IMPORTANT | - - - | - - - | - - - | - - - | - - - | - - - | VERY IMPORTANT

1 2 3 4 5 6 7

Frequency of Use

Indicate how often you actually use each information unit for this aspect of your job. Use vertical marks as was done above.

| - - - | - - - | - - - | - - - | - - - |

Daily Weekly Monthly Quarterly Yearly Less Often Than Yearly

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

RELIABILITY
The consistency and dependability of the information.

The reliability of the information unit is ...

... **COMPLETELY INADEQUATE for this job aspect.**

... **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

... **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

... **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

... **GENE°ALLY ADEQUATE for this job aspect, some improve› ›nt is possible.**

... **VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.**

... **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

TIMELINESS
The availability of the information at a time suitable for its use.

The timeliness of the information unit is . . .

. . . COMPLETELY INADEQUATE for this job aspect.

. . . SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

. . . GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.

. . . GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.

. . . GENERALLY ADEQUATE for this job aspect, some improvement is possible.

. . . VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.

. . . PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

RELEVANCY
The degree to which the information corresponds to what is needed.

The relevancy of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ________________________________

2. ________________________________

3. ________________________________

CONFIDENCE IN SYSTEMS
Your feeling of assurance or certainty about the means (systems, procedures) by which the information is developed and delivered.

The means of information unit delivery is . . .

. . . COMPLETELY INADEQUATE for this job aspect.

. . . SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

. . . GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.

. . . GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.

. . . GENERALLY ADEQUATE for this job aspect, some improvement is possible.

. . . VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.

. . . PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

COMPLETENESS
The comprehensiveness of the content of the information.

The completeness of the information unit is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

. . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

. . . **GENERALLY ADEQUATE for this job aspect, some improvement is possible.**

. . . **VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.**

. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ________________________________

2. ________________________________

3. ________________________________

ACCURACY
The correctness of the information.

The accuracy of the information unit is . . .

... COMPLETELY INADEQUATE for this job aspect.

... SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

... GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.

... GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.

... GENERALLY ADEQUATE for this job aspect, some improvement is possible.

... VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.

... PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

CURRENCY
The age of the information.

The currency of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

VOLUME
The amount of information that is supplied to you.

The information unit's volume is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

☐ ☐ ☐ . . . too much

☐ ☐ ☐ . . . too little

Job Aspect ➡ *Obtaining a Knowledge of Competitors' Products*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

Extent of Information Usage Evaluated

Indicate the portion which the information units listed above, TAKEN TOGETHER, are of all the information you actually use for this job aspect.

|---|---|---|---|---|---|---|---|---|---|

0%   10%   20%   30%   40%   50%   60%   70%   80%   90%   100%

If the portion is less than 80%, what are the other major units and the approximate portion that each represents?

	Information Unit	Additional %
1.	______________________________	__________
2.	______________________________	__________

Overall Assessment

What is your overall assessment of the extent to which you are satisfied with ALL the information that you use for this aspect of your job?

	1	2	3	4	5	6	7	
SATISFIED	extremely	quite	slightly	neither or equally	slightly	quite	extremely	DISSATISFIED

Job Aspect ➡ *Analyzing the Needs of Clients*

Information units that you <u>use</u> for this job aspect:

A. ____

B. ____

C. ____

D. ____

E. ____

F. ____

G. ____

H. ____

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

Relative Importance of Information Units

Indicate the relative importance of each information unit listed above for this job aspect. Draw a vertical mark on the scale below and place the information unit number next to your mark.

NOT VERY IMPORTANT | - - - | - - - | - - - | - - - | - - - | - - - | VERY IMPORTANT

1 2 3 4 5 6 7

Frequency of Use

Indicate how often you actually use each information unit for this aspect of your job. Use vertical marks as was done above.

| - - - | - - - | - - - | - - - | - - - |

Daily Weekly Monthly Quarterly Yearly Less Often Than Yearly

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

RELIABILITY
The consistency and dependability of the information.

The reliability of the information unit is . . .

. . . COMPLETELY INADEQUATE for this job aspect.

. . . SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.

. . . GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.

. . . GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.

. . . GENERALLY ADEQUATE for this job aspect, some improvement is possible.

. . . VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.

. . . PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

TIMELINESS
The availability of the information at a time suitable for its use.

The timeliness of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ________________________________

2. ________________________________

3. ________________________________

RELEVANCY
The degree to which the information corresponds to what is needed.

The relevancy of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ____________________

2. ____________________

3. ____________________

CONFIDENCE IN SYSTEMS

Your feeling of assurance or certainty about the means (systems, procedures) by which the information is developed and delivered.

The means of information unit delivery is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect, **SOME ROOM FOR IMPROVFMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

COMPLETENESS
The comprehensiveness of the content of the information.

The completeness of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

. . . **GENERALLY ADEQUATE** for this job aspect. **SOME ROOM FOR IMPROVEMENT** but any deficiencies can be easily gotten around.

. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ________________________________

2. ________________________________

3. ________________________________

ACCURACY
The correctness of the information

The accuracy of the information unit is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

. . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

. . . **GENERALLY ADEQUATE for this job aspect, some improvement is possible.**

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. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ______________________________

2. ______________________________

3. ______________________________

CURRENCY
The age of the information.

The currency of the information unit is . . .

. . . **COMPLETELY INADEQUATE** for this job aspect.

. . . **SERIOUSLY INADEQUATE** but the information supplied is still of some value to this job aspect.

. . . **GENERALLY ADEQUATE** for this job aspect but there is **MUCH ROOM FOR IMPROVEMENT**, deficiencies are sometimes difficult to get around.

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. . . **GENERALLY ADEQUATE** for this job aspect, some improvement is possible.

. . . **VERY ADEQUATE** for this job aspect, any improvement is probably unnecessary.

. . . **PERFECTLY ADEQUATE** for this job, absolutely no improvements are necessary.

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ________________________________

2. ________________________________

3. ________________________________

VOLUME
The amount of information that is supplied to you.

The information unit's volume is . . .

. . . **COMPLETELY INADEQUATE for this job aspect.**

. . . **SERIOUSLY INADEQUATE but the information supplied is still of some value to this job aspect.**

. . . **GENERALLY ADEQUATE for this job aspect but there is MUCH ROOM FOR IMPROVEMENT, deficiencies are sometimes difficult to get around.**

. . . **GENERALLY ADEQUATE for this job aspect, SOME ROOM FOR IMPROVEMENT but any deficiencies can be easily gotten around.**

. . . **GENERALLY ADEQUATE for this job aspect, some improvement is possible.**

. . **VERY ADEQUATE for this job aspect, any improvement is probably unnecessary.**

. . . **PERFECTLY ADEQUATE for this job, absolutely no improvements are necessary.**

☐ ☐ ☐ . . . **too much**

☐ ☐ ☐ . . . **too little**

Job Aspect ➡ *Analyzing the Needs of Clients*

The most important information units that you use for this job aspect:

1. ____

2. ____

3. ____

Extent of Information Usage Evaluated

Indicate the portion which the information units listed above, TAKEN TOGETHER, are of all the information you actually use for this job aspect.

| - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - |

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

If the portion is less than 80%, what are the other major units and the approximate portion that each represents?

Information Unit	Additional %
1. ______________________________	__________
2. ______________________________	__________

Overall Assessment

What is your overall assessment of the extent to which you are satisfied with ALL the information that you use for this aspect of your job?

	1	2	3	4	5	6	7	
SATISFIED	↑ extremely	↑ quite	↑ slightly	↑ neither or equally	↑ slightly	↑ quite	↑ extremely	DISSATISFIED

The Relative Importance of Job Aspects

Please indicate the relative importance of each of the job aspects by supplying a number between 0 and 100 in the space provided below. Ensure that the sum of the numbers comes to 100.

Importance

1. Prospecting .... ______
2. Providing service to existing clients .... ______
3. Recognizing the value of being associated with London Life .... ______
4. Maintaining a knowledge of London Life's current products .... ______
5. Obtaining a knowledge of competitors' products .... ______
6. Analyzing the needs of clients .... ______

Other job aspects: (Name as many as you like.)

______________________________ .... ______

______________________________ .... ______

Total 100

If you complete this after the interview, please place the completed booklet in the envelope that has been provided. If the envelope has become separated from this form, please call our pick-up service at 681-2288 for delivery to:

Jim Wyse
Room 35
School of Business Administration
The University of Western Ontario
London, Ontario N6A 3K7

Thank you for your participation.

Respondent Number: ☐☐-☐☐☐-☐

APPENDIX 4.3

FIELD PROCEDURE DOCUMENTS

(i) Letter to Regional Manager

(ii) Regional Office Visitation Plan

(iii) Daily Interview Schedule

Information Integration Research Project
School of Business Administration
The University of Western Ontario

Proposed Interview Schedule - London Life Locations

Date(s)	Location	Total Reps	Number Qualified	Interview Target
Sep. 25, 26 and 27AM	Kitchener/Waterloo	27	?	13
Sep. 28AM	London South	25	?	6
Oct. 2, 3 and 4	Toronto Downsview	45	?	15
Oct. 10, 11 and 12 AM	Windsor Riverview	36	?	13
Oct. 16	Hamilton East	15	?	5
Oct. 17 and 18 AM	Hamilton Mountain	21	?	8
Nov. 7 and 8	Toronto Weston	32	?	10
Nov. 14 and 15	Toronto North	29	?	10
Nov. 20 and 21	Toronto Cedarbrae	28	?	10
Nov. 23 AM	London North	25	?	4
Nov. 26 AM	Woodstock	10	?	3
Nov. 28 AM	St. Thomas	9	?	3
			Total	100

Information Integration Research Project
School of Business Administration
The University of Western Ontario

Suggested Interview Schedule

AM Interviews

8:30	First Rep.
9:45	Second Rep.
11:00	Third Rep

PM Interviews

2:00	Fourth Rep.
3:15	Fifth Rep.

APPENDIX 5.1

DESCRIPTIVE STATISTICS

FOR

MEASUREMENT MODEL VARIABLES

Antecedent Manifests

Variable	Label	Mean	Standard Deviation	Minimum	Maximum	Skewness
R_1	Reliability	1.53	0.84	0.00	4.33	1.33
T_1	Timeliness	1.58	0 85	0.00	4.25	1.18
L_1	Relevancy	1.54	0.88	0.00	4.25	1.14
S_1	Confidence	1.57	0.87	0.00	4.80	1.15
C_1	Completeness	1.45	0.83	0.00	4.25	1.20
A_1	Accuracy	1.62	0.88	0.00	4.80	1.19
U_1	Currency	1.62	0.88	0.00	5.10	1.46
V_1	Volume	1.43	0.86	0.00	5.10	1.53
O_1	Satisfaction	1.81	0.89	0.00	4.93	0.99
R_2	Reliability	0.91	0.53	0.00	3.10	1.57
T_2	Timeliness	0.90	0.60	0.00	4.30	2.67
L_2	Relevancy	0.95	0.62	0.00	4.28	2.64
S_2	Confidence	0.92	0.58	0.00	4.21	2.33
C_2	Completeness	0.90	0.57	0.00	3.60	1.95
A_2	Accuracy	0.94	0.60	0.00	4.23	2.37
U_2	Currency	0.92	0.62	0.00	4.28	2.80
V_2	Volume	0.88	0.51	0.00	3.30	1.54
O_2	Satisfaction	0.98	0.57	0.00	3.38	1.55
R_3	Reliability	0.19	0.31	0.00	2.00	2.98
T_3	Timeliness	0.19	0.29	0.00	1.80	2.65
L_3	Relevancy	0.18	0.28	0.00	1.80	2.87
S_3	Confidence	0.19	0.29	0.00	1.80	2.76
C_3	Completeness	0.19	0.30	0.00	2.00	3.12
A_3	Accuracy	0.19	0.33	0.00	2.40	3.80
U_3	Curren	0.19	0.30	0.00	1.80	2.61
V_3	Volume	0.18	0.30	0.00	2.00	3.26
O_3	Satisfaction	0.21	0.35	0.00	2.40	3.49

Antecedent Manifests

Variable	Label	Mean	Standard Deviation	Minimum	Maximum	Skewness
R_4	Reliability	0.50	0.34	0.00	1.98	1.76
T_4	Timeliness	0.47	0.31	0.00	1.62	1.35
L_4	Relevancy	0.50	0.34	0.00	1.98	1.70
S_4	Confidence	0.50	0.34	0.00	1.98	1.78
C_4	Completeness	0.49	0.31	0.00	1.65	1.45
A_4	Accuracy	0.52	0.34	0.00	1.98	1.59
U_4	Currency	0.52	0.36	0.00	1.98	1.67
V_4	Volume	0.50	0.35	0.00	1.98	1.81
O_4	Satisfaction	0.53	0.33	0.00	1.88	1.50
R_5	Reliability	0.18	0.19	0.00	0.80	1.46
T_5	Timeliness	0.17	0.19	0.00	0.80	1.46
L_5	Relevancy	0.18	0.19	0.00	0.80	1.36
S_5	Confidence	0.18	0.19	0.00	0.80	1.34
C_5	Completeness	0.17	0.19	0.00	0.81	1.48
A_5	Accuracy	0.17	0.19	0.00	0.80	1.44
U_5	Currency	0.18	0.20	0.00	0.80	1.44
V_5	Volume	0.16	0.18	0.00	0.81	1.62
O_5	Satisfaction	0.17	0.21	0.00	1.00	2.02
R_6	Reliability	0.86	0.52	0.00	3.50	2.58
T_6	Timeliness	0.90	0.55	0.00	3.85	2.68
L_6	Relevancy	0.91	0.58	0.00	4.20	2.91
S_6	Confidence	0.90	0.54	0.00	3.43	2.34
C_6	Completeness	0.85	0.51	0.00	3.30	2.25
A_6	Accuracy	0.88	0.53	0.00	3.50	2.41
U_6	Currency	0.91	0.55	0.00	3.78	2.63
V_6	Volume	0.85	0.51	0.00	3.36	2.32
O_6	Satisfaction	0.96	0.58	0.00	3.99	2.59

Dependent Manifests

Variable	Label	Mean	Standard Deviation	Minimum	Maximum	Skewness
P	Units	46.9	25.0	9.5	179.0	2.07
I	Value	1530.1	1073.4	230.0	7092.0	2.39
M	Achievement	1.7	1.4	0.0	4.0	0.45
Q	Quality	85.2	10.1	53.9	98.2	- 1.26

APPENDIX 5.2

INFORMATION UNITS EVALUATED

Information Units Evaluated for Prospecting

Code	Information Unit	N	Percent of Subjects
14	CUSTOMER INFORMATION RECORDS	73	82.0
10	PERSONAL FILE OF LEADS AND REFERRALS	64	71.9
19	NEWSPAPERS, PUBLIC PRESS, ETC.	13	14.6
41	REPS PLANNING GUIDE	12	13.5
18	CITY DIRECTORY	11	12.4
50	GATEWAY - PROSPECTING	8	9.0
102	PURCHASED INFORMATION	8	9.0
9	GROUP PLACEMENT INFORMATION	6	6.7
48	LOCAL COMMUNITY DIRECTORIES & PUBLICATIONS	6	6.7
11	PERSONAL FILE OF FOLLOW-UPS	4	4.5
17	SER[illegible] MEMOS FROM HEAD OFFICE	4	4.5
110	BUSINESS DIRECTORIES	3	3.4
131	VOTERS LIST	3	3.4
70	CSA TERMINAL USE: CLIENT RECORDS	2	2.2
120	SERVICE DETAIL - FOLDER \ MAILBOX	2	2.2
22	TRANSFERS INTO DISTRICT	1	1.1
58	GATEWAY - UNSPECIFIED \ VARIOUS	1	1.1
69	PROSPECT CARD	1	1.1
101	FILE OF LEADS ON OWN PC	1	1.1
106	TELEPHONE DIRECTORY : ETHNIC NAMES	1	1.1
111	SALES AND SERVICE PLANNING REPORT	1	1.1
124	TORONTO TRADE INDEX	1	1.1
139	RESPONSES TO OWN MAILOUT	1	1.1
142	M.D.R.T. SEMINARS	1	1.1

Information Units Evaluated
for
Service to Existing Clients

Code	Information Unit	N	Percent of Subjects
14	CUSTOMER INFORMATION RECORDS	66	74.2
70	CSA TERMINAL USE: CLIENT RECORDS	46	51.7
17	SERVICE MEMOS FROM HEAD OFFICE	20	22.5
41	REPS PLANNING GUIDE	20	22.5
11	PERSONAL FILE OF FOLLOW-UPS	10	11.2
120	SERVICE DETAIL - FOLDER / MAILBOX	8	9.0
58	GATEWAY - UNSPECIFIED / VARIOUS	7	8.0
36	OVERDUE NOTICES	3	3.4
117	USE OF HEAD OFFICE SUPPORT STAFF	3	3.4
6	LEDGER STATEMENTS	2	2.2
15	INFOPAC	2	2.2
19	NEWSPAPERS, PUBLIC PRESS, ETC.	2	2.2
22	TRANSFERS INTO DISTRICT	2	2.2
104	DIRECT COMPUTER ACCESS TO CIRS	2	2.2
2	QUOTATIONS FROM COMPETITORS	1	1.1
3	DISTRICT ORDER NUMBER (D. O. N.) REPORTS	1	1.1
9	GROUP PLACEMENT INFORMATION	1	1.1
10	PERSONAL FILE OF LEADS AND REFERRALS	1	1.1
18	CITY DIRECTORY	1	1.1
30	STAFF MEETINGS / MATERIALS ON NEW PRODUCTS	1	1.1
38	L.U.A.C. MEETINGS AND COURSES	1	1.1
49	PACE	1	1.1
50	GATEWAY - PROSPECTING	1	1.1
54	GATEWAY - C.S.S.	1	1.1
63	RATE BOOK	1	1.1
85	GATEWAY - LEDGER STATEMENTS	1	1.1
90	VARIOUS INFORMAL SOURCES: MANAGERS, REPS	1	1.1
93	GROUP RENEWAL NOTICES	1	1.1
94	NOTICES OF DISCONTINUANCE - PENSION, RRSP	1	1.1
111	SALES AND SERVICE PLANNING REPORT	1	1.1
116	REQUESTED INFORMATION FROM COMPETITORS	1	1.1
121	REPS INCOME STATEMENT	1	1.1
130	QUICK QUOTES	1	1.1
140	L.U.A.C. MAGAZINE	1	1.1
141	OWN CLIENT FILE	1	1.1

Information Units Evaluated
for
Relationship Value

Code	Information Unit	N	Percent of Subjects
44	FREEDOM 55 ADVERTISING	22	24.7
49	PACE	9	10.1
91	VARIOUS FORMAL INTERNAL COMMUNICATIONS	9	10.1
19	NEWSPAPERS, PUBLIC PRESS, ETC.	8	9.0
95	VARIOUS INFORMAL SOURCES - EXTERNAL	6	6.7
96	LONDON LIFE ANNUAL REPORT	6	6.7
15	INFOPAC	5	5.6
90	VARIOUS INFORMAL SOURCES: MANAGERS, REPS	3	3.4
115	FINANCIAL & TRADE PUBLICATIONS	3	3.4
31	VALUATION OF BENEFITS - LL REPS	2	2.2
37	STONE & COX	2	2.2
113	BUSINESS PERIODICALS	2	2.2
123	PRODUCTION BULLETIN	2	2.2
126	COMPANY HISTORY	2	2.2
129	CONFERENCES, TRADE SHOWS, ETC.	2	2.2
14	CUSTOMER INFORMATION RECORDS	1	1.1
29	FOCUS	1	1.1
32	PENSION UPDATE - LL REPS	1	1.1
34	PRODUCTION SUMMARY - LL REPS	1	1.1
45	LIFELINE BROCHURES	1	1.1
67	PLANNING AND PROGRESS BOOK	1	1.1
80	PERSONAL FINANCIAL SECURITY ASSESSMENT	1	1.1
103	JOB VALUATION	1	1.1
107	CDN. LIFE AND HEATH INS. ASSOC. PERIODICAL	1	1.1
109	SEMINARS - OTHER COMPANIES	1	1.1
112	PRODUCT COMPARISONS BY EXTERNAL SOURCES	1	1.1
119	THIRD PARTY INFORMATION	1	1.1
121	REPS INCOME STATEMENT	1	1.1
127	PFS - SALES ILLUSTRATIONS	1	1.1
132	OWN COLLECTION OF LONDON LIFE INFO	1	1.1
500	OTHER	1	1.1

Information Units Evaluated

for

Product Knowledge

Code	Information Unit	N	Percent of Subjects
15	INFOPAC	45	50.6
39	NEW PRODUCT INFORMATION KITS	45	50.6
63	RATE BOOK	26	29.2
90	VARIOUS INFORMAL SOURCES: MANAGERS, REPS	25	28.1
30	STAFF MEETING/MATERIALS ON NEW PRODUCTS	19	21.3
49	PACE	14	15.7
91	VARIOUS FORMAL INTERNAL COMMUNICATIONS	14	15.7
40	PRODUCT PORTFOLIO	6	6.7
64	AGENTS MANUAL	6	6.7
6	LEDGER STATEMENTS	4	4.5
7	PRODUCT BROCHURES	4	4.5
117	USE OF HEAD OFFICE SUPPORT STAFF	4	4.5
85	GATEWAY - LEDGER STATEMENTS	3	3.4
133	ADVANCED SALES UPDATES	2	2.2
14	CUSTOMER INFORMATION RECORDS	1	1.1
16	GROUP SCOOP	1	1.1
28	FORUM	1	1.1
55	GATEWAY - SALES ILLUSTRATIONS	1	1.1
68	SALES AIDS	1	1.1
97	MARKETPLACE	1	1.1
114	INFORMATION FROM OFFICE MANAGER AND STAFF	1	1.1
120	SERVICE DETAIL - FOLDER/MAILBOX	1	1.1
125	MODEL QUOTATIONS	1	1.1
135	PRODUCT ADVISORY COUNCIL MEMBERSHIP	1	1.1
143	GROUP REP	1	1.1

Information Units Evaluated

for

Competitor Products

Code	Information Unit	N	Percent of Subjects
25	CLIENT POLICIES	37	41.6
90	VARIOUS INFORMAL SOURCES: MANAGERS, REPS	21	23.6
5	VARIOUS FORMAL PRODUCT COMPARISONS	14	15.7
75	A. L. WILLIAMS KIT	14	15.7
15	INFOPAC	7	7.9
95	VARIOUS INFORMAL SOURCES - EXTERNAL	7	7.9
117	USE OF HEAD OFFICE SUPPORT STAFF	7	7.9
49	PACE	5	5.6
100	DISCLOSURE STATEMENTS	5	5.6
116	REQUESTED INFORMATION FROM COMPETITORS	5	5.6
19	NEWSPAPERS, PUBLIC PRESS,.ETC.	3	3.4
30	STAFF MEETING/MATERIALS ON NEW PRODUCTS	3	3.4
91	VARIOUS FORMAL INTERNAL COMMUNICATIONS	3	3.4
37	STONE AND COX	2	2.2
59	THE EXCHANGE	2	2.2
98	CUSTOMER-SERVICE-IN-ACTION MANUAL	2	2.2
109	SEMINARS - OTHER COMPANIES	2	2.2
118	M. D. R. T. MAGAZINE	2	2.2
129	CONFERENCES, TRADE SHOWS, ETC	2	2.2
140	L. U. A. C. MAGAZINE	2	2.2
4	INSURANCE BUREAU OF CANADA DIRECTORY	1	1.1
23	MARKET NEWSLINE	1	1.1
26	TEMPO	1	1.1
28	FORUM	1	1.1
29	FOCUS	1	1.1
38	L. U. A. C. MEETINGS AND COURSES	1	1.1
40	PRODUCT PORTFOLIO	1	1.1
85	GATEWAY - LEDGER STATEMENTS	1	1.1
108	BROKERS KITS - OTHER COMPANIES	1	1.1
115	FINANCIAL & TRADE PUBLICATIONS	1	1.1
136	CONSERVATION NEWSLETTER	1	1.1
137	C. L. H. I. A. 1-800 NUMBER	1	1.1

Information Units Evaluated

for

Needs Analysis

Code	Information Unit	N	Percent of Subjects
66	SELF-DEVELOPED NEEDS ANALYSIS METHOD	56	62.9
14	CUSTOMER INFORMATION RECORDS	26	29.2
80	PERSONAL FINANCIAL SECURITY ASSESSMENT	21	23.6
87	FAMILY SECURITY SERVICE	9	10.1
85	GATEWAY - LEDGER STATEMENTS	8	9.0
51	GATEWAY - NEEDS ANALYSIS	7	7.9
27	PENSION BENEFITS INFORMATION, CPP ETC	4	4.5
63	RATE BOOK	4	4.5
122	PRE-INTERVIEW INFO. FROM CLIENT	4	4.5
6	LEDGER STATEMENTS	3	3.4
10	PERSONAL FILE OF LEADS AND REFERRALS	3	3.4
83	RETIREMENT PLANNER	3	3.4
134	SELF-DEVELOPED METHODS - BUSINESS OWNERS	3	3.4
24	FACT FINDING	2	2.2
38	L. U. A. C. MEETINGS AND COURSES	2	2.2
69	PROSPECT CARD	2	2.2
70	CSA TERMINAL USE: CLIENT RECORDS	2	2.2
86	NEEDS ANALYSIS FOR SINGLES	2	2.2
7	PRODUCT BROCHURES	1	1.1
8	CLIENTS GROUP BENEFITS INFORMATION	1	1.1
30	STAFF MEETING/MATERIALS ON NEW PRODUCTS	1	1.1
49	PACE	1	1.1
52	GATEWAY - RETIREMENT NEEDS ANALYSIS	1	1.1
58	GATEWAY - UNSPECIFIED/VARIOUS	1	1.1
81	MONEY IN YOUR FAMILY'S FUTURE	1	1.1
90	VARIOUS INFORMAL SOURCES: MANAGERS, REPS	1	1.1
92	CLIENTS PENSION BENEFIT STATEMENT	1	1.1
95	VARIOUS INFORMAL SOURCES - EXTERNAL	1	1.1
105	INVESTMENT PRODUCTS INFORMATION	1	1.1
119	THIRD PARTY INFORMATION	1	1.1
128	LONDON LIFE INFORMATION CARD	1	1.1
138	CLIENT ACCOUNTANT OR LAWYER	1	1.1
141	OWN CLIENT FILE	1	1.1

APPENDIX 5.3

TABLE OF INFORMATION UNIT CODES

Code	Information Unit Label
2	QUOTATIONS FROM COMPETITORS
3	DISTRICT ORDER NUMBER (D. O. N.) REPORTS
4	INSURANCE BUREAU OF CANADA DIRECTORY
5	VARIOUS FORMAL PRODUCT COMPARISONS
6	LEDGER STATEMENTS
7	PRODUCT BROCHURES
8	CLIENTS GROUP BENEFITS INFORMATION
9	GROUP PLACEMENT INFORMATION
10	PERSONAL FILE OF LEADS AND REFERRALS
11	PERSONAL FILE OF FOLLOW-UPS
12	PERSONAL FILE OF GOVT REGS & BENEFITS
13	CUSTOMER INITIATED SERVICE REQUEST
14	CUSTOMER INFORMATION RECORDS
15	INFOPAC
16	GROUP SCOOP
17	SERVICE MEMOS FROM HEAD OFFICE
18	CITY DIRECTORY
19	NEWSPAPERS, PUBLIC PRESS, ETC
20	ECHO SYSTEM
21	MORTGAGE LEAD SYSTEM
22	TRANSFERS INTO DISTRICT
23	MARKET NEWSLINE
24	FACT FINDING
25	CLIENT POLICIES
26	TEMPO
27	PENSION BENEFITS INFORMATION, CPP ETC
28	FORUM
29	FOCUS
30	STAFF MEETING/MATERIALS ON NEW PRODUCTS
31	VALUATION OF BENEFITS - LL REPS
32	PENSION UPDATE - LL REPS
33	BENEFITS SUMMARY - LL REPS
34	PRODUCTION SUMMARY - LL REPS
35	JANUARY KICK-OFF COMPARISON SUMMARIES
36	OVERDUE NOTICES
37	STONE AND COX
38	L. U. A. C. MEETINGS AND COURSES
39	NEW PRODUCT INFORMATION KITS
40	PRODUCT PORTFOLIO
41	REPS PLANNING GUIDE
42	CLIENT-SUPPLIED INFORMATION
43	PROSPECTING APPROACHES MANUAL
44	FREEDOM 55 ADVERTISING
45	LIFELINE BROCHURES
46	PRODUCT SUMMARIES MANUAL
47	THE INSIDER
48	LOCAL COMMUNITY DIRECTORIES & PUBLICATIONS
49	PACE
50	GATEWAY - PROSPECTING
51	GATEWAY - NEEDS ANALYSIS

Code	Information Unit Label
52	GATEWAY - RETIREMENT NEEDS ANALYSIS
53	GATEWAY - QUOTES
54	GATEWAY - C. S. S.
55	GATEWAY - SALES ILLUSTRATIONS
58	GATEWAY - UNSPECIFIED/VARIOUS
59	THE EXCHANGE
60	REFERRAL CARDS - FREEDOM 55 BROCHURE
61	REFERRALS FROM HEAD OFFICE
62	REFERRED LEADS DURING POLICY PLACEMENT
63	RATE BOOK
64	AGENTS MANUAL
65	PAR BOOK
66	SELF-DEVELOPED NEEDS ANALYSIS METHOD
67	PLANNING AND PROGRESS BOOK
68	SALES AIDS
69	PROSPECT CARD
70	CSA TERMINAL USE: CLIENT RECORDS
75	A. L. WILLIAMS KIT
80	PERSONAL FINANCIAL SECURITY ASSESSMENT
81	MONEY IN YOUR FAMILYS FUTURE
82	GRANUM FACT SHEET
83	RETIREMENT PLANNER
84	LONDON LIFE FACT SHEET
85	GATEWAY - LEDGER STATEMENTS
86	NEEDS ANALYSIS FOR SINGLES
87	FAMILY SECURITY SERVICE
88	CLASSIFICATION TO BE DETERMINED
90	VARIOUS INFORMAL SOURCES: MANAGERS, REPS
91	VARIOUS FORMAL INTERNAL COMMUNICATIONS
92	CLIENTS PENSION BENEFIT STATEMENT
93	GROUP RENEWAL NOTICES
94	NOTICES OF DISCONTINUANCE - PENSION, RRSP
95	VARIOUS INFORMAL SOURCES - EXTERNAL
96	LONDON LIFE ANNUAL REPORT
97	MARKETPLACE
98	CUSTOMER-SERVICE-IN-ACTION MANUAL
100	DISCLOSURE STATEMENTS
101	FILE OF LEADS ON OWN PC
102	PURCHASED INFORMATION
103	JOB VALUATION
104	DIRECT COMPUTER ACCESS TO CIRS
105	INVESTMENT PRODUCTS INFORMATION
106	TELEPHONE DIRECTORY: ETHNIC NAMES
107	CDN. LIFE AND HEALTH INS. ASSOC. PERIODICAL
108	BROKERS KITS - OTHER COMPANIES
109	SEMINARS - OTHER COMPANIES
110	BUSINESS DIRECTORIES
111	SALES AND SERVICE PLANNING REPORT
112	PRODUCT COMPARISONS BY EXTERNAL SOURCES

Code	Information Unit Label
113	BUSINESS PERIODICALS
114	INFORMATION FROM OFFICE MANAGER AND STAFF
115	FINANCIAL & TRADE PUBLICATIONS
116	REQUESTED INFORMATION FROM COMPETITORS
117	USE OF HEAD OFFICE SUPPORT STAFF
118	M. D. R. T. MAGAZINE
119	THIRD PARTY INFORMATION
120	SERVICE DETAIL - FOLDER/MAILBOX
121	REPS INCOME STATEMENT
122	PRE-INTERVIEW INFO. FROM CLIENT
123	PRODUCTION BULLENTIN
124	TORONTO TRADE INDEX
125	MODEL QUOTATIONS
126	COMPANY HISTORY
127	PFS - SALES ILLUSTRATIONS
128	LONDON LIFE INFORMATION CARD
129	CONFERENCES, TRADE SHOWS, ETC.
130	QUICK NOTES
131	VOTERS LIST
132	OWN COLLECTION OF LONDON LIFE INFO
133	ADVANCED SALES UPDATES
134	SELF-DEVELOPED METHODS - BUSINESS OWNERS
135	PRODUCT ADVISORY COUNCIL MEMBERSHIP
136	CONSERVATION NEWSLETTER
137	C. L. H. I. A. 1-800 NUMBER
138	CLIENT ACCOUNTANT OR LAWYER
139	RESPONSES TO OWN MAILOUT
140	L. U. A. C. MAGAZINE
141	OWN CLIENT FILE
142	M. D. R. T. SEMINARS
143	GROUP REP
500	OTHER

APPENDIX 5.4

DESCRIPTIVE STATISTICS

FOR

INFORMATION UNIT IMPORTANCE

Descriptive Statistics for Information Unit Importance

Job Aspect	Information Unit	Mean	Standard Deviation	N
Prospecting	1	6.2	1.1	87
	2	5.1	1.3	82
	3	4.9	1.5	59
Service	1	6.3	0.8	87
	2	5.8	1.1	76
	3	5.5	1.3	51
Relationship Value	1	5.7	1.3	45
	2	5.4	1.1	33
	3	5.4	1.0	21
Product Knowledge	1	6.1	1.1	89
	2	5.5	1.3	83
	3	5.4	1.2	56
Competitor Products	1	5.7	1.1	66
	2	5.3	1.1	55
	3	5.1	1.2	36
Needs Analysis	1	6.4	0.7	88
	2	5.8	1.1	61
	3	5.5	1.1	27

APPENDIX 6.1

OUTER RESIDUAL COVARIANCE MATRIX

Outer Residual Covariance Matrix

(Values x 10^3)

	O_1	R_1	T_1	L_1	S_1	C_1	A_1	U_1	V_1	O_2	R_2	T_2	L_2	S_2	C_2
R_1	-2														
T_1	-3	-4													
L_1	1	3	-1												
S_1	-8	-11	-16	1											
C_1	-32	6	-10	-10	-13										
A_1	-9	4	4	-12	-23	-5									
U_1	-11	-31	0	-17	1	-12	0								
V_1	2	-44	-14	-14	1	-14	-24	33							
O_2	19	4	-3	7	4	-13	-6	-1	-12						
R_2	0	-2	-6	2	13	11	-8	-11	-5	9					
T_2	3	-1	14	0	-12	-11	7	7	-7	-14	-26				
L_2	-2	0	-3	-2	-5	3	5	-1	6	-17	1	-5			
S_2	8	0	3	1	5	-11	-2	3	-2	-8	-15	-9	-11		
C_2	-6	-2	-9	1	12	9	-10	-3	9	8	11	-31	-1	-21	
A_2	0	-2	0	1	-2	-8	6	1	8	-11	-10	-10	5	14	-10
U_2	-10	2	5	-2	-9	0	10	2	1	-27	-7	4	11	-17	-5
V_2	-11	1	-7	-7	1	24	-7	-1	4	-4	6	-20	-15	10	13
O_3	0	0	6	0	-2	-3	1	2	-6	3	0	-5	-2	2	2
R_3	1	0	-3	2	1	1	0	-2	1	-1	0	0	2	-1	3
T_3	3	-1	-3	-2	1	1	1	1	-2	2	-1	8	-1	-1	1
L_3	-1	0	-2	0	-1	0	0	4	1	2	0	-2	-1	-1	-1
S_3	3	0	-3	0	3	0	-1	-2	0	0	1	1	2	-2	-1
C_3	0	2	2	1	-1	0	-2	-2	3	-1	0	-3	-2	1	0
A_3	-5	-1	5	0	-2	1	3	1	-4	-2	2	-9	1	2	-1
U_3	-4	0	-2	1	4	2	-2	-3	4	-1	-3	7	-1	-2	0
V_3	3	0	1	-4	-2	-1	0	2	3	-3	1	2	2	2	-2
O_4	5	-4	2	5	-4	-3	-2	3	-2	17	7	-3	-2	-11	-4
R_4	-2	-1	-3	2	3	0	-2	0	4	-5	1	1	3	1	-2
T_4	4	-3	-3	-14	11	4	2	0	-3	21	-11	12	-19	8	6

Outer Residual Covariance Matrix
(Values x 10^3)

	O_1	R_1	T_1	L_1	S_1	C_1	A_1	U_1	V_1	O_2	R_2	T_2	L_2	S_2	C_2
L_4	-5	0	0	4	-2	1	1	1	-2	-6	-3	-4	3	3	-1
S_4	5	3	-5	2	-2	-7	3	-1	4	4	-3	-11	2	6	1
C_4	-5	-3	4	-2	5	3	-2	3	-2	-1	4	6	-1	-3	-1
A_4	2	1	0	0	2	2	-1	-6	-4	-9	8	-2	9	0	1
U_4	-2	3	-1	-3	-2	2	1	0	4	-3	-6	-1	-3	-2	8
V_4	-3	3	6	-2	-7	4	-1	1	-2	-14	0	15	0	-3	-5
O_5	8	-8	-4	-1	-6	-1	-5	10	18	25	5	18	-17	-20	-4
R_5	-2	3	1	1	5	-4	3	-3	-7	0	-1	-10	4	1	-1
T_5	10	-2	3	-5	-2	-4	2	3	-5	10	2	-1	0	-4	2
L_5	5	4	8	1	-2	-5	0	-5	-12	0	-2	-3	-1	5	1
S_5	-3	-1	-5	1	1	-1	5	-1	4	-14	-1	-4	7	8	0
C_5	-4	-2	0	3	-5	2	2	-2	7	-15	-6	-3	5	8	1
A_5	-5	3	7	-2	-3	2	5	-4	-7	-1	-2	5	0	5	0
U_5	-12	3	1	-2	0	7	1	2	-3	-11	-3	-2	6	0	-2
V_5	2	2	-8	4	10	2	-11	-1	1	1	6	-2	-2	1	2
O_6	11	3	9	2	-7	-11	2	2	-13	11	-5	7	-2	-3	-8
R_6	-9	-1	-4	-2	-1	5	6	4	-2	-6	5	-2	1	-5	0
T_6	-2	-1	5	-4	1	-1	2	3	-3	9	-2	-1	1	-3	2
L_6	-2	-1	5	2	-7	4	-3	4	-5	-8	-8	4	4	0	3
S_6	0	1	-7	-4	9	1	0	-3	3	-1	-1	2	-2	4	0
C_6	-7	0	-3	-1	1	8	0	-3	7	-5	4	0	2	-1	-4
A_6	-1	-1	-1	2	4	0	-1	-2	-2	-3	2	-1	-1	0	7
U_6	4	1	3	4	1	-6	-4	0	0	3	0	3	-4	6	-2
V_6	7	-1	-5	2	-3	-1	-2	-4	15	4	3	-12	1	2	0
P	-2	-4	2	-2	0	-8	8	1	10	-7	-6	12	-3	3	-5
I	5	10	13	0	-15	3	-1	-3	-19	-7	-8	3	6	10	-11
M	-6	-13	-38	6	36	16	-23	5	17	38	39	-44	-6	-34	43
Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Outer Residual Covariance Matrix

(Values x 10^3)

	A_2	U_2	V_2	O_3	R_3	T_3	L_3	S_3	C_3	A_3	U_3	V_3	O_4	R_4
R_1														
T_1														
L_1														
S_1														
C_1														
A_1														
U_1														
V_1														
O_2														
R_2														
T_2														
L_2														
S_2														
C_2														
A_2														
U_2	2													
V_2	-12	-28												
O_3	1	0	1											
R_3	0	-2	0	-4										
T_3	3	-6	1	-6	1									
L_3	0	2	1	-3	0	2								
S_3	0	-1	0	-3	1	3	-1							
C_3	1	3	0	1	-1	-3	-1	-1						
A_3	3	6	-3	6	-2	-8	-1	-9	2					
U_3	-1	-3	3	-3	-1	1	-2	2	0	-5				
V_3	0	0	-3	1	-3	0	-3	-3	0	2	-2			
O_4	-6	5	1	8	-2	-4	3	-1	-1	2	-2	-5		
R_4	-2	3	-1	-3	5	-1	0	2	0	-1	-1	-3	-1	
T_4	16	-31	0	-9	-15	21	11	-15	-6	-10	4	23	-20	-34

Outer Residual Covariance Matrix

(Values × 10^3)

	A_2	U_2	V_2	O_3	R_3	T_3	L_3	S_3	C_3	A_3	U_3	V_3	O_4	R_4	T_4
L_4	5	-2	3	2	0	-4	-2	2	1	1	1	-3	-3	5	-26
S_4	7	-3	-1	0	2	-2	-1	3	0	0	1	-4	-3	1	-35
C_4	-9	4	0	0	-1	1	-1	-1	-1	0	0	3	1	1	2
A_4	-5	0	-1	0	2	-2	-3	2	1	0	0	0	-8	3	-38
U_4	2	6	-1	-2	1	1	-1	-1	2	1	-1	-1	-8	-7	-5
V_4	-6	9	0	-1	-1	0	-2	1	2	1	0	1	-2	-8	-30
O_5	-4	-2	1	11	-9	0	1	-10	0	0	7	2	26	-10	67
R_5	7	6	-6	-3	7	-3	-2	9	1	-1	-4	-6	1	10	-56
T_5	1	-6	-2	-1	-4	5	2	-5	-2	1	-3	9	-1	-3	73
L_5	0	1	-1	1	0	0	-1	-1	1	1	-2	2	-3	-4	2
S_5	-1	0	2	-5	6	-1	-2	8	1	-1	-2	-6	-11	10	-82
C_5	0	5	3	-1	6	-4	-2	6	1	0	-1	-7	-4	6	-81
A_5	-1	-8	2	0	-4	3	3	-6	-1	2	-2	6	-14	-8	68
U_5	2	9	-2	0	4	-4	-1	3	-1	0	6	-8	1	9	-56
V_5	-4	-5	5	-2	-7	5	2	-4	-1	-1	1	8	-1	-11	65
O_6	-5	4	-3	4	-2	1	1	1	0	-1	-4	0	10	-2	-2
R_6	7	3	-3	1	1	1	4	-2	-2	3	-4	-4	6	1	2
T_6	-2	-5	2	2	0	0	-1	1	-2	1	1	-2	3	1	2
L_6	0	3	-1	0	1	-1	0	-2	1	2	-1	-2	-1	2	-3
S_6	3	-8	4	1	-1	0	-2	0	0	-1	3	0	-3	-1	3
C_6	0	6	-3	-3	-1	-2	-1	0	3	-1	3	3	-3	-4	0
A_6	1	-5	4	0	0	3	-1	2	-1	-4	4	-1	-3	0	6
U_6	-3	-3	-1	-2	1	1	1	1	0	-2	-2	2	-7	-1	-1
V_6	-1	5	0	-4	1	-2	0	-1	1	3	-1	5	0	3	-9
P	1	2	-2	4	1	1	-1	0	0	-5	-1	2	6	-2	0
I	4	-2	-1	0	1	-1	-1	2	-1	1	0	-2	-2	5	-10
M	-15	-2	8	-11	-3	-1	4	-2	3	10	2	-1	-12	-8	22
Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Outer Residual Covariance Matrix

(Values x 10^3)

	L_4	S_4	C_4	A_4	U_4	V_4	O_5	R_5	T_5	L_5	S_5	C_5	A_5	U_5	V_5
S_4	2														
C_4	-11	-7													
A_4	-2	0	6												
U_4	-1	1	-7	0											
V_4	-4	-5	3	5	5										
O_5	-15	-9	4	-16	-5	-10									
R_5	14	7	-10	-3	4	2	-43								
T_5	-5	-11	-1	-10	2	11	-15	-7							
L_5	0	0	-3	2	5	3	-20	6	11						
S_5	6	12	1	16	0	9	-51	14	-27	-7					
C_5	5	10	0	14	3	11	-48	15	-28	0	36				
A_5	-6	-8	7	2	-5	-1	-20	-21	14	0	-6	-8			
U_5	14	8	-6	1	-3	1	-26	13	-21	-11	16	17	-9		
V_5	-12	-8	7	-3	-3	-3	10	-26	22	1	-18	-20	10	-28	
O_6	-5	-2	1	-1	-1	2	13	0	1	1	-4	-3	-4	-5	-1
R_6	6	-2	-8	-5	1	-2	1	5	5	0	-4	-5	-3	5	-4
T_6	0	0	2	-2	-2	-3	-4	2	5	1	-3	-2	1	2	-1
L_6	6	1	-6	-3	2	0	-9	2	2	0	2	3	-1	4	-1
S_6	0	2	4	3	-2	-4	2	-4	-6	-1	3	3	2	1	1
C_6	-4	-2	4	5	3	4	14	-7	-11	6	1	1	2	1	2
A_6	1	-1	1	1	-1	-1	-1	1	2	-1	-1	-1	0	2	0
U_6	-2	1	1	3	1	6	-17	2	2	6	5	4	5	1	-2
V_6	-3	4	1	0	0	0	1	1	0	2	2	0	-3	-11	6
P	-3	0	0	-1	0	0	20	-1	-3	1	-6	0	2	-10	-5
I	7	-7	0	6	-4	2	-32	4	8	12	5	5	4	10	-1
M	-8	16	0	-11	10	-5	17	-5	-12	-32	5	-12	4	8	17
Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Outer Residual Covariance Matrix

(Values x 10^3)

	O_6	R_6	T_6	L_6	S_6	C_6	A_6	U_6	V_6	P	I	M
S_4												
C_4												
A_4												
U_4												
V_4												
O_5												
R_5												
T_5												
L_5												
S_5												
C_5												
A_5												
U_5												
V_5												
O_6												
R_6	-6											
T_6	1	-5										
L_6	0	1	3									
S_6	-11	-2	1	-6								
C_6	-6	-5	-11	-11	1							
A_6	-6	-1	0	-2	3	-2						
U_6	4	-8	-1	-2	-6	-3	-1					
V_6	-3	-7	-9	-9	-8	8	-4	0				
P	-2	3	-5	-5	0	5	3	-2	4			
I	4	4	6	8	0	-11	-2	1	-10	-46		
M	-3	-20	1	-4	2	11	-2	5	11	-80	-56	
Q	0	0	0	0	0	0	0	0	0	0	0	0

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