## THE ANTECEDENTS AND CONSEQUENCES OF SHARED BUSINESS-IT UNDERSTANDING: AN EMPIRICAL INVESTIGATION

## DISSERTATION

Presented in Partial Fulfillment of the Requirements for

The Degree Doctor of Philosophy in the Graduate

School of The Ohio State University

By

Michael Dale Stoel, B.S., M.S.

\*\*\*\*

The Ohio State University 2006

Dissertation Committee:

Professor Waleed Muhanna, Adviser

Professor Jay Anand

Professor John Butler

Professor Peter Ward

Approved by

Adviser Graduate Program in Accounting and Management Information Systems

#### ABSTRACT

Why are some firms—often irrespective of their relative level of IT spending—able to outperform others using IT in an environment where most information technologies are readily available to all competing firms? For sometime now, IS researchers have (at the conceptual level) emphasized the centrality of the quality of the relationship between business and information systems (IS) units. Recent studies have shown that superior relative process performance from IT rests less on the level of IT spending or on the technical skills of the IT staff and more on the degree of shared business-IT understanding—*the level common understanding between the IT and the line manager regarding how IT can be used to improve the performance of a specific process.* 

This considerable evidence regarding the role of shared business-IT understanding as a key capability and performance differentiator, gives rise to another important research question, namely, why are some firms able to develop this important tacit and socially complex capability? *What are the organizational factors, resources and capabilities that foster the development and nurturing of shared business-IT understanding*? Drawing on the knowledge management and organizational learning literature, we develop and test a theoretical model designed to address this question. We argue that shared understanding is best conceptualized at two distinct levels—operational and strategic—and that the

factors that foster the development of shared understanding differ across the two levels. Hypotheses are them developed regarding the impact of various cognitive and institutional factors on both operational and strategic shared understanding. These hypotheses are tested in the context of the manufacturing industry, in which IT is widely perceived as being strategically important.

We find that the strategic component of shared understanding explain variation in manufacturing performance; whereas, the operational component explains variation in IS unit performance and perceived IT impact on manufacturing. We also find that the primary antecedents for shared strategic understanding are a result of the organizational environment and include executive support for IS, a strong organizational learning culture, and mutual trust; whereas, the primary antecedents for shared operational understanding are focused on the specific units and include joint manufacturing and IS management of IS resources, overlapping domain knowledge between IS and manufacturing personnel and mutual trust. These results appear consistent with our assertion that knowledge type impacts which antecedents will be critical in the knowledge sharing process.

#### ACKNOWLEDGMENTS

I wish to thank Professor Waleed Muhanna for his encouragement, friendship and direction in the development of this dissertation. I would also like to thank Professor Jay Anand, Professor Peter Ward and Professor John Butler for their efforts in guiding and assisting with this research effort.

I would also like to thank the faculty of the Accounting & MIS department and the fellow graduate students for their encouragement and support in this effort.

I would also like to thank the numerous participants in this study who graciously took the time to provide the information and insight that is available from this study.

I would also like to thank my wife, Leslie, who provided many needed words of encouragement, support and prodding to pursue this degree.

# VITA

May 11, 1966	Born – Grand Rapids, MI
December 1987B.	S. Computer and Electrical Engineering, Purdue University
May 1992	M.S. Management, Purdue University
1988-1990	Systems Engineer, IBM Kingston, New York
1992-1999	Management Consultant Deloitte Consulting
1999-2001	Management Consultant Gartner Group
2001-Present	Graduate Teaching and Research Assistant, The Ohio State University

# FIELDS OF STUDY

Major Field: Accounting & Management Information Systems

Minor Fields: Statistics, Economics

# TABLE OF CONTENTS

# Page

Abs	tract	ii
Ack	nowledgments	iv
Vita	۱	v
List	of Tables	viii
List	of Figures	ix
Cha	pters:	
1.	Introduction	1
	1.1 Background 1.2 Overview of Research Methods	$\frac{1}{2}$
	1.3 Contributions	6
	1.4 Organization	9
2.	Theoretical Framework	10
	2.1 Business Value of IT Investments	10
	2.2 IS Capabilities and IS / Business Relationship	11
	2.3 Strategic Management Approaches to Investigating	10
	2.4 Summary	13 15
3.	Literature Review	17
	3.1 IS and Business Relationship	17
	3.2 IT Management Skill Constructs	19
	3.3 Proposed Definitions and Relationships for Shared Understanding	24
	3.4 Potential Antecedents for Shared Understanding	27
	3.5 Shared Understanding as a Mediator	31

4.	Research Model	33
	4.1 Relationship between Shared Understanding, Alignment	22
	4.2 Impact of Knowledge Attributes on Shared Understanding	55
	Antecedents	36
	4.3 Antecedents for Shared Operational Understanding	39
	4.4 Antecedents for Shared Strategic Understanding	44
	4.5 Shared Understanding Model Summary	50
5.	Research Methodology	52
	5.1 Questionnaire Development and Variable Operationalizations	52
	5.2 Survey Instrument Validation	62
	5.3 Survey Sample and Recipients	63
6.	Data Collection and Analysis	66
	6.1 Survey Administration	66
	6.2 Survey Response	68
	6.3 Data Analysis	71
7.	Research Summary, Limitations and Future Research	104
Ret	ferences	109
Ap	pendix A Example Management Studies on Knowledge Transfer / Sharing	118
Ap	pendix B Survey Instruments	121
Ap	pendix C Item Loadings	132

# LIST OF TABLES

Table

Page

2.1	IS Capabilities Studies	12
3.1	Performance Impacts of IT Managerial Capability, Shared Knowledge and Alignment	18
3.2	Studies of Overlapping Knowledge between Business and IS	21
3.3	Definitions of Alignment	23
3.4	Anthony's Planning Framework	25
4.1	Differences in Knowledge Attributes within Shared Understanding Levels	38
4.2	Dimensions and Definitions of Constructs for the Learning Organization	46
4.3	Shared Understanding Model and Prior Literature	51
5.1	Study Variables and Prior Instruments	60
5.2	Distribution of Survey Sample by SIC Codes and Revenues	65
5.3	Survey Recipient Titles	65
6.1	Reasons Why Companies were Deleted from Sample	68
6.2	Demographics for Sample Frame, Responders and Paired Responses	69
6.3	Response Bias: Kolmogrov-Smirnov Test	69
6.4	Latent Variable Descriptive Statistics	77
6.5	Latent Variable Correlation Matrix	79
6.6	Regression Model: Shared Operational Understanding Antecedents	81
6.7	Regression Model: Shared Strategic Understanding Antecedents	85
6.8	Impact of Shared Understanding on Performance	87
6.9	Shared Operational Understanding as a Mediator	90
6.10	Shared Strategic Understanding as a Mediator	91
6.11	Antecedents of First Order Operational Understanding	94
6.12	Antecedents of First Order Strategic Understanding	93

# LIST OF FIGURES

# Figures

# Page

4.1	Hypothesized Associations between Shared Understanding, Alignment and Performance	36
4.2	Antecedents for Shared Operational Understanding	44
4.3	Antecedents for Shared Strategic Understanding	49
4.4	Model of Shared Understanding	50
6.1	Shared Operational Understanding OLS Residual Plot	83
6.2	PLS Test of Antecedents and Consequences for Shared Understanding	96
6.3	Strategic Alignment as a Mediator of Shared Understanding on Performance	98
6.4	Alternative Model of Shared Operational Understanding Antecedents	99
6.5	Alternative Model of Shared Operational Understanding Antecedents	99

# CHAPTER 1

# **INTRODUCTION**

#### 1.1 Background

Investigation of a firm's ability to receive value from investments in information technology has been a consistent thread within information systems (IS) research. There is considerable evidence that suggests that shared understanding in the relationship between business and information systems (IS) units is a critical factor in successful utilization of information technology in the support of business objectives (Rockart 1988, Ross et al 1996, Henderson 1990). Mata (1995) identified the ability to develop shared understanding between IT and business partners as a potential source of competitive advantage under the resource-based perspective. Other researchers have considered similar concepts under the names of IT managerial knowledge, shared knowledge, shared domain knowledge, shared knowledge and understanding, shared vision, reciprocal knowledge, and alignment; however, the definitions appear to overlap and little has been done to rationalize these constructs and identify the potential antecedents and consequences (Boynton et al 1994; Nelson and Cooprider 1996; Reich and Benbasat 2000; Chan et al 1997; Ray et al 2005; Hoopes and Postrel 1999; Ranganathan and Sethi 2002). Therefore, an important research question that has not been addressed is why

some firms are able to develop this capability, and what are the organizational factors, resources and capabilities that foster the development of shared understanding.

The objective of this research is to identify and test the differential effects of various antecedents of shared understanding and consider its effect on business performance. The approach for this research is to draw upon existing theory and literature from organizational and strategic management, knowledge management and organizational learning to develop a model that describes the key antecedents of shared understanding and the relationship to measures of IS performance and business performance considered at the process level. The ability to identify antecedents and examine shared understanding allows IS and business managers to focus on efforts and activities which may lead to improved performance.

#### **1.2 Overview of Research Methodology**

This research is focused on developing a model of shared understanding and examining its development and consequences. Based on Mata's (1995) efforts as well as Ray et al (2005), we consider shared understanding as *the knowledge that the IT organization has about the business unit, the knowledge that the business unit has about the opportunities to apply IT and the common understanding between IT and business units about how IT can be used to best support and improve business operations*; however, our model of shared understanding includes a conceptualization which has two levels, operational and strategic understanding. Shared operational understanding focuses on the deployment

and management of available resources to assist with business needs; whereas, shared strategic understanding concentrates on awareness of business improvement objectives, the role of IS in assisting with these objectives, and principles for guiding investment and acquisition strategies for additional capabilities.

This conceptualization of two levels of shared understanding is based upon Anthony's (1965) framework of management planning and control which identifies different information and activities at the strategic level and operational level. This conceptualization is also consistent with several other literature streams, including learning literature which describes different approaches for learning tasks and actions versus learning concepts (Argyris and Schön 1974; Garratt 2001), as well as the alignment literature which identifies the need to address short and long term concerns within the management of the business relationship (Reich and Benbasat 2000; Henderson and Venkatraman 1993). Separating strategic and operational shared understanding in researching potential antecedents also reflects the knowledge management literature which indicates that the type of knowledge that is transferred affects the impact of potential antecedents (Zander and Kogut 1995; Szulanski 1996).

The investigation of antecedents is based upon several literature streams, including the IS and business relationship literature which has proposed several variables that overlap the discussion of shared understanding. We supplement these findings with works from knowledge management and organizational learning literature streams which provide a more foundational perspective on how knowledge is acquired and transferred and the effects of many antecedents on the process. Additionally, organizational and strategic management literatures have investigated many forms of partnerships and alliances to understand potential attributes that may lead to increased performance.

Research on knowledge transfer indicates that primary antecedents focus on ability, willingness, and opportunity for the parties to share knowledge and gain understanding. Knowledge management and organizational learning literature both focus on the cognitive aspects of the parties as a factor in their ability to develop a set of languages to share experiences and transfer information. Willingness to participate in the knowledge transfer may come from many potential sources; however, the concept of adherence to norms or culture and the influence of incentives are predominant within the literature. Opportunities to interact and transfer knowledge and gain appreciation of each parties business environment may be influenced by governance structures which may impact the scope and efficiency of knowledge transfer, as well as establish the perceived importance of information technology. The impact of antecedents has been argued to be contingent on the type of knowledge, with cultural effects being stronger for more opaque information and cognitive effects more critical in transferring detailed knowledge (Zander and Kogut 1995; Szulanski 1996). Therefore, our investigation of antecedents for shared operational understanding focuses primarily on association of cognitive measures and governance structures between IS and the business process. In considering shared strategic understanding, potential antecedents are focused on willingness / cultural factors and governance structures for the relationship between IS and the business as a whole.

Our approach to investigating the consequences of shared understanding is based upon the resource based view of the firm (RBV). We believe that the development of shared understanding is rare, valuable and firm specific and therefore qualifies as a potential source of competitive advantage. We focus our analysis on process level measures of performance, within IS and the business process, as we believe that this is where the first order impact of shared understanding will be identifiable. Due to its concern for deployment and management of current resources, shared operational understanding is argued to be directly associated with business process performance. Shared strategic understanding is considered as awareness of the business improvement objectives and the role of IS. The concept of strategic alignment has been developed within the IS literature and has been considered as the actual support and enablement of business objectives. We believe that the ability to support and enable the business objectives requires an appreciation for the current resources as well as an understanding of the business objective and guiding principles. Therefore, we conceive of shared strategic understanding and shared operational understanding as antecedents to strategic alignment. Shared understanding and strategic alignment are considered to be developed over time, and we believe that firms who demonstrate higher levels of strategic alignment are likely to have already implemented some resource changes and improved their process level performance. Similarly, we argue that shared operational understanding

5

and strategic alignment are likely to impact the business process' perception of the impact and performance of information systems.

The relationship between IS and business organizations is the focus of analysis for this study. We propose to conduct this research within the manufacturing industry and study the relationship between IS and manufacturing business processes. The use of the manufacturing industry provides a setting where large investments have occurred in information technology and the relationship between these organizations is likely to be critical. The research methodology utilizes dual surveys of the manufacturing and IS processes to measure the levels of shared understanding, as well as information about each organization and aspects of their relationship.

#### **1.3 Contribution**

The main contribution of this research effort is the development and testing of a model of shared understanding, including its antecedents and its consequences. Prior research has investigated related constructs that focus on business and IT relationship and individually tested their effects on performance; however, work on understanding the institutional factors leading to shared understanding has been limited. We review the primary constructs to develop our definitions of shared understanding and recognize the need for consideration of strategic and operational levels. Separation of shared understanding into strategic and operational levels allows us to consider the underlying types of knowledge

within each construct and how this type of knowledge may impact the effectiveness of various antecedents.

We believe that this research makes two additional secondary contributions. Within our development of the shared understanding model, we consider potential antecedents including the absorptive capacity of the two organizations. Specifically, we consider the overlap of existing knowledge bases which has been previously considered within the IS literature; however, the prior literature has measured the business representatives knowledge about specific components of IS including hardware and software and the IS representatives are measured on their general knowledge of business. We argue that these measurements are not parallel and that IS representatives should be measured on their knowledge of specific components of the business process that is being considered. Similarly, we consider the concept of alignment which has been previously considered as being between IS and the business as a whole. As we are focused on evaluating the impact of the relationship between IS and a key business process, we consider alignment as being measured between the members of the dyad. Additionally, prior research on the business and IS relationship has predominantly focused on the leader of each organization and developed concepts such as IT managerial knowledge and business competence of IT managers. We argue that shared understanding may be developed by knowledge flows that occur at many levels in the relationship based on formal and informal organization structures and governance mechanisms. This information may or may not reach the process leaders but resides within the organization and can be utilized

7

as decisions are made. Therefore, we must consider shared understanding across the organizations.

We also believe that this research provides contributions to the knowledge management, organizational learning, and manufacturing literatures. For the knowledge management and organizational learning literatures, this research provides additional empirical evidence about the impact of the potential antecedents that we investigate in a setting where the IS organization may be considered an extended component of the manufacturing organization, but also has responsibilities to other functional areas. Additionally, this is one of the few efforts that considers different types of knowledge and includes constructs to represent the ability, willingness, and opportunities to transfer knowledge. Though there is limited theory to hypothesize interactions between these items, exploratory efforts may provide insight into their interactions. This research also provides additional evidence to the manufacturing literature about the potential for information systems organization to influence their performance.

This research has a number of implications on practice. By examining the multiple antecedents in one framework, managers have the ability to understand the different concepts that may affect the levels of shared understanding. As we consider managerial practices for organizational design and relationship governance, managers may identify actions that may increase knowledge sharing within their own organizations.

Additionally, the consideration of how each type of shared understanding may be

associated with various performance measures allows managers to better understand the impact of potential investments.

#### **1.4 Organization**

The dissertation starts with a review of IT literature on business value and the resourcebased view and argues that RBV is an appropriate lens to examine IS research questions and that the study of shared understanding is a valuable research consideration. Chapter three focuses on understanding the specific works on IS and business relationship associated with shared understanding and examining literature from other fields which may shape the model and potential antecedents. The conceived relationships between existing constructs are discussed as well as work within the business relationship, knowledge management and organizational learning literature which may suggest theoretical antecedents. Chapter four details the specific research model and hypotheses including the relationships with various types of performance. Chapter five discusses how the research instruments were developed and tested, as well as the process for identifying the sample and conducting the research. Chapter six details the data analysis and results. Chapter seven provides conclusions, limitations and directions for future research.

9

## **CHAPTER 2**

# **THEORETICAL FRAMEWORK**

The desire to explain how and when IT may impact business value has been an enduring quest within IS research. Researchers have developed multiple models, studied various dependent variables, and identified many situational opportunities for IT to add business value; however, the question is still unresolved and requires additional exploration.

#### 2.1 Business Value of IT Investments

One thread of research has attempted to link IT spending and investments with business value. The general belief has been that if IT is considered valuable it will require investments in new technologies for businesses to prosper. This approach has demonstrated a linkage between IT spending and productivity, thereby dispelling the so-called "productivity paradox" from early works (Brynjolfson 1996). IT investments leading to productivity could be thought of as the effect of substituting technology for labor and automation of production tasks. The automation of previously manual activities allows for work to be performed more quickly and with less error, allowing for greater productivity, quality and variety.

However, productivity increases will not necessarily translate into financial performance and additional research efforts investigating the relationship between IT investments and business value have produced mixed results. These results have included positive relationships, negative relationships, no relationship and bimodal relationships when considering financial measures of performance. One issue with this research is that there is a lack of theory that identifies the relationship between IT spending and business value. As firms are considered to have equal access to the hardware and software available in the factors market, competitive measures of business performance are not improved as any improvement caused by the technology is competed away.

#### 2. 2 IS Capabilities and IS / Business Relationship

An alternative explanation as to how IT may provide business value focuses on the quality of the IS organization. This approach has been considered within research streams on technology conversion, IS capabilities and management of the IS and business relationship. The technology conversion literature has argued that IT spending is an input that is modified by a conversion process into IT assets, and it is the conversion process that is considered to be the source of variance in business performance (Soh and Markus 1995; Sambamurthy and Zmud 1994). The primary limitation of this approach is the assumption that IT spending is exogenous and cannot be manipulated by IT management. This approach prevents managers from recognizing that additional spending may be warranted when high value projects are available and similarly, recognizing that less spending may be optimal when appropriate projects are not present.

The IT capabilities literature argues that IT is made up of a few core capabilities and it is performance in these areas that differentiate levels of business value (Feeny and Willcocks 1998, Bharadwaj et al 1999). However, there has been limited consistency in how to define IT capability and the ability to identify a comprehensive set of IT capabilities is an open question for IS research. The following table provides an overview of a few of the IS studies that have focused on identifying capabilities and demonstrates different approaches that have been utilized for this question.

Author	IT capability approach	Components
Feeny and Willcocks,	Defined IT capabilities as the set	Defined nine capabilities in the emerging
1998	of activities, personnel and IT	IS function: IS/IT governance, Business
	assets set up to define and ensure	Systems Thinking, Relationship Building,
	delivery of the information	Designing Technical Architecture, Making
	systems requirements of the	Technology Work, Informed Buying,
	business.	Contract Facilitation, Contract Monitoring,
		and Vendor Development.
Bharadwaj et al 1999	Used Delphi process to identify	Developed IT capability construct with six
	capabilities associated with "the	categories: IT business partnerships,
	ability to sustain IT innovation	external IT linkages, business IT strategic
	success in contemporary firms."	thinking, IT business process integration,
		IT management and IT infrastructure.
Xia and King, 2002	The focus is on IT infrastructure	Utilizes a three-layer model: layer 1
	capabilities and is defined as a	consists of hardware, operating systems,
	those "that are shared across the	communications and other equipment;
	organization and that provide the	layer 2 includes human and organizational
	foundation on which IT	assets to utilize, leverage and bind IT
	applications are developed and	components; layer 3 is the shared IT
	business processes are	services which link IT components to
	supported"	business capabilities.
Ravichandran and	The authors adopt a process	Three primary dimensions: IS planning
Lertwongsatien, 2002	focus and define IS capabilities	sophistication, Systems development
	in terms of the quality and	capability, IS support maturity.
	sophistication of IS processes.	

**Table 2.1 IS Capabilities Studies** 

The IT conversion literature and IT capabilities literature seem to agree that the cause of variance in business value is derived from an event internal to the IS organization and

processes and there are some areas of overlap between the different studies. Specifically, each of the approaches includes aspects of the concept of IS management and the ability to manage the business and IT relationship as a component of overall IT capabilities.

Mata et al (1995) evaluated the IT related items generally believed to be source of competitive advantage and focused on IT management skill. Mata argued IT management skill was a unique resource that was created within the context of the firm and was not transferable to other organizations. As such, advantages that were created through the ability to identify appropriate technology investments and mix technology resources with business resources could not be easily duplicated by other firms. In an attempt to better understand IT management skill, constructs such as alignment, shared knowledge, and shared vision have been developed within the literature and have been linked with some performance measures. However, as detailed in chapter 3, there appears to be some overlap between these constructs and limited work has been performed to understand their relationships. Additionally, these efforts primarily investigate the effect on firm performance which may be overshadowed by poor performance in other areas of the business. Barua (1995), Ray et al (2005) and others have argued that the value of IT should be investigated at the business process level where IT is most likely to have a first order affect.

#### 2.3 Strategic Management Approaches to Investigating Competitive Advantage

Initial efforts within the strategy literature to investigate competitive advantage focused on the industry structure (Mason 1949, Bain 1940, Porter 1980). This approach argues that aspects of the industry structure result in superior performance for their members. Specifically, barriers to entry prevent substandard firms from entering high performing industries, and the industries are able to develop power over suppliers and buyers. However, general evidence indicates that multiple industries include firms that appear to have competitive advantages. Additionally, these industries have firms which outperform other firms in the same industry which should not be possible if the rationale for firm advantage was due to its membership within a specific industry.

The Resource Based View (RBV) has been developed within the strategy literature as an alternative theory to explain competitive advantage of a firm (Barney 1991; Wernerfelt 1984, Amit and Shoemaker 1993). Specifically, RBV focuses on the heterogeneity of internal firm resources to provide rationale for why one firm may have a competitive advantage over a similar firm. The concept of a resource within RBV is generally considered to be very broad and has been defined to include all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm; however, not all resources are sources of sustainable competitive advantage to a firm that can be used to differentiate sustained performance with a competitor. If a resource is valuable, firms have new opportunities that are of greater value than that for which the resource may be acquired in the factors market. These new opportunities may be either new business opportunities to utilize the set of resources, or the firm may continue with its existing offerings while requiring a lower quantity of inputs in

developing the offerings. However, if the resource is not rare or inimitable other firms can perform similar competitive actions and there is no reason that a firm is better off. Similarly, a resource that is valuable and rare but that is imitable may provide a temporary source of competitive advantage. The fact that the resource is valuable and rare will allow a firm to take competitive actions that may not be immediately followed by competitors; however, the ability for competitors to imitate the resource will allow the competitors to catch up with the lead firm and eliminate this source of competitive advantage. The inimitability of the resource is generally attributed to three concepts including time compression or historical accidents, causal ambiguity or social relationships.

#### 2.4 Summary

Questions about the ability of IT to generate firm advantages continue to be examined within the literature. Agreement seems to center on that it is unlikely for the technology itself to be a source of advantage due to its wide availability. Many different aspects of the literature have turned to looking within the IT organization for a potential source of advantage, and specifically at the IT management processes and personnel.

The changes within the business value of IT literature are paralleled in the strategy approach to investigating competitive advantage. The predominant strategy theories have shifted from industry and external sources of advantages to firm specific resources which are not available to other firms through the factors market. The concept of RBV has been evaluated and tested within a wide selection of industries and potential resources to identify those that might supply sustained competitive advantage. Potential resources that may provide sustained competitive advantage include organizational culture (Barney 1986), organizational alignment (Powell 1992), research and development process (Yeoh and Roth 1999), and total quality management process (Powell 1995). The theory therefore seems well positioned to be able to inform examinations of the relationship between IT capability and firm performance, and recently a number of IS scholars have turned to RBV to reason about and seek better answers to the question of IT business value and competitive advantage from IT (e.g., Mata 1995; Jarvenpaa and Leidner 1998; Powell and Dent-Micallef 1997; Bharadwaj 2000; Ray, Muhanna, and Barney 2005; Wade and Hulland 2004).

We believe that the evidence indicates that questions about associations between IT and business value are best guided through the RBV lens. Additionally, the most likely component of IT to be a source of competitive advantage is the management skill which develops overall direction and implements strategic objectives. More specifically, this research focuses on the relationship between IS and other business processes as this is the area where a valuable and firm specific resource is generated, namely shared understanding.

## **CHAPTER 3**

#### LITERATURE REVIEW

#### 3.1 IS and Business Relationship

The ability to manage the IS and business relationship has been proposed as one of the key IS management skills (Rockart et al 1988, Ross et al 1996, Henderson 1990). These works argue that management of the relationship provides additional insight into how to position IS resources in areas of critical need and reduce expenditures in other areas. Additionally, the management of the relationship between IS and business could identify future requirements while providing a structure for the capabilities to be developed.

Mata (1995) utilized an RBV framework and concluded that IT management skill was a potential source of competitive advantage. Mata's conceptualization of IT management skills included "the ability to conceive of, develop, and exploit IT applications to support and enhance other business functions. Examples of important IT management skills include: (1) the ability of IT managers to understand and appreciate the business needs of other functional managers, suppliers, and customers; (2) the ability to work with these functional managers, suppliers, and customers to develop appropriate IT applications; (3) the ability to coordinate IT activities in ways that support other functional managers,

suppliers, and customers; and (4) the ability to anticipate the future IT needs of functional managers, suppliers, and customers" (Mata 1995, p. 498).

Based on these early works, the IS literature on managing the IS-business relationship has developed many constructs around the idea of IT management skill, including managerial IT knowledge, shared knowledge, shared domain knowledge, reciprocal knowledge, IT competence and alignment. Table 3.1 demonstrates how these constructs have been empirically linked with performance.

Author	Description	Findings
Boynton et al	Analyzed relationship between	Managerial IT Knowledge was identified as
1994	Absorptive Capacity and the impact on	positively associated with IT Use for all three
	IT usage. Absorptive Capacity defined	of the units studied.
	as managerial IT knowledge and IT	
	management process effectiveness.	
Nelson and	Examines relationship between shared	Shared knowledge is associated with
Cooprider	knowledge, trust, mutual influence and	perceived I/S performance, and mediates the
1996	perceived I/S group performance.	relationships between trust and performance
		and between influence and performance.
Chan et al,	Alignment is considered as the fit	Positive association between strategic
1997	between business strategic orientation	alignment and perceived business
	and IS strategic orientation.	performance and IS effectiveness.
Hoopes and	Focuses on the relationship between	Case study focused on unsatisfactory results in
Postrel, 1999	shared knowledge and product	software projects resulting from lack of
	development performance in software	integration of knowledge. Confirms that
	development.	shared knowledge is an important resource.
Reich and	Investigated the relationship between	Shared domain knowledge was significantly
Benbasat,	shared domain knowledge and short	associated with short and long term alignment.
2000	and long term alignment.	
Sabherwal	Alignment conceived as the	Identified a relationship between the
and Chan,	consistency between business strategy	alignment of business and IS strategy with
2001	type and the IS strategy type.	perceived business performance.
Ranganathan	Examines the relationship between	Shared Domain Knowledge positively
and Sethi	shared domain knowledge and	associated with Rationality. Centralization of
2002	rationality. Considers centralization of	the IT unit structure is negatively associated
	the IT unit and formalization of unit	with shared domain knowledge and
	structure as antecedents of shared	formalization of IT unit structure is positively
	domain knowledge.	associated with shared domain knowledge.
Basselier,	Developed IT competence of business	Found that IT competence in business
Benbasat and	managers, and studied the their	managers is associated with their willingness
Reich 2003	willingness to champion IT projects.	to champion IT within the organization.
Ray et al.,	Analyses of the relationship between	Shared understanding is a capability that
2005	reciprocal IT/CS understanding and	affects process level performance and
	process performance.	moderates the impacts of explicit IT resources
	-	such as generic technologies and IT spending.

# Table 3.1: Performance Impacts of IT Managerial Capability, SharedKnowledge and Alignment

# **3.2 IT Management Skill Constructs**

As the literature has continued to investigate the effects of IT management skill, one

challenge has been to understand the relationships between the various constructs and

isolate the effects from each. One potential rationale for the limited integration of these

constructs may be due to inconsistencies in definitions and assumptions. Shared knowledge, shared domain knowledge, IT managerial knowledge, and reciprocal knowledge are concepts which have centered on similar knowledge between the business and IS organizations; however, the literature does not consistently specify who is involved in the process (individual managers or organizational groups), it does not clarify what knowledge would be beneficially shared between the IS and business organizations, and it does not specify whether performance implications should be considered at the process level (IS or business) or have potential for firm level impacts. Additionally, they generally examine only current measures of performance and do not discuss impact on forward looking measures. Table 3.2 provides an overview of a few of the key constructs and the definitions.

Reich and Benbasat (2000) conceive of shared domain knowledge, defined as the ability of IT and business executives to understand and be able to participate in the other's key processes and to respect each other's unique contributions and challenges, as an antecedent of alignment. This conceptualization seems to expect a fairly detailed understanding of current operations that would allow the IT and business personnel to participate in the others key processes and understand the associated challenges. Reich and Benbasat describe their conceptualization of shared domain knowledge as similar to Nelson and Cooprider's (1996) perspective on shared knowledge. Nelson and Cooprider define shared knowledge as an understanding and appreciation for the technologies and processes which affect mutual performance. This definition appears to require less detail and does not consider the need for each party to be prepared to participate in the others key processes. It is unclear how much detail is required by Ranganathan and Sethi (2002) and Boynton (1994) who refer to IT-related and business-related knowledge without additional clarification. Ray et al's (2005) conceptualization of shared knowledge is the only one to indicate a need for understanding about current processes and potential performance improvements through the use of IT. Ray's perspective is consistent with Mata's examples of IT management skill, where the first example focuses on current needs and the fourth considers future needs.

Author	Definition
Boynton et al	Managerial IT knowledge defined as the conjunction of IT-related and business-related
1994	knowledge possessed by and exchanged among IT managers and business units or line
	managers. Identified an association between organic management climate (clear
	mission, planning commitment, information sharing and pushing down decision
	making) and managerial IT knowledge for the three units studied, and a relationship
	between mechanistic climate (centralized decision making and use of standard
	operating procedures) and managerial IT knowledge in two of the three units.
Nelson and	Shared knowledge defined as understanding and appreciation for the technologies and
Cooprider 1996	processes which affect mutual performance. Identified trust and mutual influence as
	antecedents of shared knowledge.
Hoopes and	Shared knowledge conceived of as integration of know-how of project members.
Postrel, 1999	
Reich and	Shared domain knowledge defined as the ability of IT and business executives to
Benbasat, 2000	understand and be able to participate in the other's key processes and to respect each
	other's unique contributions and challenges.
Basselier, Reich	IT Competence of business managers defined as the set of IT-related explicit and tacit
and Benbasat	knowledge that a business manager possesses that enables him or her to exhibit IT
2001	leadership in his or her area of business.
Ranganathan	Shared domain knowledge refers to the union of IT-related and business-related
and Sethi 2002	knowledge possessed and exchanged among IT executives, top managers, and
	functional managers.
Ray et al., 2005	Shared knowledge conceived of as the knowledge that the IT manager has about the
	business process, the knowledge that the line manager has about the opportunities to
	apply IT and the common understanding of how to use IT for the business process.

Table 3.2 Studies of Overlapping Knowledge between Business and IS

These efforts also vary based on who is involved in developing the shared understanding. Reich and Benbasat (2000) focus on shared domain knowledge in executives, and similarly Boynton (1994) develops the concept of managerial IT knowledge and Basselier (2001) considers IT competence of business managers. Ray (2005) and Ranganathan and Sethi (2002) both also focus at the level of managers and above. Hoopes and Postrel (1999) conceive of shared knowledge across the teams as a whole. This conceptualization is in recognition of the possibility that a manager may not be fully aware of specific information, but the information is available for the team to act upon.

The concept of alignment is one of the most researched topics in IS and as a result, multiple definitions have been developed. One difference in these definitions is a focus on underlying capabilities of IS and business versus the linkage of business and IS strategies. For example, Chan et al. (1997) examined the concept of alignment by focusing on the consistency of an underlying series of strategic orientations between business and IS. Their belief was that if the strategic orientations were similar, the two were aligned. Within this framework, alignment was viewed as the development of generalizable IS capability that is consistent with and linked to the central strategic directions of the organization. However, a more tangible perspective provided by many researchers is that alignment occurs when the direct business objectives are enabled and supported by information technology (Luftman et al 1993, Broadbent and Weil 1993). Kearns and Lederer (2000) followed this treatment and defined alignment as the linkage between IS plans and business plans and operationalized this by determining if one plan refers to or is integrated with the other plan. Other differences in definitions of alignment include consideration of it as a state versus a process, the presence of short and long term alignment, and multiple types of alignment including cross alignment between strategies and infrastructure. Table 3.3 provides an overview of a few distinct definitions of alignment.

Author(s)	Definition of Alignment
Broadbent and Weill, (1993)	Alignment of business and information strategies referred to the extent to which business strategies were enabled, supported, and stimulated by information strategies.
Henderson and Venkatraman, 1993	Strategic alignment is a concept that replaces a traditional functional linkage model of IT planning with one that requires a highly integrated strategic management process. The definition of alignment involves strategic fit – choices to position the firm in the market place and determine best structure – and functional integration.
Luftman, Lewis, Oldach (1993)	Business and information technology strategies are in alignment when business objectives are enabled, supported, and stimulated by information technology strategies.
	Strategic alignment is a technique for continuously thinking about how to analyze and derive organizational direction.
Reich and Benbasat (1996)	Definition of linkage is the degree to which the IT mission, objectives and plans support and are supported by the business mission, objectives and plans.
	Short-term alignment defined as cross-reference between business and IT in one year plans. Long-term alignment defined as cross-reference in five year plans
Chan et al (1997)	Strategic alignment concerns integrating IS with the organization's fundamental strategic orientation and core competencies.
	"the difference between integration and alignment is the difference between providing specific support for specific business thrusts versus the development of generalizable IS capability that is consistent with, and linked to, the central strategic directions of the organization."
Kearns and Lederer (2000)	Strategic IS alignment is the linkage of the firm's IS and business plans. Ideally, the business plan and information systems plan, both products of the corporate planning function, should be linked by mapping IS strategies to one or more business strategies in a manner that optimizes the return to the organization.
	Two types of strategic alignment exist – alignment of the IS plan with the business plan, and the alignment of the business plan with the IS plan.

 Table 3.3 Definitions of Alignment

The concepts and definitions of shared knowledge, shared domain knowledge, IT management knowledge, reciprocal IT/business knowledge and alignment appear to have many similarities and potential for overlap. Reich and Benbasat's (1996, 2000) work on alignment may be most telling about some of the difficulties with the delineation of the concepts. Reich and Benbasat (1996) focused on the social dimensions of alignment which they defined as "the level of mutual understanding of and commitment to the business and IT mission, objectives and plans" (p.58). However, their empirical efforts in that study created and tested measures to operationalize only the *mutual understanding* aspect of the social dimension. "The commitment aspect was not empirically tested investigated, since it was added to our definition subsequent to the completion of this study" (p.58). Additionally, Reich and Benbasat (2000) provided an additional twist on strategic alignment by distinguishing between short (one year) and long term (five year) alignment. It is unclear if the delineation in timing is consistent with the concept of alignment or represents greater certainty in shared knowledge due to the impending time frame. As these definitions and operationalizations raise questions about the degree of information to be shared, the actors involved in the process, and their level of commitment, additional development is needed to synthesize these concepts and understand the association with other potential variables.

#### 3.3 Proposed Definitions and Relationships for Shared Understanding

Anthony (1965) proposed a planning and control framework that may provide insights into the shared understanding concept. Anthony modeled a general framework with three levels of planning and control: strategic, managerial and operational. Each level of the framework was responsible for separate decisions, but each level was interlinked and the strategic plans could not be performed without supporting managerial and operational actions. The strategic level is responsible for decisions on overall objectives and resource requirements. Anthony indicates that the distinction between managerial and operational is not as clear, and considers these levels as jointly responsible for the effective and efficient execution of the policies and obtainment of the business objectives.

Planning Level	Definition
Strategic	Strategic planning is the process of deciding on objectives of the organization, on changes in these objectives, on the resources used to attain the objectives, and on the policies that are to govern the acquisition, use, and disposition of these resources
Managerial	Management control is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives
Operational	Operational control is the process of assuring that specific tasks are carried out effectively and efficiently.

 Table 3.4 Anthony's Planning Framework

We believe that the strategic component of Anthony's framework is similar to the component of the management skill constructs which are focused on determining the directions and goals about how IT may be utilized in the future to assist the business process. This component determines the primary goal of each process and how to identify the types of technologies for investment. Similarly, the managerial and operational levels of Anthony's framework relate to the aspects of the management skill constructs which consider knowledge and understanding of the current resources. Therefore, we focus on two primary components of shared understanding: strategic and operational.

We propose that shared understanding should be composed of strategic and operational levels. We define *shared strategic understanding as a mutual awareness of the improvement objectives of the business process, the strategic principles which guide investment and resource acquisition decisions, and how IT may be used in assisting with these objectives.* This definition is focused on establishing communication of specific areas of concentration, as well as developing boundaries on the types of capabilities and resources that are appropriate for the organization. The shared strategic understanding allows IS and the business process to independently search for new capabilities to improve performance. *Shared operational understanding is defined as an appreciation of the processes, resource requirements and challenges within the current business process and IS organizations.* Shared operational understanding focuses on the day to day abilities to deploy and manage existing resources, and thereby improve performance through better resource allocations.

The concept that there may be multiple layers of understanding within the business and IS relationship is similar to work we find on business partnerships and organizational learning. Henderson (1990) investigated the factors which developed strong partnerships and conceived of two types of partnership, Partnership in Context (PIC) and Partnership in Action (PIA). PIC focuses on the factors which influence the sustainability of the relationship over time and PIA focuses on the day to day factors of the working relationship. We see the concept of PIC as focusing on the strategic level of the relationship and responsible for developing the objectives and scope of the relationship; whereas, PIA relates to Anthony's operational concepts by thinking about the immediate actions needed given the current resources available.

Organizational learning literature also reflects the belief that there are multiple learning processes to deal with concrete and abstract concepts. One example is the concept of single and double loop learning described by Argyris and Schön (1974). In single-loop learning, the given or chosen goals, values, plans and rules are operationalized rather than questioned. In double-loop learning, the governing variables are subject to scrutiny which may then lead to an alteration in the governing variables and, thus, a shift in the way in which strategies and consequences are framed. We conceive of single-loop learning as being consistent with Anthony's managerial/operational concepts which focus on efficiency and effectiveness, and double-loop learning as being parallel with Anthony's concept of strategic planning. An alternative example from organizational learning is Garratt's (2001) work on learning cycles. Garratt conceived of the concepts of policy learning and operational learning to reflect the need to understand the external world and its changing environment and also to understand the internal world where products are designed and produced, and services delivered by the staff. Again, these concepts appear to parallel the ideas put forth by Anthony's planning and control framework.

#### 3.4 Potential Antecedents of Shared Understanding

Though the relationship between IT and business may have some unique attributes, the foundational concepts of knowledge accumulation, sharing, transfer and integration are
examined within the knowledge management and organizational learning literature. The origin of organizational learning can be traced back to works by Cyert and March (1963); however, multiple perspective on the appropriate definition for organizational learning have been debated, with some parties believing that learning has occurred once there is recognition of new information and potential alternatives, while other parties argue that learning happens only when different decisions are made than would have otherwise occurred. Both of these approaches consider how new knowledge is accumulated and integrated with existing knowledge bases. The knowledge management literature initially focused on technical solutions to storing and retrieving existing knowledge for future use; however, recognition of a need to understand which knowledge may be valuable to store and how the knowledge is best transferred has lead to an increase in scope which has created greater overlap and similarities in the efforts with organizational learning.

Within the knowledge management literature the focus is primarily on how the characteristics of elements involved in the exchange influence the success of knowledge transfer. Specifically, these tend to focus on characteristics of the parties involved, characteristics of the relationship between the parties, characteristics of the knowledge itself, and characteristics associated with the exchange of knowledge (Argote et al 2003). Research which focuses on characteristics of the parties may examine their place in social networks or the backgrounds of individuals in one of the organizations and argues that differential effects of knowledge transfer are due to the capabilities of the messenger or

the receiver; whereas, research that focuses on the relationship between the parties may examine levels of trust between the organizations or the cultural distance between the organizations and its impact on knowledge transfer arguing that it is not the characteristics of the messenger or receiver that impacts knowledge transfer, it is the relationship between messenger and receiver. Additionally, the knowledge management studies examine the impact of different types of knowledge on the transfer process. Knowledge has been classified on various dimensions with the concepts of explicit or tacit being the most widely considered (Zander and Kogut 1995). As knowledge becomes more tacit and ambiguous, the knowledge transfer is stickier and less likely and relies more on relationship and cultural effects (Szulanski 1996; Simonin 1999).

Organizational learning considers two primary categories of antecedents: cultural and cognitive (Pawlowsky 2001). The cultural aspect considers that shared values, beliefs and emotions of an organization lead to shared interpretations of subjective information. Therefore, development of a learning culture allows members to process information similarly and act as an organization (Marsick 2003). The cognitive aspect is considered a combination of general ability, experience, and the structural aides (sometimes referred to as organizational learning mechanisms) (Pawlowsky 2001, Lipshitz et al 1996). Lipshitz defines organizational learning mechanisms as institutionalized structural and procedural arrangements that allow organizations to systematically collect, analyze, store, disseminate and use information that is relevant to the effectiveness of the organization.

We have also examined the strategic and organizational management literatures which have studied various forms of partnerships and organizational relationships to better understand characteristics that may lead to knowledge transfer and constructs similar to shared understanding. One example of a related construct is that of absorptive capacity identified by Cohen and Levinthal (1990). Cohen and Levinthal defined absorptive capacity as the collective ability to value, assimilate, and apply new knowledge. Our concept of shared understanding appears to overlap with absorptive capacity as the ability to assimilate knowledge would appear to be crucial to shared understanding; however, the ability to apply new knowledge would be beyond the development of shared understanding. The concept of absorptive capacity has been examined in many environments and the primary antecedents have included the level of prior knowledge on the subject and the ability for sender and messenger to interact and share a similar language. Van den Bosch et al (2003) provides an overview of the prior literature on absorptive capacity, including the models and antecedents.

The management literature also provides examples of the impact of incentives on knowledge transfer. Incentives may be more critical in knowledge transfer between firms where each firm may have conflicting incentives; however, Fisher et al (1997) examines the relationship between marketing and engineering and identify that integrated goals are still important when looking at two functions within the same firm. Our review of the management literature finds many related concepts; however, the proposed antecedents seem to be consistent with the general classifications in the knowledge management and organizational learning literature. Appendix 1 highlights some of the prior efforts and indicates the antecedent categories which are examined.

Based on the prior literate, we develop a model of shared understanding by focusing on three categories of antecedents: cultural, cognitive, and learning mechanisms / routine. The cultural aspect focuses on the desire and willingness of the parties to share information. Cognitive components include the ability of the members to share information, and specifically characteristics of the receiver or sender organizations which may impact the ability to reach a shared understanding. Learning mechanisms / routines considers decisions and actions within the organizations that impact the scope or efficiency of the information sharing.

### 3.5 Shared Understanding as a Mediator

Prior literature has hypothesized and demonstrated linkages between an organization's cultural characteristics, cognitive abilities and learning mechanisms with performance at business unit and firm level (Barney 1986; Nelson and Winter 9182; Cohen and Levinthal 1990). However, these elements may be general and require development of firm specific contextualization to be beneficial to a firm. For example, an organizational unit with high general cognitive ability may only impact firm performance if it is able to understand firm specific activities and translate the general knowledge into information that can be shared and distributed within the context of the firm.

Development of these contextualized elements may lead to other firm-specific capabilities, such as shared understanding which can apply the capabilities within the firm and may be associated with improved performance. It is the application of the capabilities which may affect performance rather than the generalized elements of culture, cognition or routines. Therefore, the research model considers that the presence of cultural characteristics, cognitive abilities and learning mechanisms may be associated with performance indirectly through firm specific shared understanding.

# **CHAPTER 4**

### **RESEARCH MODEL**

### 4.1 Relationship between Shared Understanding, Alignment and Performance

The concept of alignment has been given many definitions as indicated in Table 3.3; however, we believe that most of the definitions consider *strategic alignment as having the business strategies and plans enabled and supported by IT* (Luftman et al 1993; Broadbent and Weill 1993; Reich and Benbasat 1996). Specifically, we consider strategic alignment to be developed when commitment to strategic objectives has occurred as may be considered in the existence of mutually referencing business and IS plans (Kearns and Lederer 2000; Reich and Benbasat 2000). The development of these business and IS plans requires awareness of the future business objectives, and appreciation of the current resources available to assist with the transition. Therefore, we consider both levels of shared understanding as antecedents to strategic alignment.

H1: Shared operational understanding is positively associated with strategic alignment.

H2: Shared strategic understanding is positively associated with strategic alignment.

As shown in Table 3.1, prior IS literature has indicated a relationship between the IT management skill constructs and performance of the IS process, performance of the business process, and performance of the organization as a whole (Ray et al 2005; Nelson and Cooprider 1996; Chan et al 1997). Most similar to this research effort is the work of Ray et al (2005) who investigates the relationship between shared knowledge at process improvement in the customer service organization for insurance companies. Ray et al finds that shared knowledge impacts process performance as well as moderates the impact of other resources. Similarly, strategic alignment has been linked to business performance (Chan et al 1997). Chan et al (1997) consider the alignment between business and IS strategic orientation, and find a positive association with perceived overall business performance. Sabherwal and Chan (2001) also study the impact of alignment and performance by identifying strategic type and assessing alignment between the actual IS investments and the theoretical investments for the strategic type. They find that alignment is associated with perceived business performance. These works finds significance at the firm level; however, it is likely that the firm performance is due to improved performance within key business processes. The relationships between alignment and performance have been postulated to be due to an increased understanding of the issues, challenges and key performance factors which allow for better management of operational costs and better direction of organizational resources to create future capabilities. We believe that our conceptualization of shared operational understanding allows for management to better deploy and utilize current resources and positively influence measures of business process performance. Shared strategic understanding

focuses on awareness of business objectives and strategic principles to guide investment decisions, and we believe this awareness allows IS to identify capabilities that fit with the business process resources to improve performance. We believe that shared strategic understanding is developed over time, and therefore this ability to identify needed resources may provide benefits in our cross sectional analysis. Therefore, we hypothesize:

H3: Shared operational understanding is positively associated with business process performance.

H4: Shared strategic understanding is positively associated with business process performance.

H5: Strategic alignment is positively associated with business process performance.

We also consider the impact of shared understanding and strategic alignment on the performance of information systems as perceived by the business process. Nelson and Cooprider (1996) argue that shared understanding is associated with IS success as the improved knowledge about the business partner's needs and requirements will allow the IS unit to focus on delivering these capabilities. Chan et al (1997) argue that alignment of IS and business resources' strategic orientation leads to greater perceived value from the IS resources due to the likelihood that these IS resources will directly benefit the business stakeholders. Additionally, Chan's empirical test finds that alignment is positively related to IS effectiveness as perceived by the business partner. Therefore, as shared understanding leads to management of current resources and improved resources

in line with the business managers' requirements, we anticipate the business process

partner's perception of IS quality and impact to increase. Therefore we hypothesize:

H6: Shared operational understanding is positively associated with IS performance as perceived by the business process partner.

H7: Shared strategic understanding is positively associated with IS performance as perceived by the business process partner.

H8: Strategic alignment is positively associated with IS performance as perceived by the business process partner.



Figure 4.1 Hypothesized Associations between Shared Understanding, Alignment and Performance

### 4.2 Impact of Knowledge Attributes on Shared Understanding Antecedents

Review of literatures in IS, management, knowledge management and organizational learning suggest that the primary categories of variables that impact the level of shared understanding include social / cultural, cognitive, and learning mechanisms. Social

variables focus on the quality of the relationship between the business and IS organizations and the need and willingness to exchange information; whereas, the cognitive variables focus on the ability of each party to communicate existing knowledge and process and receive new knowledge. Learning mechanisms focus on specific approaches and activities which may by utilized to assist in the knowledge transfer including items about the frequency and process associated with how knowledge is exchanged.

The literature also indicates that the relative importance and effect of the potential antecedents is impacted by the type of knowledge which is processed. As we consider shared strategic understanding and shared operational understanding, we believe that the underlying knowledge is different based on the level of codification, complexity, system dependence, and ability to teach to others as defined by Zander and Kogut (1995). Shared strategic understanding focuses on future directions and is based on a series of high-level assumptions and contingent objectives. Strategic plans typically document the desired outcomes and potential objectives; however, assumptions and alternatives are rarely described or communicated. The concepts are not necessarily overly complex or cognitively demanding as they focus on a few key items. Additionally, there may be limited connection between strategies and current resources and abilities, thereby limiting the ability to teach the undocumented components. Shared operational understanding concerns detailed knowledge that is related to current resources and capabilities.

ability to document standard operating procedures. The more detailed and specific knowledge associated with our conceptualization of shared operational understanding allows for greater transferability of the knowledge without direct interactions. Table 4.1 summarizes the differences between strategic and shared operational understanding.

Attribute	Shared strategic understanding	Shared operational understanding
Codifiability	Plan documents may be developed that indicate primary objectives and supporting strategies; however, assumptions and conditions which would change the plan are rarely documented	Many organizations define standard operating procedures which define the assets and tasks for primary activities
Complexity	Strategy is generally limited to few key items and assumptions; however, may depend on customers, competitors and technology	Potential for great number of components and the capability of the business process may be limited by the ability of the technology.
System Dependence	Strategic knowledge is generally developed through communications with limited dependence on specific assets	High level of knowledge may be embedded within procedures and processes, and details of technology may restrict operational options available to business process
Teachability	Difficult to communicate all aspects and undocumented components	Staff are taught components on a need to know basis and observe for additional insight
Overall	Directional and imprecise, results of many assumptions which may not be documented or fully communicated	Highly detailed with ability to codify some information and additional information embedded in organizational routines

Table 4.1 Differ	ences in Knowl	edge Attributes	within Shared	<b>Understanding</b>	Levels
		8			

Tacit knowledge transfer may assist in developing shared operational understanding; however, the cognitive burdens appear to be greater within the shared operational understanding due to the detailed operations and contingencies which may be explicitly teachable and observable. Therefore, we consider the cognitive antecedents to be more critical to shared operational understanding. Likewise, we believe that shared strategic understanding may be more ambiguous and therefore the social and cultural antecedents are more critical due to the need to be a part of the development and discussion as many key assumptions and alternatives may never be documented (Szulanksi 1996; Simonin 1999). Leaning mechanisms are likely to be important in both levels of shared understanding; however, the specific mechanisms are likely to be different between the strategic and operational levels.

### 4.3 Antecedents for Shared Operational Understanding

Based on the prior literature and the conceptualization of shared operational understanding, we believe the antecedents are likely to focus on the organizational cognitive ability, specific learning mechanisms and willingness of participants. The management literature has developed the concept of absorptive capacity to represent the level of organizational cognitive ability and specifically, it represents the ability to value, assimilate, and apply new knowledge (Cohen and Levinthal 1990). Within the IS literature, Boynton et al (1994) conceived of absorptive capacity as an antecedent to IT use based on the need for the organization to value IT and recognize the potential contribution before IT would be utilized. Boynton considered absorptive capacity within the IT context to be a combination of managerial IT knowledge and IT practices.

Absorptive capacity within a specific relationship has been termed relative absorptive capacity and is argued to be largely a function of prior knowledge including basic skills and shared language (Lane and Lubatkin 1998). Similarly, Reich and Benbasat (2000) identified shared domain knowledge as an antecedent to alignment, and their conceptualization of shared domain knowledge appears consistent with the concept of

overlapping domain knowledge in the absorptive capacity literature. Therefore, we define overlapping knowledge as an awareness of key topics in information systems and manufacturing which may create a common language that allows for the understanding of the firm's specific manifestation of technology and process, and we consider it as a potential antecedent to shared operational understanding.

H9: Shared operational understanding is positively associated with overlapping domain knowledge between IS and business process organizations

Review of the literature provides many potential mechanisms; however, we focus on the governance of the relationship between IS and the business process. Grant (1991) conceived of knowledge integration as a process that was based on flexibility, efficiency and scope, and we believe that it is the governance factors of the IS and business process relationship which establish the levels of flexibility, efficiency and scope. Similarly, Dyer and Singh (1998) describe governance as a key component in developing relational rents due to its ability to guide decisions and ease or restrict the flow of communication as desired.

Weill and Ross (2004) recently considered the concept of IS governance as the allocation of decision rights to different levels in the organization. They also find that there are many different patterns of allocation of decision rights within organizations. We believe that governance may be more than where decision rights are allocated, but may also include who is involved in the decision making and what control mechanisms are utilized. Therefore, we consider relationship governance to include a formal interface, use of performance tracking measures, and joint IS management.

Formality in the relationship and structure may assist the transfer of knowledge between the IS and business units (Ranganathan and Sethi 2002). The formal structures may facilitate the coming together and interactions which lead to knowledge transfer. Ranganathan and Sethi 2002 empirically test and find a positive relationship between formalization of IT unit structure and shared domain knowledge. Similar mechanisms such as steering committees and dedicated relationship managers have been identified as influencing the level of IT knowledge creation (Nambisan et al 1999; King and Teo 1994; Boynton et al 1994). Therefore, organizations with more formal interfaces between IS and business units may increase the level of knowledge transfer and positively impact the level of shared understanding.

Governance choices may also be characterized by the level of decision making within the relationship. Boynton et al (1994) suggests that pushing down decision making to the lowest level improves knowledge transfer. This approach would increase the scope of knowledge transferred about the capabilities of each organization as they jointly make decisions versus independently determining how to implement decisions from above. Boynton et al finds that pushing down the level of decision making is a significant antecedent in developing an organic IT management culture which is positively associated with the level of IT use. Ranganathan and Sethi (2002) empirically indicate

that joint management of the IS unit, where the business partner and IS are responsible for determining the use of IS resources, may improve the level of knowledge transfer between the IS and business units.

Henderson (1990) suggests the use of performance measurement processes to improve partnership due to the efficiency of identifying issues and opportunities in the current environment. We believe that these review processes create an additional opportunity for the IS and business process organizations to develop shared understanding about the deployment and management of the current resources. Therefore, we hypothesize that formal organizational interfaces, joint IS management, and use of performance tracking measures and reviews will impact the level of shared operational understanding.

H10: Shared operational understanding is positively associated with formal organizational interfaces.

H11: Shared operational understanding is positively associated with the degree of performance measurement.

H12: Shared operational understanding is positively associated with joint levels of decision making authority within IS and business units.

We also believe that the level of willingness to participate in knowledge transfer will impact the level of shared understanding, and that willingness will increase as the relationship is perceived as more important. Our review of the literature indicate that information intensity, mutual trust and mutual dependence between the organizations may increase the need and willingness to share information between the IS and business units. IS literature has postulated that as the use of technology increases within the organization, its relative importance increases and the desire to better understand the available resources may become more important to organizations (Boynton et al 1994, Kearns and Lederer 2003). Kearns and Lederer (2003) study the impact of information intensity on alignment and find that it affects both the IS units involvement in business planning as well as the business units involvement in IS planning. Nelson and Cooprider (1996) highlight the role of mutual trust arguing that mutual trust reduces the perception that the other organization may use information inappropriately and therefore increases the likelihood that organizations are willing to share information. They find that mutual trust is an antecedent of shared knowledge which they find to be associated with IS team success. Sivadas & Dwyer (2000) argue that mutual dependence creates the need for organizations to interact and communicate, and that without mutual dependence there is limited reason for organizations to share information. They empirically find that in new product initiatives, mutual dependence is a significant construct in developing cooperative competency which aids in integrating information from other organizations. Fisher et al (1997) also find that in enhancing communication between marketing and engineering units, that integrated activities and goals is a key factor. Therefore, we hypothesize that information intensity, mutual trust and mutual dependence will be associated with the level of shared operational understanding.

H13: Shared operational understanding is positively associated with the level of information intensity in the business process.

H14: Shared operational understanding is positively associated with the degree of mutual trust between IS and the business process.

H15: Shared operational understanding is positively associated with the degree of mutual dependence between IS and the business process.



Figure 4.2 Antecedents for Shared Operational Understanding

### 4.4 Antecedents for Shared Strategic Understanding

Shared strategic understanding is concerned with developing an understanding about the future business objectives and the potential opportunities for IT to assist the organization. We believe that the knowledge underlying shared strategic understanding is more opaque and therefore we focus one source of potential antecedents on organizational culture which is likely to assist in similar interpretations of opaque information. We also consider governance mechanisms between IS and the business as a whole, as these may establish the set of opportunities for IS to better understand the strategic principles and information about the future objectives.

Components of an organizational culture may influence the development of common practices and shared beliefs which create similar interpretations of information (Pawlosky 2001). In developing shared strategic understanding, much of the information is based on assumptions about what might happen in the future and how best to be position the organization and develop resources. We believe that similar interpretation about the assumptions and likelihood creates greater levels of shared strategic understanding. Shared operational understanding focuses on information which is more explicit and system dependent with less opportunity for individual interpretation; therefore, we have not considered organizational culture as being a critical factor for shared operational understanding.

Nelson and Cooprider (1996) considered the association between shared knowledge and one dimension of culture, mutual trust. However, based on the organizational learning and knowledge management literature, we believe that there may be multiple cultural parameters which may influence shared strategic understanding. Limited work is available on a conceptual knowledge sharing culture or climate; however, Hoegl et al (2003) define it as "the set of shared understandings about providing employees access to relevant information as well as building and using knowledge networks within organizations" (p.745). This definition appears to be more related to the manageremployee relationship and is focused on access versus our conceptualization of shared strategic understanding. Greater development has occurred in identifying aspects of an organizational learning culture, and we believe that this may be appropriate for shared strategic understanding as one critical component is learning about the assumptions and prior experiences used to set strategic direction. Marsick and Watkins (2003) define

45

organizational learning culture as "a set of values, beliefs and assumptions focused on continuous learning. Learning is a continuous, strategically used process – integrated with and running parallel to work." The idea of organizational learning culture being a strategically used process is consistent with our views of how culture may assist in developing common interpretations of information and share tacit information. Marsick and Watkins identify seven dimensions within their interpretation of organizational learning culture, including continuous learning, inquiry and dialogue, collaboration and team learning, systems to capture and share learnings, empowerment, connection between organization and environment, and strategic leadership.

Dimension	Definition	
Continuous Learning	Learning is designed into work so that people can learn on the job; opportunities	
	are provided for ongoing education and growth.	
Inquiry and Dialogue	People gain productive reasoning skills to express their views and the capacity to	
	listen and inquire into the view of others; the culture is changed to support	
	questioning, feedback and experimentation.	
Collaboration and	Work is designed to use groups to access different modes of thinking; groups are	
Team Learning	expected to learn together and work together; collaboration is valued by the	
	culture and rewarded.	
Systems to Capture	Both high and low technology systems to share learning are created and	
and Share Learning	integrated with work; access is provided; systems are maintained.	
Empowerment	People are involved in setting, owning, and implementing a joint vision;	
	responsibility is distributed close to decision making so that people are motivated	
	to learn toward what they are held accountable to do.	
Connection of	People are helped to see the effect of the work on the entire enterprise; people	
Organization to	scan the environment and use information to adjust work practices; the	
Environment	organization is linked to its communities.	
Strategic Leadership	Leaders model, champion, and support learning; leadership uses learning	
- •	strategically for business results.	

# Table 4.2 Dimensions and Definitions of Constructs for the Learning Organization – Marsick and Watkins (2003), p.139.

The dimensions of inquiry and collaboration foster the ability to question and share

underlying assumptions about the strategic positioning of the organization.

Empowerment and strategic leadership dimensions may assist in creating the

development of common mental models and relationship between proposed positioning of the firm and supporting technology resources. The dimensions of continuous learning, connection to the environment, and systems development support the overall concept of knowledge transfer within the organization. Therefore, we consider organizational learning culture as an antecedent of shared strategic understanding.

H16: Shared strategic understanding is positively associated with the degree of organizational learning culture.

As with shared operational understanding, we believe that there are governance components which influence the level of shared strategic understanding; however, these governance mechanisms focus on how IS is perceived throughout the entire organization and are not related to the direct relationship between IS and the business process. Sabherwal et al (2001) argued that the firm level perception of IS impacted the perceived need to create alignment between business and IS, and through examination of case studies identified that changes in the overall perception of the IS organization was one factor for creating alignment or disrupting alignment.

One mechanism for setting the perception of IS is the presence of an overall corporate business strategy (Broadbent and Weill 1993; Reich and Benbasat 2000). The corporate strategy establishes boundaries of the organization and prioritizes competitive requirements of the supporting business processes, thereby providing an initial point for discussion between IS and the business process. Broadbent and Weill (1993) studied the alignment of business and information strategies within the banking industry and find that the firm-wide strategy-formation processes for the banks were central to the level of alignment. Similarly, Reich and Benbasat (2000) studied the antecedents of the social dimensions of alignment and find that strategic business plans is a predictor of both short and long term alignment.<sup>1</sup> We believe that the development of shared strategic understanding is enhanced by the presence of an overall business strategy due to its ability to create guidelines about the role of each process and how they may interact to improve firm performance.

Existence of the plan is important for shared strategic understanding; however, the defined direction and objectives contained within a documented plan do not typically address how these objectives were defined or what alternatives and limiting conditions were considered. Tacit knowledge transfer is required for full understanding of the business plan and the ability to execute to the spirit of the plan. Pyburn (1983) and Luftman and Brier (1999) suggested that the support of senior management for IS is an antecedent for alignment as it creates additional discussion of the role of IS. The sign of support may be explicit in terms of organizational positioning, or the signs of support may be implicit and be demonstrated by senior executives knowledge of the subject area and willingness to be involved in IS projects. Kearns and Lederer (2003) study the affect of business support in the IT planning process and find this sign of executive support leads to IT being viewed as a competitive weapon by the organization. The additional

<sup>&</sup>lt;sup>1</sup> Social dimension of alignment in Reich and Benbasat (2000) refers to the state in which business nd IT understand and are committed to the business and IT mission, objectives and plans.

clarification and awareness of the corporate position with regards to IS increases the

desire for IS and the business units to develop shared strategic understanding.

H17: Shared strategic understanding is positively associated with the existence of a clear corporate strategy.

H18: Shared strategic understanding is positively associated with executive support for IS.

Similarly to the discussion within shared operational understanding, we believe that

information intensity, mutual trust and mutual dependence will impact the willingness to

transfer knowledge and increase the level of shared strategic understanding.

H19: Shared strategic understanding is positively associated with the level of information intensity.

H20: Shared strategic understanding is positively associated with the degree of mutual trust.

H21: Shared strategic understanding is positively associated with the degree of mutual dependence.



Figure 4.3 Antecedents for Shared Strategic Understanding

### 4.5 Shared Understanding Model Summary

This research focuses on identifying the antecedents and consequences of shared understanding. The concept of shared understanding has been separated into two constructs, strategic and operational; to allow for isolation as to how antecedents may affect each construct, and how each construct may impact different performance types.



Figure 4.4 Model of Shared Understanding

Figure 4.4 demonstrates the model of shared understanding, and each of the links within the shared understanding model has been identified through reviews of prior theoretical efforts or empirical efforts. Table 4.3 identifies the relationship between the links within our model and the supporting literature.

Linkage	Examples of Supporting Literature	
Shared operational understanding -> Strategic Alignment	Reich and Benbasat 2000; Broadbent and Weill 1993; Kearns and Lederer 2000	
Shared strategic understanding -> Strategic Alignment	Reich and Benbasat 2000; Chan 1997; Luftman 1993	
Overlapping domain knowledge ->Shared operational understanding	Boynton et al 1994; Basselier et al 2003; Lane and Lubatkin 1998	
Formal IS and Bus Interface -> Shared operational understanding	Ranganathan and Sethi 2002; Grant 1991; Van den Bosch et al 1999	
Performance Tracking -> Shared operational understanding	Henderson 1990	
Joint IS Management -> Shared operational understanding	Weill and Ross 2004; Boynton et al 1994; Ranganathan and Sethi 2002	
Information Intensity -> Shared operational understanding	Kearns & Lederer 2003	
Mutual Trust ->Shared operational understanding	Nelson & Cooprider 1996	
Mutual Dependence ->Shared operational understanding	Fisher et al 1997; Sivadas and Dwyer 2000	
Clear Corporate Strategy ->Shared strategic understanding	Reich and Benbasat 2000; Broadbent and Weill 1993	
Executive Support for IS -> Shared strategic understanding	Kearns & Lederer 2003; Pyburn 1983; Luftman and Brier 1999	
Information Intensity -> Shared strategic understanding	Kearns & Lederer 2003	
Mutual Trust ->Shared strategic understanding	Nelson & Cooprider 1996	
Mutual Dependence ->Shared strategic understanding	Fisher et al 1997; Sivadas and Dwyer 2000	
Shared Operational Understanding -> Performance	Ray et al 2005; Boynton et al 1994; Nelson and Cooprider 1996	
Shared Strategic Understanding -> Performance	Ray et al 2005; Boynton et al 1994; Nelson and Cooprider 1996	
Strategic Alignment -> Performance	Chan et al 1997; Sabherwal and Chan 2001	

# Table 4.3 Shared Understanding Model and Prior Literature

### **CHAPTER 5**

## **RESEARCH METHODOLOGY**

This study focuses on developing potential antecedents and consequences for the concept of shared understanding. We have chosen to focus on the relationship between IS organizations and manufacturing organizations within the manufacturing industry to examine shared understanding. The manufacturing process was chosen for this study as it is typically one of the most important processes within a manufacturing organization and we believe that the business process must be perceived as critical for shared understanding to be a concern of the business organization. Additionally, manufacturing processes are traditionally large users of information systems and have been studied within prior work on IS and business relationships (Chan et al 1997; Nelson and Cooprider 1996). Research in manufacturing provides insights into manufacturing knowledge bases and performance measures which assist in operationalizations of critical variables for our study. This chapter describes the development of the survey, validation efforts, and overall sample and respondents.

### 5.1 Questionnaire Development and Variable Operationalizations

Our research methodology is based on the use of dual surveys of the manufacturing and IS organizations, similar to the work of Ray et al (2005), Chan (1997) and Nelson and

Cooprider (1996). This study utilizes key informants within the IS and manufacturing organizations to provide information about the organizations and their relationship, the resulting levels of shared understanding and alignment between the organizations. The manufacturing informant will also be requested to provide information about the performance of the IS organization and of the manufacturing organization. We believe that as a key member of the business organization, the manufacturing informant is able to provide a perspective on the performance of the IS organization. The choice of the manufacturing informant to provide process level performance reduces the number of informants required for the study and is intended to increase response rate; however, this approach provides the potential for common method bias (Campbell and Fiske 1959). Phillips (1981) indicates that high ranking informants tend to be more reliable sources of information and therefore we focus on high level manufacturing managers. Phillips also indicates that large organizations have better data collection systems than small firms and so we focus on larger firms in our sample. We believe that the same respondent issue can be mitigated more by examining multiple performance measures and by requesting quantitative as well as subjective measures of manufacturing performance.

#### Shared Understanding, Alignment and Performance

This study requires operationalizations of shared understanding, alignment, performance, and their potential antecedents. A review of existing literature identified several existing survey instruments that measure similar constructs and we have combined and modified these instruments to form the basis for our surveys to the IS and manufacturing informants. The primary variable of our study is shared understanding, and our conceptualization has two levels – operational and strategic. This conceptualization is based on the overlapping definitions from prior studies; therefore, we combine and expand Ray et al (2005) and Nelson and Cooprider (1996) to develop items for shared strategic understanding and shared operational understanding. Appendix 2 provides the intended survey instruments for information systems and manufacturing processes.

These levels of shared understanding are conceptualized as antecedents to alignment which develops when commitment is created within the organization. We consider alignment to be developed when plans are created which identify the business objectives and necessary technology resources. This definition is similar to those within Kearns and Lederer (2001) and Reich and Benbasat (2000); however, we examine the availability of plans relating to the manufacturing process versus the organization as a whole. Ray et al (2005) argue that competitive advantage needs to be considered at the process level due to the potential for other processes to reduce overall financial performance. Similarly, we believe that alignment must be considered at the process level to eliminate the potential for interference generated from misalignment with other processes within the firm.

Within our model of shared understanding, we investigate the association between shared understanding and process level performance. We focus on process level performance as that is where we expect the first order effect of shared understanding, and as Ray et al (2005) argue, the impacts at a process level may not be seen at the firm level due to the

performance of other processes. We believe the effect of shared understanding should be seen within both the manufacturing unit and within the IS unit. We utilize the manufacturing literature to provide objective and subjective measures for manufacturing performance. Schroeder et al (2002) utilizes an RBV framework to investigate the effect of internal and external learning on the creation of proprietary systems and the result of these unique assets on manufacturing performance. Schroeder identifies five quantifiable factors (flexibility, scrap rate, cost, delivery time and cycle time) and develops an index that may be considered to represent overall manufacturing performance. Jayaram (1999) identifies similar perceptual factors as they examine the association of human resource management concepts with perceived manufacturing performance in the areas of quality, flexibility, time-based competition, and cost reduction. Measurement of IS performance is typically focused on subjective measures; however, the measures may be perceptions of the quality of the IS unit or they may be considered as the impact of IT on the business. We utilize measures from Nelson and Cooprider (1996) to consider manufacturing's perception of the quality of the IS unit, and measures from Ray et al (2005) to consider the impact of IT on the manufacturing process.

#### Antecedents of Shared Understanding

We have hypothesized that overlapping prior knowledge bases may be a key antecedent to shared operational understanding. Overlapping domain knowledge consider awareness of key topics in information systems and manufacturing which may create a common language that allows for the understanding of the firm's specific manifestation of technology and process. Our conceptualization of the business and IS relationship is that it may have many levels and may take different forms across organizations. Some organizations may utilize a centralized form of relationships where interaction occurs at the leadership level and other organizations may identify key liaisons or teams to interface between business and IS. Therefore, we believe that in assessing overlapping domain knowledge it is important to look beyond the leaders of the organization and consider key members who may have specialized knowledge and are able to assist in developing communications between the respective organizations. This approach is different than much of the prior literature which has focused on knowledge of the specific actors versus the knowledge of the organization (Reich and Benbasat 2000; Ray et al 2005).

Basselier (2001,2004) develops the concept of IT competence in a business manager and the concept of business competence in IT personnel. IT competence is measured by evaluating their knowledge of IT concepts such as types of hardware, software and specific IT management processes; whereas, business competence measures more general business components including organizational responsibilities, IT-business integration, interpersonal communication, and leadership. Utilization of the different levels of detail knowledge between IT competence and business competence may be appropriate when considering the relationship between IS organization and the business as a whole; however, within a specific dyad relationship, the development of shared language and exchange of experiences would seem to require some detailed knowledge for both parties. Therefore, we focus on the manufacturing literature to define manufacturing competence and pair with Basselier's (2001) concept of IT competence. The theory of production competence was put forth by Cleveland et al (1989) and revisited by Vickery (1991), and has since been referenced and used within many production and manufacturing studies. This approach does not consider specific areas of knowledge that are required of individuals (ala Basselier); however, it identifies critical production concepts (flexible manufacturing, supply chain and logistics, resource planning, etc.) which organizations must perform well to be considered competent. We focus on knowledge of these concepts to define manufacturing competence of the IS personnel.

The existence of a formal IS and business interface and the involvement of manufacturing personnel in jointly managing information systems are also predicted as antecedents to shared operational understanding. Ranganathan and Sethi (2002) consider the rationality in information systems decision making. In this work, Ranganathan and Sethi identify the level of joint management of the information systems efforts as a potential antecedent to shared knowledge. This scale is the basis for our measurement of the joint IS management variable. Ranganathan and Sethi (2002) also consider the influence of formalization in the IT unit on shared domain knowledge. We draw from this conceptualization to develop our measures for formalization of the business and IS unit interface. Information intensity, mutual trust and mutual dependence are considered as antecedents to operational and shared strategic understanding as both variables are perceived to make the relationship more important to the organization's success. IT intensity is operationalized within the IS literature using quantitative (IT spending or spending ratio) measures; however, we believe that the information requirements are more likely to impact the relationship that is developed rather than the level of spending. Therefore, we focus on the subjective measures of information intensity identified by Kearns and Lederer (2000). Mutual trust is based on the work by Nelson and Cooprider (1996); however, we expand the operationalization of trust to capture the components of competence, integrity and benevolence. We combine items developed by McKnight (2002) and Levin and Cross (2005) to develop mutual trust that encompasses all three components. Our conceptualization of mutual dependence is centered on the ability for the IS organization and the manufacturing organization to be able to perform their activities without the use of resources or support from the other organization. We believe this is similar to the approach by Sividas and Dwyer (2000) who investigate dependence in new product alliances. We adjust their scale to fit the IS and manufacturing relationship.

We have also hypothesized organizational learning culture, clear corporate strategy and executive support for IS as potential antecedents of shared strategic understanding. Our operationalization of the organizational learning culture is based on Marsick and Watkins (2003) learning organization questionnaire. The learning culture instrument has been utilized and validated in several research studies, and we consider the condensed version of the survey by Yang (2003). The operationalization of clear corporate strategy is operationalized in four items based on a scale from Kerns and Lederer (2000). Executive support for IS measured in a five item scale from Jarvenpaa and Ives (1991) who tested the impact of executive involvement and management in supporting information systems efforts. Table 5.1 provides a summary of the primary variables in this study and the literature which is the basis for their development.

Construct	Definition	Prior Literature Basis for Item Development
Shared Operational Understanding	Appreciation of the processes, resource requirements and challenges within the current business process and IS organizations.	Ray et al 2005; Nelson & Cooprider 1996
Formal IS & Bus Interface	Management of the IS and Business relationship is based on defined practices and interactions which guide daily activities.	Ranganathan and Sethi 2002; Sividas & Dwyer 2000
Performance Reviews and Tracking	Establishing, measuring and communicating performance goals and results.	New
Overlapping Knowledge	Awareness of key topics in information systems and manufacturing which may create a common language that allows for the understanding of the firm's specific manifestation of technology and process.	Bassilier 2001; Cleveland et al 1989; Vickery 1991
Joint IS Mgmt	Responsibility for IS management significantly involves the business units.	Ranganathan & Sethi 2002
Mutual Trust	The confidence one unit has in the ability and character of the other unit to produce positive outcomes.	Nelson &Cooprider 1996; McKnight et al 2002; Cross and Levin 2005
Information Intensity	The level and frequency of information utilized within the process.	Kearns & Lederer 2000
Mutual Dependence	IS unit and the manufacturing unit require the resources and abilities of each other for their success.	Sividas & Dwyer 2000
Shared Strategic Understanding	Mutual awareness of the improvement objectives of the business process, the strategic principles which guide investment and resource acquisition decisions, and how IT may be used in assisting with these objectives.	Ray et al 2005; Nelson & Cooprider 1996
Clear, Corp. Strategy	The corporate strategy is known and understandable, including assumptions.	Kearns & Lederer 2000
Executive Support for IS	The corporate level of the organization views IS as a critical component of firm's success.	Jarvenpaa & Ives 1991
Organizational Learning Culture	A set of values, beliefs and assumptions focused on continuous learning. Learning is a continuous, strategically used process – integrated with and running parallel to work.	Marsick & Watkins 2003
Business Performance	Financial results at the firm level.	Powell & Dent-Micallef 1997
Mfg Performance	Key results at the manufacturing process level.	Jayaram et al 1999
IS Performance	Key results at the IS process level.	Nelson & Cooprider 1996
IT Impact	The degree to which IT is perceived to have had an effect on the performance of the manufacturing unit.	Ray et al 2005
Strategic Alignment	The business strategies and plans are enabled and supported by IT plans.	Kearns & Lederer 2003

# Table 5.1 Study Variables and Prior Instruments

The concept of formalized performance reviews is one that we do not find well developed in prior literature. The contractual nature of IS outsourcing has developed the use of formalized statements of work, service measurement and performance reviews. We believe that similar documentation of services and the review of actual to planned service measurements are similar with Henderson's perspective on formalized performance reviews. We develop three items to represent the level of definition of services and goals, measurement programs, and performance reviews.

There are several controls that may be considered in this analysis. For example, firm size may be related to the ability to create shared understanding as smaller firms may be more focused on very specific tasks. We consider employees and revenues as proxies for firm size. The length of the relationship may also be important in developing shared understanding and we measure this by considering the tenure of the leaders of the IS and manufacturing organizations (Fisher et al 1997). The focus on manufacturing firms helps with industry specific phenomenon; however, there may be unique issues which occur within a sub-sector of the industry, such as the level of market change and dynamism which may impact the need and ability to create shared understanding. Additionally, manufacturing literature has discussed the impact of unionization and age of facilities as potential predictors of manufacturing performance.

### **5.2 Survey Instrument Validation**

We use previously validated scales in development of our instrument which may reduce the concern about validity. However, the scales come from separate surveys and there may be some concern as they are combined in the same instrument. Additionally, in some cases, the items have been rewritten to match the scales used throughout this survey. The survey validation efforts consisted of three steps: sorting exercise, external review, and initial pilot.

The initial validation effort was a sorting exercise where participants were asked to match the individual items with the constructs that they represented. The exercise was performed by three manufacturing PhD students and three IS students. Each participant was provided with a list of the individual constructs and definitions used in this study, and a separate listing of all the survey items in random order. The participants were asked to match each item with the construct that they best felt was represented by the item. Items which were incorrectly matched with the appropriate construct by the majority of the participants were reviewed and lead to rewording or elimination of items.

The second step of the survey validation was to send the surveys to three manufacturing and three IS professionals. The manufacturing professionals were asked to complete the manufacturing component of the survey and note any questions which were difficult to understand or may provide for uncertainty in what was being asked. After completion of the survey, a phone interview was utilized to solicit feedback on the manufacturing component survey questions. A similar approach was utilized with the IS professionals on the IS component survey questions. This validation process resulted in additional rewriting of items and elimination of a few items to simplify the questionnaires.

The third step in survey validation was an initial pilot test with the Columbus chapters of the Society of Manufacturing Engineers and American Society for Quality. Each chapter was asked to forward an email message to their local members inviting them to participate in our survey. The email message described the intent of our survey and directed the recipients to a web site where the survey could be completed. Twelve completed manufacturing surveys were received. This limited amount prevented us from testing the hypotheses put forth in the model; however, we were able to perform initial reliability and factor analysis. This analysis indicated that items in two constructs did not factor as desired and these factors possessed low reliability. In both cases, the items were modified to be more consistent with items from prior literature.

### **5.3 Survey Sample and Recipients**

Our research focuses primarily on the relationship between IS units and manufacturing units and the effect on the level of shared understanding; therefore, we wish to identify manufacturing organizations with sufficient size to allow for the separation of these units. Based on review of thresholds in prior literature, we require firms to have minimum sales revenue of \$100 million. We believe this threshold is significant and identifies organizations who may be concerned with the interaction between IS and business units.
We have also chosen to focus on the manufacturing industry; however, there are many types of manufacturing industries (sic codes 2000-3999) and we wish to identify a subset of the manufacturing industries to achieve a sample with more similar characteristics. We use the Bureau of Economic Analysis input-output tables to identify the manufacturing sub industries which are heavier users of IT relative to other expenditures. We identify the SIC code ranges of 34 through 39 as amongst the most significant users of IT, and based on the Dunn & Bradstreet Million Dollar Database we identify 2185 records which are in these industries and also meet the sales criteria.

The Dunn & Bradstreet listing includes multiple records for the same organization. For example, there may be listings for headquarter and branch locations, as well as a listing for the public company and also listings for the organization identified as public family member. Additionally, there may be multiple records for organizations which appear to be highly related due to shared addresses and phone numbers. We therefore eliminate these duplicates and reduce the potential sample to 1593 firms.

We focus on identifying managerial contacts in the information systems unit, who may forward the manufacturing component of the survey to the manufacturing managers. We utilize Top Computer Executives, Hoovers, and Dunn & Bradstreet to identify contacts in the information systems unit for 1019 firms. For the remaining 574 firms, we search Hoovers and Dunn & Bradstreet and are able to identify senior business executive contacts for 484 of the firms. The senior business executives will receive the IS and manufacturing components of the survey and be asked to forward each component to the appropriate manager. This reduces the overall sample to 1503 firms. Table 5.2 provides a breakdown of the sample by SIC code and by sales revenue and Table 5.3 provides a summary of survey recipients' titles.

SIC	# of Companies
34	209
35	368
36	381
37	252
38	219
39	74
	1503

nies	<b>Revenue Range</b>	# of Companies
	\$100-250 million	788
	\$250-500 million	296
	\$500-750 million	115
	\$750-1000 million	61
	\$1 billion +	243
		1503

Table 5.2 Distribution of Survey Sample by SIC Codes and Revenues

Contact Type	Titles	Quantity
Executive Contacts	CEO/President	467
Executive Contacts	VP/Exec/Director	17
IS Contacts	CIO/CTO	395
IS Contacts	VP/Director of IT	446
IS Contacts	Manager of IT	178
Total		1503

**Table 5.3 Survey Recipient Titles** 

# **CHAPTER 6**

## DATA COLLECTION AND ANALYSIS

#### **6.1 Survey Administration**

The survey was initially sent out in June 2005. The survey package included a cover letter and the IS and Manufacturing survey components. For those surveys sent to the IS executive, the cover letter identified the survey and requested their participation by completing the IS component of the survey and forwarding the manufacturing component to the manager responsible for manufacturing of the company's primary product line. For the surveys sent to the senior executive, the cover letter requested them to forward the surveys to the IS and manufacturing managers responsible for the primary product line. The surveys also indicated that the IS and manufacturing managers could complete the surveys online.

A follow-up letter was sent after ten days thanking them if they had already participated and reminding the managers of the survey and asking for their participation if they had not already completed the survey. Phone numbers and emails were identified from company websites, Hoovers and Dunn & Bradstreet, and a follow-up by phone or email

was completed in early August 2005. A second mailing of the survey was performed in September 2005. This mailing was identical to the first mailing with the exception that 189 of the senior executive contacts were replaced with manufacturing contacts. This change to the contact list was made based on the response to the first mailing where companies were more likely to respond if the survey had been directed to the IS manager. This could be due to the fact that the survey did not have to be handed off from the senior manager to the IS and manufacturing managers. Additionally, the survey is focused on shared understanding between the IS and manufacturing units and they may be more interested in the results; therefore, the survey may appear more relevant when sent directly to senior IS and manufacturing executives. Company websites, Hoovers and Dunn & Bradstreet were used to identify manufacturing managers with titles such as VP Manufacturing/Operations/Production, Global Manufacturing Leader, Manufacturing Executive, and Manufacturing Manager. These manufacturing managers received a survey package with a cover letter identifying the survey and asking for their participation. The cover letter asked the manufacturing managers to complete the manufacturing component of the survey and forward the IS component to the IS counterpart.

As possible, email addresses for the contacts were identified from company websites. Email reminders were sent in late September, October and November. Additionally, targeted emails were sent to managers who had replied to the survey however their manufacturing or IS counterpart had not replied. These reminders asked the managers to check with their counterpart and request their participation on our behalf. The last email reminders were sent in early December 2005.

## 6.2 Survey Response

The survey was initially targeted to 1503 companies; however, 111 companies were dropped from the sample for the reasons shown in table 6.1, reducing the overall sample to 1392 companies.

# of Companies	Reason for exclusion
11	Contact not responsible for IS or manufacturing
17	Contact no longer there
36	Surveys returned / wrong address or contact information
18	Declined – against policy
19	Declined – no mfg or IS

#### Table 6.1 Reasons why companies were eliminated from sample

We received responses from 171 companies, representing a response rate of 12.3%. Of the 171 companies, 75 companies (5.4%) provided both the IS and manufacturing responses<sup>2</sup>, 54 companies provide the IS component only and 42 companies provided the manufacturing component only. This level of response is similar to the 7% response rate in Sabherwal and Chan (2001) as well as the 9% response rate in Ray (2005). We also believe that this response rate and the resulting sample size is satisfactory given the length of the survey (4 pages) and the request for matched pairs of senior level respondents.

 $<sup>^{2}</sup>$  Of the 75 paired responses, six are removed from further analysis due to missing data. Detailed analysis is performed with the 69 complete responses.

The survey responses were examined for potential bias based on responders vs. nonresponders by comparing the characteristics of the responders to the originally targeted 1503 companies. We compare the organizations across three attributes: revenue, employees, and public/private ownership<sup>3</sup>. The demographics for the sample frame, responders and paired responders<sup>4</sup> are shown in table 6.2.

	Sample Frame	Responders	Paired Responses		
revenue (million \$)	1234	1053	694		
employees	5358	4994	4000		
public (private)	609 (894)	82 (89)	31 (38)		

## Table 6.2 Demographics for Sample Frame, Responders and Paired Responses

The distributions of the two populations were compared by a Kolmogorov-Smirinov test and the resulting p-values shown in table 6.3.

	Sample Frame vs Responders	Sample Frame vs Paired Responders				
Revenues	0.001	0.018				
Employees	0.041	0.145				
Public / Private	0.135	1				

# Table 6.3 Response Bias: Kolmogrov-Smirinov Test of Sample Frame vs Responders

The results indicate that there is a difference between all responders and the sample frame, and that organizations who respond are likely to be smaller. When limiting the responders to only those organizations that provided paired responses, these organizations are still smaller in revenue but not in employees.

<sup>&</sup>lt;sup>3</sup> Data from Dunn & Bradstreet.

<sup>&</sup>lt;sup>4</sup> Paired responders are the 69 firms that provide paired responses used for further analysis.

We are also concerned with potential differences in responses to survey questions from early and late responders. To examine for potential bias in responses, we compare the responses on a question by question basis using the Kolmogorov-Smirinov test. For the purposes of this test, early responders are considered those responses received by September 1<sup>st</sup> which would be shortly before the second mailing of the survey. We find that there are no items for the IS survey and three items for the manufacturing survey where the null hypotheses that the distributions of responses are the same between the two groups could be rejected. The IS survey contains 66 items and the manufacturing survey contains 72 items; therefore, we believe that this evidence suggests that the response distributions are similar and the data can be pooled.

Similarly, we also compare for potential difference between responders who use the paper version of the survey and the online survey. We find that there are four items in the IS survey and two items in the manufacturing survey where the null hypotheses could be rejected. Two of the IS items also demonstrate lower reliability to other items in their latent variable and are dropped in further analysis. We believe that based on the number of items considered, the evidence suggests that the responses are not likely to be different based on use of paper survey vs online survey and therefore we pool these for further analysis.

Surveys were sent to the IS unit and asked to be forward to their manufacturing counterpart; therefore, it is possible that only firms with a higher level of shared understanding will provide us with paired responses. We test for differences in responses between the organizations which provided paired responses and organizations which provided only the IS or manufacturing responses. We find that there are two items in the IS survey and zero items in the manufacturing survey where the null hypotheses could be weakly rejected. Additionally, the two IS items with a significant result were not related to the shared understanding constructs; therefore, we believe it is less likely that the bias in our paired sample is toward organizations with higher levels of shared understanding.

#### **6.3 Data Analysis**

The research questions are focused on the relationship between IS and manufacturing; therefore, we focus our analysis on the organizations that provided paired responses. Of the seventy-five paired responses, there are six which contain missing responses to items regarding shared understanding, thus reducing the sample for our analysis to 69 firms.<sup>5</sup>

The data analysis utilizes two related methods: OLS regression and PLS. In the regression analysis, latent variables which are considered reflective<sup>6</sup> are calculated through a principal component analysis of the latent variable's indicators. Formative latent variables are created through a simple sum of the indicators, thus creating an index

<sup>&</sup>lt;sup>5</sup> Missing data in other items was calculated as the average score of the other respondents for that item. This approach has been found to be as effective as a person mean substitution when the missing data is less than 20% (Downey and King 1998).

<sup>&</sup>lt;sup>6</sup> Reflective latent variables are viewed as affected by the same underlying concept; whereas, formative indicators are measures that form or cause the creation or change in a latent variable (Chin 1998).

to represent the latent concept. The latent variables may then be used in a regression as dependent or independent variables. The PLS model also uses principal component analysis and regression; however, the latent variable scores are calculated simultaneously with the path values. This allows PLS to consider the measurement error associated with the latent variable while also calculating the path weights between the latent variables. PLS is a form of structural equation modeling tools; however, PLS is able to consider formative variables and works well with smaller sample sizes.

#### 6.3.1 Common Method Variance and Psychometric Properties

#### Common Method Variance

Within survey research, one potential concern is common method variance. The use of a common respondent to provide the independent and dependent measures may result in a correlation between the measures due to characteristics of the respondent rather than due to an actual association between the measures. The most common test for common method variance is Harman's (1976) one-factor test where a factor analysis is performed on the data. If common method variance is present, the items should load onto a limited number of factors and the first factor would represent the respondent and would account for a great percentage of the variance. Our results find that the items load on multiple factors (more discussion about the loadings is provided in the section on psychometric properties) and that the variance accounted for by the first factor is .26. We also correlate the self-reported firm performance measure for the public firms who responded to either

part of the survey with actual financial performance from Compustat. Compustat provides net income for the three prior years for seventy-one of our firms, and the correlation between self-reported firm performance and the average of the three years net income to assets has a correlation of .46 and is statistically significant with a p-value of less than .01. Other measures of firm performance (net income to sales (.38), operating income to assets (.54) and to sales(.43)) provide similar results. These tests would suggest that common method variance is not an issue for this study; however, there two additional design methods which may help alleviate the concern on common method variance. One method used in this study to reduce the chance of common method variance is that the central constructs, shared operational understanding and shared strategic understanding, require input from the information systems survey and the manufacturing survey. The dyadic measurement of this construct reduces the direct effect of the responses from either of the respondents. A second method for reducing common method variance is that several of the independent measures as well as the firm performance and IS quality dependent measures are included in both the IS and manufacturing surveys. Our intent is to average these responses into a single firm level response; however, we wish to verify that the responses from both parties are generally similar. One possible way to check the responses is to consider the manufacturing and IS counterparts as two raters and check for inter-rater reliability using Cohen's Kappa. Kappa is calculated based on the level of agreement between the two respondents and the expected level of agreement. The resulting Kappa is measured between 1 and -1, with greater positive results indicating greater similarity in rating. We calculate kappa's for

each of the 37 common items and find that the kappa is positive for 27, and the test statistic is significant for 10 of these. For the 10 items which produce negative kappa's, none of them are significant. One issue with using kappa for this analysis is that it measures the level of agreement between raters; however, any difference between ratings is considered to be disagreement. Therefore, a rating of a 4 and a 5 may be very similar but they would be considered to be in disagreement. As an additional analysis, we check the correlations between the manufacturing and IS respondents for the 37 common items. We find that 24 of the items are significantly correlated at the .10 level. We also perform this analysis by considering the correlation between the eight latent variables which are based on these 37 common items. We develop latent variable scores separately based on either the manufacturing or IS items and then examine the correlation and find that 7 of the 8 latent variables are significantly correlated at the .10 level. The lone exception is IS unit quality. We believe that these results indicate that averaging these responses does not present a significant problem; however, the analysis may examine the IS unit quality variable from perceptions of manufacturing and IS separately.

#### **Psychometrics**

As an initial step in the data analysis, factor analysis was used as an exploratory method to confirm that the survey items loaded on the appropriate latent variables. One of the major findings from the factor analysis was that for the manufacturing respondents the items for information intensity and dependence loaded on the same factor. This implies that these may be the same factor and this seems reasonable as the use of information (intensity) may drive the level of need for IS resources (dependence). Therefore, we have dropped the manufacturing component of dependence from the model and focused on the IS dependence and information intensity.

Factor analysis also identified a few items that had lower loadings within their construct and higher cross-loadings to another construct. This analysis resulted in one item being dropped from each of the following constructs: alignment (survey item a12), joint IS management (b2), IS dependence (b14), and formal business and IS interface (c2). Additionally, the item F12 has been dropped from shared operational understanding. Survey items F11 and F12 are highly correlated and both load with the other strategic understanding questions. F11 was intended to focus on strategy by examining the common understanding regarding the role of IS in meeting new manufacturing objectives; whereas, F12 was intended to focus on operations by considering the common understanding regarding the role of IS in supporting current operations. The two items may have been similar enough to result in the high correlation; therefore, we focus on the first item (F11) for our analysis.

In evaluating each latent variable there are two primary concerns, reliability of indicators for reflective latent variables and the discriminant validity of the latent variable. Reliability in PLS is measured by the composite reliability of the indicators. As opposed to cronbach alpha, composite reliability considers the weights of each indicator. Prior literature suggests a minimum cronbach alpha of .7, and though no specific threshold is suggested for composite reliability we would expect it to also be greater than the .7 threshold (Nunnally, 1967). Mutual Trust, Shared Operational Understanding and Shared Strategic Understanding are conceived of and measured as second order factors. The second order factors are created through a principal component analysis of the two first order latent variables; therefore we are focused on the reliability of the first order factors. Table 6.4 identifies the latent variables in the model, the number of items used for the latent variable, factor type, cronbach alpha, composite reliability, and descriptive statistics for the latent variable. The reliability information shown in Table 6.4 for the second order factors is the reliability score for each of the first order factors. The cronbach alphas for each latent variable are above the recommended .7 threshold and the composite reliability factors are all above .8, providing evidence that the scales should be considered reliable.

Latent Variable	Construct Type	# of Items	Composite Reliability	Cronbach Alpha	min	max	avg	stdev
Clear Corporate Strategy *	Reflective	4	0.966	0.953	2.00	5.00	3.76	0.74
Executive Support of IS*	Reflective	5	0.962	0.95	1.50	4.80	3.56	0.76
Joint IS Management*	Reflective	4	0.923	0.886	1.50	4.38	2.99	0.75
MFG Metrics	Reflective	3	0.836	0.881	1.33	5.00	3.45	0.85
IS Metrics	Reflective	3	0.847	0.889	1.00	4.67	2.71	0.86
Information Intensity *	Reflective	3	0.883	0.853	2.83	5.00	4.18	0.52
IS Dependence	Reflective	2	0.92	0.823	1.00	5.00	3.52	0.94
Formal Interface*	Reflective	2	0.921	0.828	1.25	4.75	2.78	0.74
Mutual Trust	2nd Order	6,6	.895, .915	.849, .881	2.42	4.92	3.86	0.53
Organizational Learning Culture*	Reflective	7	0.916	0.887	2.36	4.71	3.41	0.54
Overlapping Knowledge **	Formative	9	N/A	N/A	1.78	4.44	3.42	0.54
Shared Operational Understanding	2nd Order	3,3	.898, .923	.772, .830	1.67	4.17	3.12	0.66
Shared Strategic Understanding	2nd Order	3,3	.943, .921	.878, .827	1.50	4.50	3.32	0.71
IS Quality	Reflective	2	0.911	0.804	2.00	5.00	3.76	0.51
Manufacturing Performance	Formative	5	N/A	N/A	1.40	5.00	3.89	0.66
IT Impact on Manufacturing	Reflective	3	0.923	0.871	1.00	5.00	3.35	0.82
Firm Performance	Reflective	3	.952	.923	1.83	5.00	3.89	0.73
Alignment	Reflective	4	.94	.915	1.25	4.63	3.24	0.78

Note: Min, max, avg., and standard deviation based on additive formation of latent variables.

\*The same questions are asked of the manufacturing and IS counterparts. These responses are averaged and used as an indicator.

\*\* Overlapping knowledge is a formative factor that includes five questions asked in the IS Component and four questions asked in the Manufacturing Component.

\*\*\* The first order components are calculated through principal component analysis and then used as inputs into the second order factor.

## **Table 6.4 Latent Variables Descriptive Statistics**

Discriminant validity is utilized to determine that the latent variables in the model are each unique. PLS modeling focuses on confirmatory method of considering discriminant validity by ensuring that the square root of the average variance explained by the latent variable is greater than the correlation between that latent variable and any of the other latent variables in the model. Additionally, the prior literature has suggested that the correlations between the indicators and the latent variable that they represent should be greater than the correlation between the items and any other latent variable.

Table 6.5 provides a correlation table among the latent variables. The value on the diagonal represents the square root of the average variance explained. We find that the square root of the average variance explained is greater than the correlation between the latent variable and any of the other latent variables. The item loadings have also been examined and we see that the items are loading higher on their latent variables than on any of the other latent variables.<sup>7</sup> This provides evidence of convergent and discriminant validity (Geffen and Straub 2005).

<sup>&</sup>lt;sup>7</sup> Detailed item loading tables are in Appendix 3.

Align.	IT Impact	Mfg Perf	IS Quality	Firm Perf.	Sh Strat. Under.	Sh. Ops Under.	Overlap Knowledge	Org. Learn Culture	Mutual Trust	Formal Interface	IS Depend.	Info. Intensity	IS Metrics	MFG Metrics	Joint IS Mgmt	Exec Support	Corp. Strategy	
.745	.292	.458	.431	.498	.604	.508	.338	.500	.581	.477	.397	.350	.448	.393	.427	.615	.937	Corp. Strategy
.677	.364	.360	.457	.327	.679	.522	.392	.544	.585	.385	.279	.416	.396	.355	.446	.913		Exec Support
.642	.423	.207	.346	.087	.653	.639	.278	.453	.493	.561	.492	.511	.463	.408	.866			Joint IS Mgmt
.468	.357	.534	.216	.351	.474	.342	.158	.488	.282	.430	.147	.415	.245	.796				MFG Metrics
.413	.251	.191	.314	.277	.338	.364	.275	.248	.400	.418	.289	.249	.806					IS Metrics
.553	.450	.202	.281	.213	.435	.334	.226	.294	.492	.418	.323	.846						Info. Intensity
.353	.240	.014	.043	.081	.384	.298	.041	.347	.225	.312	.922							IS Depend.
.562	.352	.172	.457	.191	.577	.582	.369	.430	.461	.924								Formal Interface
.581	.490	.262	.542	.309	.655	.609	.345	.426	.784									Mutual Trust
.511	.386	.368	.290	.258	.556	.405	.382	.781										Org. Learn Culture
.457	.153	.271	.451	.061	.334	.448	.612											Overlap Knowledge
.626	.502	.335	.573	.000	.678	.801												Sh. Ops Under.
.694	.500	.395	.511	.286	.802													Sh Strat. Under.
.355	.172	.450	.094	.932														Firm Perf.
.577	.442	.456	.914															IS Quality
.497	.478	.779																Mfg Perf
.503	.894																	IT Impact
.892																		Align.

Note: Values on diagonals are square root of average variance extracted

# Table 6.5 Latent Variable Correlation Matrix

#### 6.3.2 Shared Operational Understanding

In the OLS analysis, there are three separate analyses: 1) antecedents of shared operations understanding, 2) antecedents of shared strategic understanding, and 3) impact of shared operations understanding and shared strategic understanding on performance.

The primary antecedents for shared operations understanding that have been included in the model are formal IS and manufacturing interface, performance tracking (use of IS and manufacturing metrics), overlapping knowledge and joint IS management. Additionally, information intensity, mutual trust and IS dependence are considered as possible antecedents to both levels of shared understanding. Column A of Table 6.6 contains the results of analysis on the hypothesized antecedents for shared operations understanding. Column B of Table 6.6 adds controls for the IS organizational form based on whether the organization reports directly to the CEO and whether the predominant services to the manufacturing unit are provided by a centralized IS service unit. Additional controls for organization size (sales) and for relationship length are included. Column C provides exploratory analysis which separates the overlapping knowledge variable and mutual trust into an IS component and a manufacturing component. Column D explores the type of trust that may be important in the relationship. Specifically, each group's trust is broken down into three components: competence, integrity and benevolence. In the exploratory analyses, variables not found to significant in prior models were dropped to save degrees of freedom for the analysis.

	Shared	Shared	Shared	Shared
	Operational	Operational	Operational	Operational
	Understanding	Understanding	Understanding	Understanding
	(Column A)	(Column B)	(Column C)	(Column D)
Formal IS and Mfg	.165 (0.078)*	.155 (0.109)	.161 (0.070)*	.153 (0.086)*
Interface				
IS Metrics	060 (0.422)	063 (0.421)		
Mfg Metrics	.045 (0.546)	.028 (0.728)		
Overlapping Knowledge	.057 (0.007)***	.054 (0.018)**		.050 (0.021)**
Joint IS Management	.250 (0.002)***	.255 (0.002)***	.264 (0.000)***	.196 (0.014)**
Information Intensity	140 (0.077)*	152 (0.065)*	132 (0.083)*	121 (0.114)
Mutual Trust	.351 (0.001)***	.391 (0.001)***		
IS Dependence	.030 (0.708)	.002 (0.980)		
Direct Report to CEO		.152 (0.530)		
Centralized IS		160 (0.441)		
Ln_sales		051 (0.628)		
Relationship Length <sup>8</sup>		007 (0.812)		
IS Knowledge of MFG			.056 (0.026)**	
MFG Knowledge of IS			.045 (0.198)	
IS Trust of MFG			.066 (0.232)	
MFG Trust of IS			.179 (0.001)***	
IS Trust of MFG –				
Competence <sup>9</sup>				043 (0.584)
IS Trust of MFG – Integrity				.034 (0.701)
IS Trust of MFG –				
Benevolence				.156 (0.084)*
MFG Trust of IS –				
Competence				.012 (0.899)
MFG Trust of IS – Integrity				.255 (0.010)**
MFG Trust of IS –				
Benevolence				.081 (0.408)
<b>R</b> <sup>2</sup>	.625	.636	.634	.664
Power $(alpha = .05)^{10}$	.99	.99	.99	.99

Regression coefficient shown with p-value in parentheses

\*Denotes significance at 0.10 level, \*\* at 0.05 level and \*\*\* at 0.01 level

# **Table 6.6 Shared Operational Understanding Antecedents**

<sup>&</sup>lt;sup>8</sup> Relationship length is measured as the minimum of the responses to question H.12 on the IS survey and question H.4 on the manufacturing survey. These questions ask how long the senior management team from the other component of the dyad has been in place.

<sup>&</sup>lt;sup>9</sup> The competence component of trust is measured by items c4 and c5 of the surveys, integrity is measured by items c6 and c7, and benevolence is measured by items c8 and c9. In each case, the responses to the two items are summed to develop the score.

<sup>&</sup>lt;sup>10</sup> Power analysis is performed based on method described by Cohen (1988).

The regression models indicate that overlapping knowledge, joint IS management and mutual trust are strongly significant. Formal business and IS interface and information intensity are weakly significant; however, the sign of the information intensity is opposite of predicted. This may be due to information intensity also revealing the level of complexity within the organization, and more complexity may result in a greater difficulty in reaching shared understanding. We also identify through the exploratory analyses that IS knowledge of general manufacturing concepts and manufacturing's view of the integrity of the IS unit are significant explanatory variables.

#### **Regression Diagnostics**

The use of OLS may be impacted by a few outlying data points, non-normal data and highly correlated independent variables. Diagnostics for the OLS models focus on scatter plots and calculations of the variance inflation factors. Figure 6.1 provides a scatter plot of the residuals versus the fitted values for the base model in table 6.6. The plot indicates that there do not appear to be any outliers among the residuals and that the values are distributed fairly evenly between positive and negative. The distribution of the residuals can be tested for normality using a Shapiro-Wilk test. All regressions are checked using the Shapiro-Wilk test, and in all cases the p-value is large indicating that the hypotheses that the residuals are normal cannot be rejected. The residuals can also be examined for homogeneity in variance through a Cook-Weisberg test. All regressions are examined with the Cook-Weisberg test, and in all cases the p-value is greater than .1 indicating that the hypotheses that the residual variance is homogenous cannot be rejected.



**Figure 6.1 Residual Plot** 

High levels of multicollinearity between independent variables may result in some of the independent variables not being identified as significant predictors. Variance inflation factors may be used to assess the level of multicollinearity, and a typical threshold is that variance inflation factors of less than 10 are generally considered as evidence that multicollinearity is not a significant factor in the model. For the models in table 6.6, we find that the average variance inflation factors are between 1.55 and 1.83 and that the highest variance inflation factor is 2.23. Therefore, this would indicate that it is not likely that multicollinearity is a significant factor in these models.

#### 6.3.3 Shared Strategic Understanding

Shared strategic understanding has been modeled with antecedents that are predicted to help the organization transfer sensitive and latent information. Specifically, the model

focuses on the presence of a clear corporate strategy, executive support for IS and an organizational learning culture. Additionally, information intensity, mutual trust and IS dependence are considered as possible antecedents which may increase the need and willingness to share information. Column A of Table 6.7 contains the results of analysis on the potential antecedents for shared strategic understanding. Similar to the analysis for shared operational understanding, column B of Table 6.7 adds controls for the IS organizational form based on whether the organization reports directly to the CEO, whether the predominant services to the manufacturing unit are provided by a centralized IS service unit, the size of the organization and the length of the relationship between the IS and manufacturing management teams. Column C provides exploratory analysis which separates mutual trust into an IS component and a manufacturing component. Column D further explores trust by examining the three subcomponents for each party: competence, integrity and benevolence. In the exploratory analyses, variables not found to significant in prior models were dropped to save degrees of freedom for the analysis.

	Shared	Shared	Shared	Shared
	Strategic	Strategic	Strategic	Strategic
	(Column A)	Understanding	Understanding	(Column D)
Class Canada Charter	$\frac{\text{(Column A)}}{058,(0,240)}$	(Column B)	(Column C)	(Column D)
Clear Corporate Strategy	.058 (0.349)	.024 (0.708)		
Executive Support for IS	.171 (0.004)***	.189 (0.003)***	.171 (0.004)***	.233 (0.000)***
Organizational Learning				
Culture	.108 (0.030)**	.106 (0.039)**	.108 (0.032)**	.085 (0.089)*
Information Intensity	.032 (0.622)	.005 (0.942)		
Mutual Trust	.343 (0.001)***	.381 (0.001)***		
IS Dependence	.098 (0.170)	.063 (0.394)		
Direct Report to CEO		.273 (0.200)		
Centralized IS		189 (0.302)		
Ln_sales		.047 (0.606)		
Relationship Length		014 (0.573)		
IS Trust of MFG			.127 (0.022)**	
MFG Trust of IS			.125 (0.012)**	
IS Trust of MFG –				
Competence				.054 (0.501)
IS Trust of MFG – Integrity				.087 (0.268)
IS Trust of MFG –				
Benevolence				.102 (0.180)
MFG Trust of IS –				
Competence				135 (0.162)
MFG Trust of IS – Integrity				.292 (0.001)***
MFG Trust of IS –				
Benevolence				.113 (0.197)
$R^2$	.692	.708	.692	.723
Power (alpha = $.05$ )	.99	.99	.99	.99

Regression coefficient shown with p-value in parentheses

\* Denotes significance at 0.10 level, \*\* at 0.05 level and \*\*\* at 0.01 level

# Table 6.7 Shared Strategic Understanding Antecedents<sup>11</sup>

Our models indicate that mutual trust, organizational learning culture, and executive support for IS are significant predictors of shared strategic understanding. Similar to shared operational understanding, we find that manufacturing's perspective on the integrity of the IS unit is the key component of mutual trust which predicts shared strategic understanding in these models. However, unlike shared operational

<sup>&</sup>lt;sup>11</sup> We also examine for outliers and multicolinearity. Examination of residual plots does not find evidence of potential outliers and variance inflation factors for the various models is less than 3.

understanding, we find that the overall level of IS trust in manufacturing is significant in column C.

#### 6.3.4 Impact on Performance

Shared operational understanding and shared strategic understanding are conceptualized as impacting performance due to the ability for an organization to better understand the resources that are available and maximize the efficiency and effectiveness of each resource. The shared understanding concept is a process level measure; therefore, the primary performance impact would be expected in the manufacturing unit performance and the IS unit performance. As manufacturing unit performance is expected to be a primary component of firm performance for our sample, we also examine the impact of shared understanding variables and size measures (revenue and employees) against manufacturing performance, IS organizational quality, perceived IT impact on manufacturing performance, firm performance and alignment between IS and manufacturing.

	MFG	IS	IT Impact	Firm	
	Performance	Quality	on MFG	Performance	Alignment
Shared Operational	.075	.417	.436	748	.326
Understanding	(0.811)	(0.039)**	(0.074) *	(0.009)***	(0.181)
Shared Strategic	.424	.244	.254	.897	.792
Understanding	(0.059) *	(0.200)	(0.269)	(0.001)***	(0.001)***
LN Sales	.108	.034	.433	090	.082
	(0.666)	(0.826)	(.028) **	(0.686)	(0.672)
Age of Facilities	014	007	013	001	002
	(0.550)	(0.628)	(0.477)	(0.993)	(0.921)
Level of Unionization	003	.005	.007	011	001
	(0.720)	(0.325)	(0.308)	(0.162)	(0.929)
$\mathbb{R}^2$	.138	.331	.355	.201	.481
Power (alpha = $.05$ )	.68	.99	.99	.88	.99

Regression coefficient shown with p-value in parentheses

\* Denotes significance at 0.10 level, \*\* at 0.05 level and \*\*\* at 0.01 level

## Table 6.8 Impact of Shared Understanding on Performance<sup>12</sup>

Our results suggest that the levels of shared understanding impact different types of performance. We find that manufacturing performance is significantly associated with shared strategic understanding but not with the shared operational understanding. This finding appears consistent with the prior literature that looks at tacit knowledge transfer as a potential for performance gains, given that culture is a significant predictor of shared strategic understanding. IS quality and perceived IT impact on manufacturing is associated with shared operational understanding but not with the shared strategic understanding. Notably, firm performance is positively associated with shared strategic understanding and negatively associated with shared operational understanding. Additionally, shared strategic understanding is significantly related to alignment in IS and manufacturing plans.

<sup>&</sup>lt;sup>12</sup> Regressions which contain additional controls for industry provide similar results to those shown in Table 6.8.

#### 6.3.5 Shared Understanding as a Mediator

Identification of the antecedents in the model of shared understanding was based on prior literature which considered their relationship with other constructs including alignment and various types of performance measures. We therefore explore the potential for these antecedents to have a direct relationship with the performance variables and for shared understanding to act as a mediator in these relationships. The tests for mediation are based on Baron and Kenny (1986) who propose four steps for testing for mediation. The four steps include:

- The independent variable is shown to be significantly correlated with the dependent variable.
- The independent variable is shown to be significantly correlated with the mediating variable.
- The mediating variable is shown to be significantly correlated with the dependent variable.
- The mediating variable is shown to be significantly correlated with the dependent variable when controlling for the original independent variable. If the coefficient on the original independent variable is not statistically different from zero than its effect is fully mediated, otherwise, if its effect is reduced from the original model than the path is partially mediated.

The results from table 6.6 indicate that overlapping knowledge, joint IS management, mutual trust, formal interface and information intensity were significant in the relationship with shared operational understanding (requirement number 2 of mediation) and their potential relationships with performance measures may be mediated by shared operational understanding. Table 6.7 indicates that shared operational understanding is associated with IS quality, IT impact and firm performance; therefore, the paths between overlapping knowledge, joint IS management, mutual trust, formal interface and information intensity to either IS quality, IT impact, or firm performance are the paths which may be mediated by shared operational understanding (requirement three for mediation). The top set of results in table 6.9 is from regressions where all of the antecedents for shared operational understanding are considered as independent the direct effect of antecedents on performance measures is tested (requirement number 1 for mediation). We find that overlapping knowledge is significant in the relationships with manufacturing performance, IS quality and alignment. Joint IS management is significant in the relationships with firm performance and alignment; whereas, mutual trust is significant in all of the models except for where manufacturing performance is the dependent variable. Formal interface and information intensity are not significant in any of the models.

The bottom set of results in table 6.9 is from regressions which include the antecedents as well as shared operational understanding as independent variables (requirement number four). The bottom set indicates that shared operational understanding is significant for the relationships to IS quality, IT impact and firm performance. Shared operational understanding fully mediates the relationships between overlapping knowledge and IS quality, between mutual trust and IT impact, and between joint IS management and firm performance. Additionally, shared operational understanding partially mediates the relationship between mutual trust and IS quality.

	MFG		IT Impact on	Firm	
	Performance	IS Quality	MFG	Performance	Alignment
Formal IS and Mfg Interface	251 (.181)	.217 (.102)	.028 (.867)	006 (.975)	.119 (.419)
IS Metrics	.063 (.676)	.037 (.730)	009 (.943)	.260 (.092) *	.033 (.780)
MFG Metrics	.704 (.000) ***	016 (.883)	.163 (.233)	.382 (0.14) **	.204 (.092) *
Overlapping Knowledge	.075 (.076) *	.062 (.039) *	018 (.643)	023 (.571)	.081 (.018) **
Joint IS Management	024 (.874)	.034 (.749)	.096 (.490)	292 (.063) *	.252 (.042) **
Information Intensity	075 (.635)	023 (.834)	.180 (.210)	.053 (.740)	.177 (.160)
Mutual Trust	.230 (.274)	.432 (.005) ***	.437 (.024) **	.393 (.066) *	.322 (.056) *
IS Dependence	046 (.779)	141 (.228)	.043 (.770)	.060 (.714)	.099 (.448)
R <sup>2</sup>	0.358	0.418	0.336	0.245	0.615
	MFG		IT Impact on	Firm	
	Performance	IS Quality	MFG	Performance	Alignment
Formal IS and Mfg Interface	309 (.106)	.157 (.234)	056 (.737)	.091 (.624)	.082 (.590)
IS Metrics	.084 (.575)	.059 (.575)	.021 (.874)	.224 (.133)	.048 (.694)
MFG Metrics	.687 (.000) ***	032 (.759)	.141 (.291)	.408 (.007) ***	.194 (.110)
Overlapping Knowledge	.054 (.218)	.041 (.180)	047 (.232)	.009 (.822)	.067 (.059) *
Joint IS Management	113 (.495)	056 (.631)	031 (.832)	146 (.371)	.195 (.145)
Information Intensity	025 (.875)	.027 (.809)	.252 (.080) *	029 (.853)	.209 (.107)
Mutual Trust	.105 (.644)	.305 (.057) *	.259 (.199)	.598 (.009) ***	.242 (.185)
IS Dependence	057 (.726)	151 (.183)	.027 (.847)	.078 (.623)	.092 (.480)
Shared Oper. Understanding	.357 (.172)	.362 (.048) **	.509 (.029) **	585 (.024) **	.229 (.268)
R <sup>2</sup>	0.378	0.455	0.388	0.308	0.623

Regression coefficient shown with p-value in parentheses

\* Denotes significance at 0.10 level, \*\* at 0.05 level and \*\*\* at 0.01 level

#### Table 6.9 Shared Operational Understanding as a Mediator

Similar to the analysis for shared operational understanding, we test direct relationships between the antecedents for shared strategic understanding and the performance variables. The initial analysis in table 6.7 indicated that executive support for IS, organizational learning culture and mutual trust were significant antecedents to shared strategic understanding. We test the relationship between the antecedents and the performance measures in the top series of results shown in table 6.10. These results indicate that executive support for IS is significant in the relationship with alignment and that mutual trust is significant in the relationships with IS quality and IT impact. The bottom set of results in table 6.10 includes the antecedents and shared strategic understanding. We find that shared strategic understanding is significant in the relationships with manufacturing performance and alignment in both table 6.8 and table 6.10. These results indicate that shared strategic understanding fully mediates the

relationship between executive support and alignment; whereas, prior literature has

focused on the direct relationship between executive support and alignment.

	MFG		IT Impact on	Firm	
	Performance	IS Quality	MFG	Performance	Alignment
Clear Corporate Strategy	.413 (.005) ***	.113 (.266)	099 (.419)	.449 (.001) ***	.449 (.000) ***
Executive Support for IS	.058 (.657)	.109 (.244)	.011 (.921)	.009 (.940)	.206 (.022) **
Org. Learning Culture	.187 (.103)	.004 (.957)	.154 (.120)	.024 (.819)	.058 (.445)
Information Intensity	.115 (.451)	.018 (.865)	.256 (.055) *	.084 (.559)	.326 (.002) ***
Mutual Trust	188 (.425)	.428 (.012) **	.461 (.026) **	024 (.913)	.018 (.911)
IS Dependence	351 (.035) **	161 (.169)	.071 (.616)	199 (.198)	018 (.869)
R <sup>2</sup>	.294	0.350	0.335	0.270	.696

	MFG		IT Impact on	Firm	
	Performance	IS Quality	MFG	Performance	Alignment
Clear Corporate Strategy	.384 (.008) ***	.087 (.379)	125 (.305)	.459 (.001) ***	.424 (.000) ***
Executive Support for IS	028 (.838)	.033 (.732)	064 (.589)	.038 (.772)	.133 (.149)
Org. Learning Culture	.132 (.258)	044 (.588)	.105 (.293)	.043 (.700)	.012 (.874)
Information Intensity	.098 (.513)	.003 (.971)	.242 (.065) *	.089 (.536)	.313 (.002) ***
Mutual Trust	362 (.153)	.275 (.123)	.308 (.158)	.034 (.886)	128 (.442)
IS Dependence	400 (.016) *	204 (.078) *	.027 (.847)	183 (.247)	059 (.582)
Shared Strat. Understanding	.507 (.083) *	.447 (.031) **	.444 (.079) *	171 (.539)	.425 (.030) **
R <sup>2</sup>	0.328	0.398	0.368	0.275	0.719

Regression coefficient shown with p-value in parentheses \* Denotes significance at 0.10 level, \*\* at 0.05 level and \*\*\* at 0.01 level

# Table 6.10 Shared Strategic Understanding as a Mediator

#### 6.3.6 Alternative Second Order Configurations

Mutual trust, shared operational understanding and shared strategic understanding are conceived of as second order factors throughout this study. These factors have been operationalized by first creating first order reflective factors for the IS organization and for the manufacturing organization and then creating a second order reflective factor from these two results. We focus on this approach as we believe it is most consistent with prior literature (Ray et al 2005); however, other approaches are discussed in the literature. One alternative approach for creating a second order factor is to use all of the original indicators as indicators to a second order reflective latent factor (Chinn and Gopal 1995). In our case, this approach may result in unequal weights given to the IS and manufacturing parts of the shared understanding component. We do investigate this method and find that the resulting latent variables are highly correlated to the original latent variables and the general pattern of results does not change. Another alternative approach for creating a second order factor is to multiply the latent variable scores for the first order variables (Boynton et al 1994). This approach results in additional variance in the second order factors. We test this method and find that the results are similar to our original model.

With our original implementation of the second order factors we can explore how the antecedents relate to each of the levels of shared understanding. Tables 6.11 and 6.12 are exploratory results examining how the proposed antecedents impact the first order terms of shared operational understanding and shared strategic understanding.

	MFG Understanding of IS Ops <sup>13</sup>	IS Understanding of MFG Ops
Formal Interface	.364 (0.030)**	.021 (0.903)
IS Metrics	.089 (0.508)	241 (0.092)*
Mfg Metrics	179 (0.183)	.305 (0.033)**
Overlapping		
Knowledge	.058 (0.123)	.082 (0.040)**
Joint IS Management	.385 (0.006)***	.225 (0.121)
Information Intensity	116 (0.409)	221 (0.137)
Mutual Trust	.159 (0.390)	.708 (0.001)***
IS Dependence	061 (0.672)	.137 (0.371)
$\mathbb{R}^2$	.452	.468

Regression coefficient shown with p-value in parentheses

\* Denotes significance at 0.10 level, \*\* at 0.05 level and \*\*\* at 0.01 level

### Table 6.11 Antecedents of First Order Operational Understanding

	MFG Understanding	IS Understanding	
	of IS Strategy	of MFG Strategy	
Clear Corporate			
Strategy	.022 (0.774)	.127 (0.391)	
Executive Support for			
IS	.382 (0.001)***	.046 (0.798)	
Org. Learning Culture	.062 (0.507)	.319 (0.042)**	
Information Intensity	.036 (0.774)	.065 (0.754)	
Mutual Trust	.249 (0.198)	.913 (0.006)***	
IS Dependence	.188 (0.161)	.073 (0.741)	
$\mathbf{R}^2$	.501	.346	

Regression coefficient shown with p-value in parentheses

\* Denotes significance at 0.10 level, \*\* at 0.05 level and \*\*\* at 0.01 level

#### Table 6.12 Antecedents of First Order Strategic Understanding

These results indicate that the antecedents of the development of shared understanding may be different for each of the two organizations. Manufacturing's development of an understanding of IS operations appears to be improved by the use of formal interfaces and joint IS management; whereas, IS's understanding of manufacturing's operations

<sup>&</sup>lt;sup>13</sup> Manufacturing's understanding of IS operations and IS strategy are as reported by the IS unit, and the IS units understanding of manufacturing's operations and strategy are as reported by the manufacturing unit.

appear to be aided by overlapping knowledge, mutual trust and manufacturing's use of performance tracking and associated metrics. We also see differences in shared strategic understanding where executive support for IS appears to be the primary for manufacturing to understand the strategic value of IS and organizational learning culture and mutual trust are the key factors for IS understanding of manufacturing strategy. One factor considered in knowledge transfer is a member's position within a social network. The manufacturing organization is likely to be more central in the network; therefore, executive support for IS may be more readily apparent to the manufacturing organization and increase there desire to learn about the IS strategies. Similarly, the learning culture of the organization may result in the manufacturing organization being more willing to share information about their strategies with the IS unit; however, the learning culture may not impact the level of manufacturing understanding of IS strategy as IS is already willing to share with manufacturing due to a perceived subservient relationship. Trust is also a factor which appears to be more important to the IS unit's ability to gain knowledge about the manufacturing unit. Trust may allow the manufacturing unit to be more willing to provide critical information to the IS unit.

#### 6.3.7 PLS Model Results

PLS\*GRAPH is used to test the fully hypothesized model of shared understanding. The methods are similar to the regression framework with the exception that the latent variable scores and the path weights are simultaneously determined. This allows error

from the latent variable measurement to be considered in determining the path weights.

Figure 6.2 provides the results from the PLS model.



Figure 6.2 PLS Test of Antecedents for Shared Operational Understanding and Shared Strategic Understanding

The primary results from the PLS model are very similar to the results from the regression framework. There are some slight differences in level of significance; however, the main significant factors are joint IS management, overlapping knowledge, executive support for IS, organizational learning culture, and mutual trust.<sup>14</sup> We also see similar results between the PLS and the regression models in how the two levels of shared understanding are related to the various performance measures.

The research model also includes the hypotheses that strategic alignment may mediate the relationship between shared understanding and performance. The results, as shown in Figure 6.3, indicate that alignment fully mediates the relationship between shared strategic understanding and manufacturing performance and alignment partially mediates the relationship between shared strategic understanding and firm performance.

<sup>&</sup>lt;sup>14</sup> We also run models with the IS Quality variable separated into manufacturing perceptions and IS perceptions. The results from the manufacturing perception are similar to the overall model; however, models with the IS perceptions as the dependent variable provide a stronger, more significant link to shared strategic understanding.



Ln\_sales, facilities age, and level of unionization included as controls

\* Denotes significance at 0.10 level, \*\* at 0.05 level and \*\*\* at 0.01 level

# Figure 6.3 Test of Strategic Alignment as a Mediator of Shared Understanding on Performance

## 6.3.8 Alternative Model Test

Development of our hypotheses was based on the assertion that the knowledge types are different within shared operational understanding and shared strategic understanding. Based on this assertion, the hypothesized antecedents for shared operational understanding considered governance (IS and business unit) and cognitive ability; whereas, we focused on governance (IS and firm) and willingness (cultural) antecedents for shared strategic understanding. We consider that there may be a possibility for the set of proposed antecedents to impact both levels of shared understanding. Therefore we develop an alternative model where all of the key variables are considered as potential antecedents for both shared operational understanding and shared strategic understanding. Figures 6.4 and 6.5 presents the results from this PLS model.



\* significance at .10 level; \*\* significance at .05 level; \*\*\* significance at .01 level
 Figure 6.4 Alternative Model of Shared Operational Understanding Antecedents<sup>15</sup>



\* significance at .10 level; \*\* significance at .05 level; \*\*\* significance at .01 level

Figure 6.5 Alternative Model of Shared Strategic Understanding Antecedents<sup>16</sup>

<sup>&</sup>lt;sup>15</sup> To test potential lack of significance due to limited power, we run several related models where we eliminate some paths and examine whether other antecedents become significant. We do not find evidence that reduced power is the cause for insignificance.

<sup>&</sup>lt;sup>16</sup> To test potential lack of significance due to limited power, we run several related models where we eliminate some paths and examine whether other antecedents become significant. We do not find evidence that reduced power is the cause for insignificance.
We find that the pattern of significant antecedents to shared operational understanding is the same as those in the original model and we do not find significant results for the paths from corporate strategy, executive support or organizational learning culture. These additional potential antecedents to shared operational understanding were not included in the original model based on the assertion that these factors are more likely to assist in the transfer of tacit knowledge and that shared operational knowledge is more explicit.

We do find additional significant antecedents for shared strategic understanding. Specifically, joint IS management and manufacturing performance metrics are significant antecedents as well as executive support, organizational learning culture, mutual trust and information intensity which were included in the original model. Joint IS management and manufacturing performance metrics were conceived of as governance variables for the relationship between IS and the specific manufacturing unit. These governance variables may affect shared strategic understanding similarly to executive support for IS which was included as a governance variable for the relationship between IS and the firm as a whole. Specifically, joint IS management may also communicate strategic understanding through manufacturing's involvement in budget setting and priority development for the IS unit.

We also note that overlapping knowledge was not found to be a significant antecedent of shared strategic understanding. Overlapping knowledge was included as an antecedent to shared operational understanding as a proxy for the cognitive capability required in transferring the detail knowledge associated with operations. Overlapping knowledge was not included in the original model as an antecedent to shared strategic knowledge based on the assertion that strategic knowledge is less complex and more tacit. We believe that these results and the difference in significant antecedents provide supporting evidence to our initial assertion that the operational and strategic understanding levels are comprised of different types of knowledge.

# 6.3.9 Limitations

The main limitations of this study are based on the response rate and associated sample size; the use of survey-based, self reported data; and the cross-sectional nature of this research design. The sample size is modest for survey-based research but is closer to those studies which require matched pairs from senior management (Ray et al 2005; Sabherwal and Chan 2001). We also perform power analysis on the main OLS models and find that the model power is generally well above the .8 recommended threshold (Cohen 1988). The one exception to our power results is the test of manufacturing performance relative to shared operational understanding and shared strategic understanding where power is .68. This model is rerun without the controls, which were highly insignificant, and the p-value for shared strategic understanding indicates a slightly stronger association; however shared operational understanding is insignificant. The models have also been rerun dropping items that were highly insignificant to account for potential power issues, and the results are generally similar. For each individual

predictor in the main models, we look at the t-value and consider it as a difference of means test. Based on Cohen's discussion of power for difference of means, we find that with our sample size a t-value of .5 would generate a .90 power. We find that the t-values for all the predictors except one are greater than .5 and result in power greater than .9. The one exception is is\_dependence which has a t-value of .38 and power of .71. The results of these tests and the power analysis would conclude that though the sample size is limited, statistical power limitations for the models do not appear to be significant.

An additional limitation is the potential for common method variance as we utilize key informants to provide information about the independent and dependent measures. The Harman one-factor test indicated that the items do load on multiple factors, suggesting that common method variance may be limited. Additionally, the measurement of the shared understanding constructs utilized inputs from both respondents and the measurement of several other variables was based on the averaging of responses from the IS and manufacturing responses. This approach to measurement of these constructs should reduce the potential for common method variance based on one parties responses to independent and dependent measures.

An additional limitation of this research is that it is cross-sectional which limits our ability to investigate how shared understanding and the associated performance gains are developed and sustained. For example, we find a performance increase for firms with shared strategic understanding; however, we are unable to investigate whether this advantage is temporary or sustainable through time. We also find relationships between our proposed antecedents and shared understanding, yet we cannot consider causality between these antecedents and the levels of shared understanding. A longitudinal study may help understand how the development of shared operational understanding and shared strategic understanding affect each other.

# **CHAPTER 7**

# **RESEARCH SUMMARY**

Manufacturing organizations are currently investing increasing amounts on information technology to assist their ability to compete. Resource-based logic argues that it is not the level of investment that creates competitive advantage; rather, it is how organizations use and combine these resources to provide a unique capability. These research focuses on how organizations are able to create a shared understanding between the IS and manufacturing units and the impact of the shared understanding.

The primary contribution of this research is to develop and test a model of potential antecedents on shared understanding. This research utilizes knowledge management and organizational learning literature to build an initial framework and develops a specific research model from prior work on the business-IS relationship. We are also able to provide a contribution to the literature focused on knowledge transfer by considering how the antecedents relate to the different types of shared knowledge. We also believe that there are contributions to practitioners who are attempting to create greater levels of shared understanding in their organizations. Testing the associations of the proposed

antecedents in a single model allows managers to understand how different governance choices may interact and allow managers to focus on a few drivers.

Similarly to prior literature, we find that many factors individually are correlated with shared understanding. However, the separation of shared understanding into strategic and operational levels as well as the inclusion of these factors in a consolidated model reveals that some factors may be more significant. Specifically, we find that factors such as management support for IS, mutual trust and organizational learning culture are the primary factors in shared strategic understanding and overlapping knowledge, joint IS management and mutual trust are the key antecedents for shared operational knowledge. We believe that these findings are consistent with the knowledge transfer and organizational learning literature which suggests that willingness (mutual trust and learning culture), ability (overlapping knowledge) and governance (executive support for IS and joint IS management) are the key factors in exchanging knowledge within an organization. These results also appear to be consistent with the literature that argues that the strength of the antecedents may be impacted by the type of knowledge which is being shared. In the full model tests, we find that overlapping knowledge is significant for transfer of operational understanding but not significant for shared strategic knowledge. Similarly, we find that organizational learning culture is significant in the relationship with shared strategic understanding but not for shared operational understanding. We believe these results are consistent with our assertion that the shared operational

understanding is more complex and relies more on the cognitive antecedents; whereas, shared strategic understanding is more tacit and the cultural antecedents are stronger in this relationship.

We also further examine the influence of overlapping domain knowledge and mutual trust. We find that the level of IS knowledge of manufacturing appears to be the significant factor rather than the level of manufacturing knowledge of IS. This may imply that organizations should focus investments in training IS personnel on manufacturing concepts and processes, and it may provide implications to hiring and rotation programs for IS personnel. We also find that within mutual trust, manufacturing's perception of IS integrity appears to be a key factor in shared understanding. Additionally, competence does not appear to be significant. These results may indicate that manufacturing's perceptions of trust and willingness to work with IS is based on the openness of the communications rather than the success of the past.

This research also considers the impact on various forms of performance. We find that the shared strategic understanding is a significant factor in strategic alignment, and that alignment mediates the relationship between shared strategic understanding and manufacturing performance. We believe these findings indicate that understanding how IT can effect manufacturing operations allows managers to determine the type of resources that provide performance benefits for the manufacturing unit. Similarly, shared operational understanding is positively related to IS quality and perceived IT impact on manufacturing. This indicates that detailed understanding of operations may relate to the ability to improve IS service as one tool which may be combined with manufacturing skills and processes. We also find that shared operational understanding and shared strategic understanding are related to firm performance; however, there are many different drivers which may impact overall firm performance and lead to this association.

Unique to this study has been the ability to explore the impact of the antecedents on each party's level of shared understanding. We find that the significant antecedents are different for each group with IS's understanding developed more through ability (overlapping knowledge and metrics) and willingness (trust and learning culture); whereas, manufacturing understanding of IS are impacted more by the governance factors (executive support for IS and joint IS management). One reason for this difference in the significant antecedents may be the view that IS is the junior player in the IS and manufacturing relationship; therefore, IS needs the willingness of manufacturing to share information and manufacturing uses the governance factors to evaluate IS capabilities against other investments. This perspective may be evidenced in our sample as only approximately a quarter reports directly to the CEO. Additionally, conversations with manufacturing and IS managers indicated that IS exists to serve manufacturing and IS investments are evaluated by their potential impact on manufacturing performance. Future research may further explore the significant antecedents which impact each party's level of shared understanding.

This research on shared understanding focuses on understanding potential antecedents of shared understanding and how the levels of shared understanding may impact performance. Future research may extend this work and be able to consider how shared understanding develops over time and if there is significance in whether shared operational or shared strategic understanding may lead to a desire to gain more shared operational understanding to learn how to implement the shared strategy. Alternatively, shared operational understanding may provide insights into current inefficiencies which may lead to shared strategic understanding in an attempt to improve the type of resources which are developed. Additionally, future research may wish to determine if the antecedents are similar in other industries where the relationship between information technology and the key process area for that industry may be difference in the importance of governance activities relative to cognitive and culture aspects.

# REFERENCES

- Amit, R., and Schoemaker, P. J. "Strategic Assets and Organizational Rent," *Strategic Management Journal*, 14 (1), January 1993, pp. 33-46.
- Anthony, R.N. Planning and control systems: A framework for analysis, 1965, Boston: Harvard University Press.
- Argyris, C. and Schön, D. Theory in practice: Increasing professional effectiveness, 1974, San Francisco: Jossey-Bass.
- Argote, L., McEvily, B., Reagans, R. "Managing Knowledge in Organizations: An integrative Framework and Review of Emerging Themes", *Management Science*, April 2003, pp.571-582.
- Bain, J.S. Industrial Organization, 1959, New York: Wiley.
- Baron, R. M., and Kenny, D. A. "The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations." *Journal* of Personality and Social Psychology, 51, 1986, pp. 1173-1182.
- Barney, J. "Firm Resources and Sustained Competitive Advantage," *Journal of Management*, 17 (1), March 1991, pp. 99-120.
- Barney, J. "Organizational Culture: Can it be a source of sustained competitive advantage," *Academy of Management Review*, 11 (3), July 1986, pp.656-665.
- Barua, A., Kriebel, C., and Mukhopadhyay, T. "Information Technology and Business Value: An Analytic and Empirical Investigation", *Information Systems Research*, 6 (1), March 1995, pp. 3-23.
- Bassellier, G., Reich, B., and Benbasat, I., "Information Technology Competence of Business Managers: A Definition and Research Model", *Journal of Management Information Systems*, 17 (4), Spring 2001, pp. 159-182.
- Bassellier, G., Benbasat, I., and Reich, B. "The Influence of Business Managers' IT Competence on Championing IT", Information Systems Research, 14 (4), December

2003, pp. 317-336.

- Bassellier, G. and Benbasat, I., "Business Competence of Information Technology Professionals: Conceptual Development and Influence on IT-Business Partnerships", *MIS Quarterly*, forthcoming.
- Bharadwaj, A. "A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation," *MIS Quarterly*, 24 (1), March 2000, pp. 169-196.
- Bharadwaj, A.S., Sambamurthy, V., and Zmud, R.W. "IT Capabilities: Theoretical Perspectives and Empirical Operationalization", International Conference on Information Systems, 1999, pp. 378-385.
- Birkinshaw, J., Nobel, R., and Ridderstrale, J. "Knowledge as a Contingency Variable: Do the Characteristics of Knowledge Predict Organization Structure", *Organization Science*, May 2002, pp. 274-289
- Boynton, A.C., Zmud, R.W. and Jacobs, G.C. "The Influence of IT Management Practice on IT Use in Large Organizations", *MIS Quarterly*, September 1994, pp. 299-318
- Broadbent, M. and Weill, P., "Improving Business and Information Strategy Alignment: Learning from the banking industry," *IBM systems Journal*, 32(1), 1993, 162-179
- Brown, C.V. and Magill, S.L., "Alignment of the IS functions with the enterprise: toward a model of antecedents," *MIS Quarterly*, 18(43), 1994, 371-403
- Brynjolfsson, E., and Hitt, L. "Paradox lost? Firm-level evidence on returns to information systems spending," *Management Science* (42:4), April 1996, pp.541-558
- Burton, R., Lauridsen, J. and Obel, B. "The Impact of Organizational Climate and Strategic Fit on Firm Performance", *Human Resource Management*, Spring 2004, pp.67-82
- Campbell, D., and Fiske, D. "Convergent and divergent discriminant validation by the multitrait-multi-method matrix", *Psychological Bulletin*, 56, 1959, pp. 81-105.
- Chan, Y.E. and Huff, S.L., "Strategic information systems alignment," *Business Quarterly*, Autumn 1993, 51-55.
- Chan, Y.E., Huff, S.L., Barclay, D.W., and Copeland, D.G., "Business strategic orientation, information systems strategic orientation, and strategic alignment," *Information Systems Research*, 8(2), 1997, 125-150.

- Chin, W.W., "Issues and Opinion on Structural Equation Modeling," MIS Quarterly, 22(1), March 1998, pp.
- Chin, W. W., and Gopal, A. "Adoption Intention in GSS: Importance of Beliefs." *Data Base Advances*, Volume 26, 1995, pp. 42-64.
- Cleveland, G., Schroeder, R. and Anderson, J., "A Theory of Production Competence", *Decision Sciences*, Fall89, 20 (4), pp. 655-668.
- Cohen, J. Statistical Power Analysis for Behavioral Sciences, Lawrence Erlbaum Associates, Hillsdale, NJ, 1988
- Cohen, W.M. and Levinthal, D.A. "Absorptive Capacity: A New Perspective on Learning and Innovation", *Administrative Science Quarterly*, 35 (1990), pp.128-152.
- Cyert, R. and March, J. A behavioral theory of the firm, 1963, Englewood Cliffs, NJ: Prentice-Hall.
- DeCotiis, T.A. and Koys, D.J. "Identification and Measurement of the Dimensions of Organizational Climate," *Proceedings*, National Meeting of the Academy of Management, Detroit, MI, 1980, pp. 171-175
- Dedrick, J., Gurbaxani V., and Kraemer, K. L. "Information Technology and Economic Performance: A Critical Review of the Empirical Evidence," ACM Computing Surveys (35:1), March 2003, pp.1-28
- Delone, W.H. and Mclean, E.R., "Information System success: The Quest for the Dependent Variable", *Information Systems Research*, Vol. 3, No. 1, March 1992, pp.60-95
- Dyer, J.H., and Sing, H. "The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage", *Academy of Management Review*, 23 (4), October 1998, pp. 660-679.
- Feeny, D. and Willcocks, L. "Re-designing the IS Function around Core Capabilities", Long Range Planning, 31(3), 1998, pp.354-367
- Fisher, R., Elliot, M. and Jaworski, B. "Enhancing Communication Between Marketing and Engineering: The Moderating Role of Relative Functional Identification", *Journal of Marketing*, July 1997, pp. 54-70
- Garratt, B, "The Learning Organization: Developing Democracy at Work", Harper Collins Publishers, 2001

- Gefen, D. and Straub, D. "A Practical Guide to Factorial Validity Using PLS-GRAPH: Tutorial and Annotated Example", *Communications of the Association for Information Systems*, 16, 2005, pp. 91-109
- Grant, R. (1996). 'Towards a knowledge-based theory of the firm', *Strategic Management Journal*, Winter Special Issue, 17, pp. 109-122
- Harman, H. H. (1976). *Modern Factor Analysis*. University of Chicago Press. Chicago. IL.
- Henderson, J.C. "Plugging into Strategic Partnerships: The Critical IS Connection", *Sloan Management Review*, Spring 1990, pp. 7-18
- Henderson, J.C. and Venkatraman, N., "Strategic alignment: Leveraging information technology for transforming organizations," *IBM Systems Journal*, 32(1), 1993, 4-16
- Hoegl, M., Parboteeah, K., Munson, C. "Team-Level Antecedents of Individuals Knowledge Networks", *Decision Sciences*, Fall 2003, 34 (4), pp. 741-770
- Hoopes, D. and Postrel, S. "Shared Knowledge, Glitches, and Product Development Performance", *Strategic Management Journal*, 20, 1999, pp. 837-865
- Huber, G. "Organizational Learning: The Contributing Processes and the Literature", *Organization Science*, February 1991, pp.88-115
- Jarvenpaa, S. L., and Leidner, D. E. "An Information Company in Mexico: Extending the Resource-Based View of the Firm to a Developing Country Context," *Information Systems Research* (9:4), 1991, pp. 342-361
- Jarvenpaa, S. L. and Ives, B. "Executive involvement and participation in the management of information technology," *MIS Quarterly* (15:2), June 1991, pp. 205-227.
- Jayaram, J., Droge, C., and Vickery, S., "The impact of human resource management practices on manufacturing performance", *Journal of Operations Management*, 18 (1), December 1999, pp. 1-20.
- Kearns, G. and Lederer, A., "The effect of strategic alignment on the use of IS-based resources for competitive advantage," *Journal of Strategic Information Systems*, 9(4), 2000, 265-293
- Kearns, G. and Lederer, A., "Strategic IT alignment: A model for competitive advantage," ICIS 2001, 1-12.

- Kearns, G. and Lederer, A., "A Resource-Based View of Strategic IT Alignment: how Knowledge Sharing Creates Competitive Advantage," *Decision Sciences*, 34(1), Winter 2003
- Kessler, E., Bierly, P., and Gopalakrishnan, S. "Internal vs External Learning in New Product Development: Effects on Speed, Costs and Competitive Advantage", *R&D Management*, 30 (3), 2000, pp. 213-223
- Ketokivi, M. and Schroeder, R. "Manufacturing practices, strategic fit and performance: A routine-based view," *International Journal of Operations & Production Management*, 24 (2), 2004, pp.171-191.
- King, W.R. and Teo, T.S.H., "Integration between business planning and information system planning: Validating a stage hypothesis," *Decision Sciences*, 28(2), 1997, 279-308
- Koys, D. and DeCotiis, T. "Inductive Measures of Psychological Climate", *Human Relations*, 44(3), 1991, pp. 265-285
- Lane, P. and Lubatkin, M. "Relative absorptive capacity and interorganizational learning", *Strategic Management Journal*, 19, May 1998, pp. 461-477
- Levin, D., and Cross, R. "The Strength of Weak Ties you can Trust: The Mediating Role of Trust in Effective Knowledge Transfer", forthcoming in *Management Science*
- Lipshitz, R., Popper, M. and Oz, S. "Building Learning Organizations: The Design and Implementation of Organizational Learning Mechanisms", *Journal of Applied Behavioral Science*, 32(3), 1996, pp.292-305
- Luftman, J. and Brier T., "Achieving and sustaining business-IT alignment," *California Management Review*, 42(1), 1999, 109-122
- Luftman, J.N., Lewis, P.R. and Oldach, S.H., "Transforming the enterprise: the alignment of business and information technology strategies," *IBM Systems Journal*, 32(1), 1993, 198-221.
- Marsick, V. and Watkins, K. "Demonstrating the Value of an Organization's Learning Culture", *Advances in Developing Human Resources*, 5 (03), May 2003, pp.132-151.
- Mason, E. "The Current State of Monopoly Problem in the U.S.", Harvard Law Review, 1949, 62, pp.1265-1285.

- Mata, F., Fuerst, W. and Barney, J. "Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis", *MIS Quarterly*, December 1995, pp. 487-505
- McKnight, D. H.; Choudhury, V.; and Kacmar, C. "Developing and Validating Trust Measures for e-Commerce: An Integrative Typology," Information Systems Research (13:3), September 2002, pp. 334-359.
- Menon, T. and Pfeffer, J. "Valuing Internal vs External Knowledge: Explaining the Preference for Outsiders", *Management Science*, April 2003, pp.497-513
- Melville, N., Kraemer, K., and Gurbaxani, V. "Information Technology and Organizational Performance: An Integrative Model of IT Business Value," *MIS Quarterly* (28:2), June 2004, pp. 283-322.
- Nadler, J., Thompson, L., and Van Boven, L. "Learning Negotiation Skills: Four Models of Knowledge Creation and Transfer", *Management Science*, April 2003, pp. 529-540
- Nelson, K.M. and Cooprider, J.G. "The Contribution of Shared Knowledge to I/S Group Performance", *MIS Quarterly*, December 1996
- Nelson, R.R. and Winter, S.G. An Evolutionary Theory of Economic Change, 1982, Belknap Press of Harvard University Press: Cambridge, MA
- Downey, R.G. and King, C.V. "Missing data in Likert ratings: a comparison of replacement methods method for measuring attitudes developed by R. Likert", Journal of General Psychology, April 1998
- Nunnally, J.C. "Psychometric Theory", Mc-Graw Hill, New York, 1967.
- Okhuysen, G.A. and Eisenhardt, K.M. "Integrating Knowledge in Groups: How Formal Interventions Enable Flexibility", *Organization Science*, July 2002, pp. 370-386
- Olson, M.H. and Chervany, N.L. "The Relationship Between Organizational Characteristics and the Structure of the Information Services Function", *MIS Quarterly*, June 1980, pp. 57-68
- Pawlowsky, P. "The Treatment of Organizational Learning in Management Science", in Handbook of Organizational Learning and Knowledge, edited by Dierkes, M, Antal, B., Child, J. and Nonaka, I, Oxford, Oxford University Press, 2001
- Phillips, L. "Assessing Measurement Error in Key Informant Reports. A Methodological Note on Organizational Analysis in Marketing", *Journal of Marketing Research*, 18, November 1981, pp.395-415.

- Pinto, M., Pinto, J., and Prescott, J. "Antecedents and Consequences of Project Team Cross-functional Cooperation," *Management Science*, 39 (10), October 1993, pp. 1281-1297.
- Porter, M.E. Competitive Strategy, 1980. New York: Free Press.
- Powell, T. "Organizational Alignment as competitive advantage", *Strategic Management Journal*, 13, 1992, pp.119-134.
- Powell, T. "Total Quality Management as competitive advantage: A review and empirical study," *Strategic Management Journal* (16:1), 1995, pp.15-37.
- Powell, T., and Dent-Micallef, A. "Information Technology as Competitive Advantage: The Role of Human, Business and Technology Resource," *Strategic Management Journal* (18:5), 1997, pp.375-405.
- Pyburn, P., "Linking the MIS plan with corporate strategy: An exploratory study," *MIS Quarterly*, 7(2), 1983, 1-14.
- Ranganathan, C. and Sethi, V. "Rationality in Strategic Information Technology Decisions: The Impact of Shared Domain Knowledge and IT Unit Structure," *Decision Sciences* (33:1), Winter 2002, pp. 59-86.
- Ravichandran, T. and Lertwongsatien, C. "Impact of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective", *Proceedings Twenty Third International Conference on Information Systems*, New Orleans, La., 2002, pp. 577-582.
- Ray, G., Barney, J., and Muhanna, W. "Capabilities, Business Processes, and Competitive Advantage: Choosing the Dependent Variable in Empirical Tests of the Resource-Based View", *Strategic Management Journal*, January 2004, pp. 23-38.
- Ray, G., Muhanna, W. A., and Barney, J. B. "Information Technology and the Performance of the Customer Service Process: A Resource-Based Investigation," *MIS Quarterly*, 29(4), December 2005, pp. 625-651.
- Reich, B. H. and Benbasat, I., "Measuring the linkage between business and information technology objectives," *MIS Quarterly*, 20(1), 1996, 55-81.
- Reich, B. H. and Benbasat, I., "Factors that influence the social dimension of alignment between business and information technology objectives," *MIS Quarterly*, 24(1), 2000, 81-111.

- Rockart, J. "The Line Takes the Leadership IS Management in a Wired Society", *Sloan Management Review*, 1988, 29 (4), pp.55-64.
- Ross, J.W., Beath, C.M., and Goodhue, D.L. "Developing Long-Term Competitiveness through IT Assets", *Sloan Management Review*, Fall 1996, pp. 31-42.
- Sabherwal, R. and Chan, Y. E., "Alignment between business and IS strategies: A study of Prospectors, Analyzers, and Defenders," *Information Systems Research*, 12(1), 2001, 11-33.
- Sabherwal, R., Hirscheim, R. and Goles, T., "The Dynamics of Alignment: Insights from a Punctuated Equilibrium Model," *Organization Science*, 12(2), 2001, 179-197.
- Sambamurthy, V. and Zmud, R.W. IT Management Competency Assessment: A Tool for Creating Business Value Through IT, 1994, Morristown, NJ: Financial Executives Research Foundation.
- Schlegelmilch, B. and Chini, T. "Knowledge transfer between marketing functions in multinational companies: a conceptual model", *International Business Review*, 12 (2), Apr2003, pp. 215-232.
- Schroeder, R., Bates, K., and Junttila, M., "A Resource-based View of Manufacturing Strategy and the Relationship to Manufacturing Performance", *Strategic Management Journal*, Feb2002, 23 (2), pp. 105-117.
- Simonin, B.L. "Ambiguity and the Process of Knowledge Transfer in Strategic Alliances", *Strategic Management Journal*, 20, 1999, pp.595-623.
- Sividas, E and Dwyer, F.R. "An Examination of Organizational Factors Influencing New Product Success in Internal and Alliance Based Processes", *Journal of Marketing*, January 2000, pp.31-49.
- Soh, C., and Markus, M. L. "How IT Creates Business Value: A Process Theory Synthesis," in *Proceedings of the International Conference on Information Systems*, Amsterdam, The Netherlands, 1995, pp. 29-42
- Szulanski, G. "Exploring Internal Stickiness: Impediments to the Transfer of Best Practices Within the Firm", *Strategic Management Journal*, Winter 1996, pp.27-43
- Teo, T.S.H. and Ang, J., "Critical success factors in the alignment of IS plans with business plans," *International Journal of Information Management*, 19(2), 1999, 173-185

- Tsai, W. "Knowledge Transfer in Intraorganizational Networks: Effects of Network Position and Absorptive Capacity on Business Unit Innovation and Performance", *Academy of Management Journal*, 44 (5), 2001, pp.996-1004
- Van den Bosch, F., van Wijk, R., and Volberda, H. "Absorptive Capacity: Antecedents, Models and Outcomes", in The Blackwell Handbook of Organizational Learning and Knowledge Management edited by Easterby-Smith, M. and Lyles. M., 2003, Malden, MA : Blackwell Publishing.
- Van den Bosch, F., Volberda, H., and de Boer, M. "Coevolution of Firm Absorptive Capacity and Knowledge Environment: Organizational Forms and Combinative Capabilities", *Organization Science*, September 1999, pp. 551-568
- Vickery, S. "A Theory of Production Competence Revisited", *Decision Sciences* (22:3), July 1991, pp. 635-643.
- Wade, M.W., and Hulland, J. "The Resource-Based View and Information Systems Research: Review, Extension, and Suggestions for Future Research," *MIS Quarterly* (28:1), March 2004, pp.107-142
- Wernerfelt, B. "A Resource-based View of the Firm," *Strategic Management Journal* (5:2), April-June 1984, pp.171-180
- Weill, P., and Ross, J.W. IT Governance: How Top Performers Manage IT Decision Rights for Superior Results, 2004, Boston: Harvard Business School Press.
- Xia, W. and King, W.R. "Determinants of Organizational IT Infrastructure Capabilities: An Empirical Study", Working Paper, The University of Minnesota, 2002.
- Yang, B. "Identifying Valid and Reliable Measures for Dimensions of a Learning Culture", Advances in Developing Human Resources, 5 (03), May 2003, pp. 152-161.
- Yeoh, P. and Roth, K. "An empirical analysis of sustained advantage in the US pharmaceutical industry: impact of firm resources and capabilities," *Strategic Management Journal* (20:7), July 1999, pp.637-653
- Zander, U. and Kogut, B. "Knowledge and the Speed of the Transfer and Imitation of Organizational Capabilities: An Empirical Test", *Organization Science*, January 1995, pp.76-92
- Zahra, S. and George, G. "Absorptive Capacity: A Review, Reconceptualization, and Extension", *Academy of Management Review*, 27:2, 2002, pp. 185-203

# **APPENDIX A**

Author	Element of	Description	Findings
	Interest		
Levin and Cross, forthcoming	Social Characteristics	Investigate the relationship between strong / weak ties between two parties and the receipt of useful knowledge.	The link between strong ties and receipt of useful knowledge is mediated by trust. Competence- based trust was especially important for receipt of tacit knowledge.
Kessler et al, 2000	Social Characteristics	Investigated the effect of internal vs external collaborative partners on the ability to innovate, specifically the time and cost to complete projects.	Identified increased time to complete R&D efforts, however, did not find a statistically significant relationship with costs.
Schlegelmich and Chini 2003	Social and Cognitive Characteristics	Developed propositions and a theoretical model of knowledge transfer effectiveness.	Key factors include organizational distance, cultural distance, strategic mandate, ability to engage in knowledge transfer (knowledge stock and absorptive capacity) and development of knowledge transfer capabilities
Tsai, 2001	Social and Cognitive Characteristics	Investigated the effect of the entity's network position and their absorptive capacity on business unit innovation and performance	Network position, absorptive capacity and the interaction were significantly associated with innovation; however, less significant findings with performance as the dependent variable.
Fisher et al., 1997	Social and Routine Characteristics	Examined the communication between marketing and engineering and the effects of information sharing norms (organizational guidelines and expectations that foster the free exchange of information), integrated goals and relative functional identification (a sense of connection to the function compared to the organization as a whole).	The authors find that relative functional identification has a moderating role, and that the choice of information sharing strategy (norms or integrated goals) should be dependent on relative functional identification. Additionally, the authors indicate that bidirectional communication is as important as frequency in increasing information use.

# Examples of Management Studies on Knowledge Transfer / Sharing

Author	Element of	Description	Findings
Okhuysen and Eisenhardt 2002	Routines	Experimentally investigated the effects of formal interventions during the knowledge exchange. The formal interventions studied include: Information Sharing, Questioning Others, and Managing Time.	Simple formal interventions associated with improved knowledge integration
Menon and Pfeffer, 2003	Cognitive Characteristic	The authors study how managers value knowledge from internal and external sources. Paper focuses on two case studies and additional survey data.	Identify preferences for external knowledge which may be attributed to the scarcity of this knowledge.
Van den Bosch, Volberda, and de Boer 1999	Cognitive and Routine Characteristics	Develops propositions about the associations between organizational form (grouping of activities and hierarchical levels) and absorptive capacity and between combinative capabilities and dimensions of knowledge integration (efficiency, scope, and flexibility).	Theoretical discussion only on influencers of absorptive capacity.
Lane and Lubatkin, 1998	Cognitive Characteristics	Studied a series of alliances between pharmaceutical and biotechnology firms. Examined the impact of absorptive capacity and similar knowledge levels and processing systems between the alliance partners.	Absorptive capacity identified as a predictor of organizational learning as well as relative similarities in knowledge levels and knowledge processing systems.
Szulanski, 1996	Social and Cognitive Characteristics	Examined causes that impede transfer of best practices within the organization. Studied the effects from characteristics of the knowledge, characteristics of the source of the knowledge, characteristics of the recipient, and characteristics of the context.	The study findings show the major barriers to internal knowledge transfer include the recipient's absorptive capacity, causal ambiguity, and an arduous relationship.
Simonin, 1999	Social Characteristics	Investigates the effect of knowledge ambiguity and its antecedents – tacitness, asset specificity, prior experience, complexity, partner protectiveness, cultural distance, organizational distance – on technological knowledge transfer.	Identifies knowledge ambiguity as mediator between antecedents and knowledge transfer. Additional moderating effects from collaborative know-how (defined as experience and expertise in interfirm cooperation and operationalized as self-rated knowledge on alliance concepts), learning capacity (operationalized as commitment of resources) and alliance duration.

Author	Element of	Description	Findings
	Interest		
Sivadas and Dwyer 2000	Social and Routine	Developed the concept of cooperative competency which was defined as the composite of three interrelated facets: trust, communication, and coordination.	Formalized and clannish administration, mutual dependence and institutional support are identified as antecedents of cooperative competency.
		Proposed model of cooperative competency based on governance structure (internal vs external), administrative mechanism (decentralized, formalism, or clan), partner type (competitor vs non- competitor), mutual dependence, innovation type, and institutional support.	
Nadler et al., 2003	Routines	Experimentally tested the impact of four learning methods (didactic learning, information revelation, analogical revelation, observational learning) on learning negotiation skills.	Identified that observational learning and analogical learning led to negotiated outcomes that were more favorable for both parties.

# **APPENDIX B**

# SURVEY INSTRUMENTS

The survey instruments for the information systems and manufacturing processes are included on the next few pages. The following table provides a reference between the variables included in the study and the original items within each instrument.

*Note*: As described in chapter 6, some items were dropped due to low loadings or high crossloadings. The items that were dropped are: A12, B14, C2, F12 as well as the manufacturing dependence items due to high correlation with information intensity.

Construct	Mfg Items	IS Items	Prior Literature
			Boynton et al 1994; Ray et al
			2005; Nelson & Cooprider
Shared Operational Understanding	F.1-3;F.7-9;F12	F.1-3;F.7-9;F12	1996
			Boynton et al 1994; Sividas &
			Dwyer 2000; Ranganathan &
Formal IS & Bus Interface	C.1-C.3	C.1-C.3	Sethi 2002
Performance Reviews and Tracking	B.6-B.8	B.6-B.8	New
			Bassilier 2001; Cleveland et
Overlapping Knowledge	E.1-E.4	E.1-E.5	al 1989; Vickery 1991
Joint IS Mgmt	B.1-B.5	B.1-B.5	Ranganathan & Sethi 2002
			Sividas & Dwyer 2000;
			Nelson &Cooprider 1996;
Mutual Trust	C.4-C.9	C.4-C.9	McKnight et al 2002
Information Intensity	B.9-B.11	B.9-B.11	Kearns & Lederer 2000
Dependence	B.12-B.13	B.12-B.14	Sividas & Dwyer 2000
			Boynton et al 1994; Ray et al
			2005; Nelson & Cooprider
Shared Strategic Understanding	F.4-6;F.10-11	F.4-6;F.10-11	1996
Clear, Corp. Strategy	A.1-A.4	A.1-A.4	Kearns & Lederer 2000
Executive Support for IS	A.5-A.9	A.5-A.9	Jarvenpaa & Ives 1991
Organizational Learning Culture	D.1-D.7	D.1-D.7	Marsick & Watkins 2003
Business Performance	G.1-G.3	G.1-G.3	Powell & Dent-Micallef 1997
Mfg Performance	G.4-G.8	N/A	Jayaram et al 1999
IS Performance	G.12-G.13	G.4-G.5	Nelson & Cooprider 1996
IT Impact	G.9-G.11	N/A	Ray et al 2005
Strategic Alignment	A.10-A.14	A.10-A.14	Kearns & Lederer 2000

Thank you for participating in our study on the relationship between information systems units and manufacturing units, and its affect on firm performance. The survey consists of **four** pages of questions. You may leave a question blank if you do not wish to answer it, but where possible, an estimate is best for our purposes.

This survey may also be completed online at:

### http://fisher.osu.edu/people/stoel\_2/websurvey/cover.htm.

The data collected in this study will remain strictly confidential, and study results will only be reported in the aggregate. If you wish to receive a copy of the results of our study with comparisons of your scores relative to industry averages, please enter your name, title and email address.

Name:	
Title:	
Company:	
Email:	

When completed, the survey may be returned in the included business response envelope, or faxed to Prof. Waleed Muhanna at 614-292-2118, or sent to: Prof. Waleed Muhanna, 420 Fisher Hall, Fisher College of Business, 2100 Neil Avenue, Columbus, OH 43210.

For this survey, the manufacturing unit refers to the organization(s) responsible for production of the primary product line and the IS unit refers to the organization(s) providing information systems services.

## A. Business and Information Systems (IS) Planning

Please indicate the extent to which you agree with the following statements. Not at all = 1 A little = 2 Moderately = 3 Greatly = 4 Very Great = 5

1.	We have a formal, strategic business plan for the company.	1	2	3	4	5
2.	The company's strategic plan is clear and understandable.	1	2	3	4	5
3.	The company's strategic plan defines the company's mission, goals and objectives.	1	2	3	4	5
4.	The company's strategic plan defines key assumptions and alternatives.	1	2	3	4	5
5.	Top executive management recognizes the strategic potential of IS.	1	2	3	4	5
6.	Top executive management is committed to the IS function.	1	2	3	4	5
7.	Top executive management is knowledgeable about our information assets and opportunities	1	2	3	4	5
8.	Top executive management recognizes that IS is critical to the company's success.	1	2	3	4	5
9.	Top executive management views IS spending as a strategic investment.	1	2	3	4	5
10.	We have a formal, strategic plan for manufacturing.	1	2	3	4	5
11.	The strategic manufacturing plan identifies IS needs.	1	2	3	4	5
12.	We have a formal, strategic plan for IS.	1	2	3	4	5
13.	The strategic IS plan refers to initiatives and objectives in the strategic manufacturing plan.	1	2	3	4	5
14.	IS planning is integrated with the strategic manufacturing planning process.	1	2	3	4	5

**B.** Perception of the Relationship between Manufacturing and Information Systems Units – section I *Please indicate the extent to which you agree with the following statements.* 

Not at all = 1 A little = 2 Moderately = 3 Greatly = 4 Very Great = 5

1.	Manufacturing personnel are actively involved in decisions about information technology infrastructure (hardware, networks and technology platforms).	1	2	3	4	5
2.	Manufacturing personnel are actively involved in IS unit's budget development.	1	2	3	4	5
3.	Manufacturing personnel are actively involved in establishing IS unit priorities.	1	2	3	4	5
4.	Manufacturing personnel are actively involved in choosing business application software.	1	2	3	4	5
5.	Manufacturing personnel are actively involved in IS project management decisions.	1	2	3	4	5
6.	Descriptions of IS services and performance targets have been developed.	1	2	3	4	5
7.	Actual performance metrics for the IS unit are measured and tracked.	1	2	3	4	5
8.	Actual performance results for the IS unit are reviewed with the manufacturing unit.	1	2	3	4	5
9.	The success of our manufacturing unit relies on access to a high quantity of information.	1	2	3	4	5
10.	Information used in our manufacturing operations requires frequent updating.	1	2	3	4	5
11.	Our manufacturing operations require accurate information.	1	2	3	4	5
12.	Manufacturing unit resources and support are important factors in achieving IS unit goals.	1	2	3	4	5
13.	The manufacturing unit resources and support would be difficult for the IS unit to replace.	1	2	3	4	5
14.	Manufacturing unit performance is an important determinant in IS personnel compensation.	1	2	3	4	5

For this survey, the manufacturing unit refers to the organization(s) responsible for production of the primary product line and the IS unit refers to the organization(s) providing information systems services.

#### C. Perception of the Relationship between Manufacturing and Information Systems Units – section 2

Please indicate the extent to which you agree with the following statements. Not at all = 1 A little = 2 Moderately = 3 Greatly = 4 Very Great = 5

1.	Standard operating rules and procedures are utilized extensively in making decisions regarding the manufacturing and IS relationship.	1	2	3	4	5
2.	Disagreements in the IS and manufacturing relationship are resolved by a third party.	1	2	3	4	5
3.	Written procedures are followed in most aspects of the manufacturing and IS relationship.	1	2	3	4	5
4.	The manufacturing unit is a capable and proficient unit.	1	2	3	4	5
5.	The manufacturing unit possesses the appropriate skills to work effectively.	1	2	3	4	5
6.	The manufacturing unit works with the IS unit openly and honestly.	1	2	3	4	5
7.	The manufacturing unit displays ethical behavior and integrity.	1	2	3	4	5
8.	We trust that decisions made by the manufacturing unit will be in the IS unit's best interest.	1	2	3	4	5
9.	The manufacturing unit is concerned about the well-being of the IS unit, not just its own.	1	2	3	4	5

#### **D.** Organizational Culture

Please indicate the extent to which you agree with the following statements. Not at all = 1 A little = 2 Moderately = 3 Greatly = 4 Very Great = 5

1.	People in the company are rewarded for learning.	1	2	3	4	5
2.	People in the company spend time building trust with each other.	1	2	3	4	5
3.	Teams/groups revise their thinking as a result of group discussions or information collected from other groups.	1	2	3	4	5
4.	The company makes its lessons learned available to all employees.	1	2	3	4	5
5.	The company recognizes people for taking initiative.	1	2	3	4	5
6.	The company utilizes external organizations (consultants, professional associations, training classes) as a source of knowledge.	1	2	3	4	5
7.	Leaders continually look for opportunities to learn.	1	2	3	4	5

### E. Knowledge and Experience with Manufacturing Concepts

Please indicate the average level of knowledge and experience of <u>yourself and direct reports</u> responsible for the relationship with manufacturing for each of the specified topics. Please score your knowledge and experience level on a scale of 1 to 5, where 1=Not at all knowledgeable and 5 = extremely knowledgeable.

1.	Flexible manufacturing techniques.	1	2	3	4	5
2.	Manufacturing logistics and supply chains.	1	2	3	4	5
3.	Manufacturing quality management techniques, including total quality management.	1	2	3	4	5
4.	Manufacturing cost management techniques, including inventory management and labor management.	1	2	3	4	5
5.	Manufacturing resource planning.	1	2	3	4	5

For this survey, the manufacturing unit refers to the organization(s) responsible for production of the primary product line and the IS unit refers to the organization(s) providing information systems services.

#### F. Understanding of Objectives, Practices and Procedures

Please indicate the extent to which you agree with the following statements.

Not at all = 1 A little = 2 Moderately = 3 Greatly = 4 Very Great = 5

1.	The manufacturing unit understands the operational procedures and practices of the IS unit.	1	2	3	4	5
2.	The manufacturing unit understands the IS unit's resources (financial, personnel, assets).	1	2	3	4	5
3.	The manufacturing unit understands the operational strengths and limitations of the IS unit.	1	2	3	4	5
4.	The manufacturing unit recognizes IS as a tool to increase their productivity (efficiency).	1	2	3	4	5
5.	The manufacturing unit recognizes IS as a tool to increase their product and process quality.	1	2	3	4	5
6.	The IS unit understands the improvement objectives of the manufacturing unit.	1	2	3	4	5
7.	The IS unit understands the operational procedures and practices of the manufacturing unit.	1	2	3	4	5
8.	The IS unit understands the manufacturing unit's resources (financial, personnel, assets).	1	2	3	4	5
9.	The IS unit understands the operational strengths and limitations of the manufacturing unit.	1	2	3	4	5
10.	The IS unit understands the manufacturing unit's strategic decision making approach.	1	2	3	4	5
11.	There is a common understanding between the IS unit and the manufacturing unit regarding the role of IS in meeting new manufacturing objectives.	1	2	3	4	5
12.	There is a common understanding between the IS unit and the manufacturing unit regarding the role of IS in supporting current manufacturing operations.	1	2	3	4	5

#### **G. Organizational Performance**

Please assess the performance of your organization for each of the following areas.

Very Poor = 1 Poor = 2 Fair = 3 Good = 4 Very Good = 5

1.	The company's financial performance relative to your competitors over the past three years.	1	2	3	4	5
2.	The company' profitability relative to your competitors over the past three years.	1	2	3	4	5
3.	The company's market share growth relative to your competitors over the past three years.	1	2	3	4	5
4.	The quality of the work produced by the IS unit.	1	2	3	4	5
5.	The efficiency of the IS unit.	1	2	3	4	5

For this survey, the manufacturing unit refers to the organization(s) responsible for production of the primary product line and the IS unit refers to the organization(s) providing information systems services.

## H. IT Organizational Information

Please provide the following information about your organization.

1.	What is your company's primary product line?							
2.	If you know, what is the SIC code of this primary product line?							
3.	What is the total number of employees in the company?							
4.	What is the total number of employees in the IS unit?							
5.	What percentage of IS employees are outsourced?							
6.	What is your annual IT budget ( including outsourcing contracts)?							
7.	What percentage of the IS employees are involved in supporting manufacturing for the primary product line?							
8.	What percentage of the IT budget is focused on supporting manufacturing for the primary product line?							
9.	What are the number of management levels between the CEO and the senior IS executive?							
10.	If not a direct report to the CEO, to what functional area does IS report?							
11.	Which of the following is the focus of your company's business strategy for your primary product line:							
	low cost production high quality products							
	targeted consumer segments other, please specify							
12.	How long has the senior manufacturing team been in place?							
13.	How are IS services predominantly provided to the manufacturing unit:							
	from a central IS unit servicing multiple organizations							
	from a specialized IS unit focused on the manufacturing unit							
	a combination of central and specialized IS units							

Thank you very much for your participation in this survey. The completed survey may be returned in the included business response envelope, faxed to Prof. Waleed Muhanna at 614-292-2118, or sent to: Prof. Waleed Muhanna, 420 Fisher Hall, Fisher College of Business, 2100 Neil Avenue, Columbus, OH 43210. Thank you.

Thank you for participating in our study on the relationship between information systems units and manufacturing units, and its affect on firm performance. This survey consists of **four** pages of questions. You may leave a question blank if you do not wish to answer it, but where possible, an estimate is best for our purposes.

This survey may also be completed online at:

http://fisher.osu.edu/people/stoel\_2/websurvey/cover.htm.

The data collected in this study will remain strictly confidential, and study results will only be reported in the aggregate. If you wish to receive a copy of the results of our study with comparisons of your scores relative to industry averages, please enter your name, title and email address.

Name:	
Title:	
Company:	
Email:	

When completed, the survey may be returned in the included business response envelope, or faxed to Prof. Waleed Muhanna at 614-292-2118, or sent to: Prof. Waleed Muhanna, 420 Fisher Hall, Fisher College of Business, 2100 Neil Avenue, Columbus, OH 43210.

For this survey, the manufacturing unit refers to the organization(s) responsible for production of the primary product line and the IS unit refers to the organization(s) providing information systems services.

#### A. Business and Information Systems (IS) Planning

Please indicate the extent to which you agree with the following statements. Not at all = 1 A little = 2 Moderately = 3 Greatly = 4 Very Great = 5

1.	We have a formal, strategic business plan for the company.	1	2	3	4	5
2.	The company's strategic plan is clear and understandable.	1	2	3	4	5
3.	The company's strategic plan defines the company's mission, goals and objectives.	1	2	3	4	5
4.	The company's strategic plan defines key assumptions and alternatives.	1	2	3	4	5
5.	Top executive management recognizes the strategic potential of IS.	1	2	3	4	5
6.	Top executive management is committed to the IS function.	1	2	3	4	5
7.	Top executive management is knowledgeable about our information assets and opportunities	1	2	3	4	5
8.	Top executive management recognizes that IS is critical to the company's success.	1	2	3	4	5
9.	Top executive management views IS spending as a strategic investment.	1	2	3	4	5
10.	We have a formal, strategic plan for manufacturing.	1	2	3	4	5
11.	The strategic manufacturing plan identifies IS needs.	1	2	3	4	5
12.	We have a formal, strategic plan for IS.	1	2	3	4	5
13.	The strategic IS plan refers to initiatives and objectives in the strategic manufacturing plan.	1	2	3	4	5
14.	IS planning is integrated with the strategic manufacturing planning process.	1	2	3	4	5

### B. Perception of the Relationship between Manufacturing and Information Systems Units - section I

Please indicate the extent to which you agree with the following statements.Not at all = 1A little = 2Moderately = 3Greatly = 4Very Great = 5

1.	Manufacturing personnel are actively involved in decisions about information technology infrastructure (hardware, networks and technology platforms).	1	2	3	4	5
2.	Manufacturing personnel are actively involved in IS unit's budget development.	1	2	3	4	5
3.	Manufacturing personnel are actively involved in establishing IS unit priorities.	1	2	3	4	5
4.	Manufacturing personnel are actively involved in selecting business application software.	1	2	3	4	5
5.	Manufacturing personnel are actively involved in IS project management decisions.	1	2	3	4	5
6.	Descriptions of manufacturing activities and performance targets have been developed.	1	2	3	4	5
7.	Actual performance metrics for the manufacturing unit are measured and tracked.	1	2	3	4	5
8.	Actual performance results for the manufacturing unit are reviewed with the IS unit.	1	2	3	4	5
9.	The success of our manufacturing unit relies on access to a high quantity of information.	1	2	3	4	5
10.	Information used in our manufacturing operations requires frequent updating.	1	2	3	4	5
11.	Our manufacturing operations require accurate information.	1	2	3	4	5
12.	IS unit resources and support are important factors in achieving manufacturing unit's goals.	1	2	3	4	5
13.	The IS unit resources and support would be difficult for the manufacturing unit to replace.	1	2	3	4	5

For this survey, the manufacturing unit refers to the organization(s) responsible for production of the primary product line and the IS unit refers to the organization(s) providing information systems services.

### C. Perception of the Relationship between Manufacturing and Information Systems Units - section II

Please indicate the extent to which you agree with the following statements. Not at all = 1 A little = 2 Moderately = 3 Greatly = 4 Very Great = 5

1.	Standard operating rules and procedures are utilized extensively in making decisions regarding the manufacturing and IS relationship.	1	2	3	4	5
2.	Disagreements in the IS and manufacturing relationship are resolved by a third party.	1	2	3	4	5
3.	Written procedures are followed in most aspects of the manufacturing and IS relationship.	1	2	3	4	5
4.	The IS unit is a capable and proficient unit.	1	2	3	4	5
5.	The IS unit possesses the appropriate skills to work effectively.	1	2	3	4	5
6.	The IS unit works with the manufacturing unit openly and honestly.	1	2	3	4	5
7.	The IS unit displays ethical behavior and integrity.	1	2	3	4	5
8.	We trust that decisions made by the IS unit will be in the manufacturing unit's best interest.	1	2	3	4	5
9.	The IS unit is concerned about the well-being of the manufacturing unit, not just its own.	1	2	3	4	5

#### **D.** Organizational Culture

Please indicate the extent to which you agree with the following statements. Not at all = 1 A little = 2 Moderately = 3 Greatly = 4 Very Great = 5

1.	People in the company are rewarded for learning.	1	2	3	4	5
2.	People in the company spend time building trust with each other.	1	2	3	4	5
3.	Teams/groups revise their thinking as a result of group discussions or information collected from other groups.	1	2	3	4	5
4.	The company makes its lessons learned available to all employees.	1	2	3	4	5
5.	The company recognizes people for taking initiative.	1	2	3	4	5
6.	The company utilizes external organizations (consultants, professional associations, training classes) as a source of knowledge.	1	2	3	4	5
7.	Leaders continually look for opportunities to learn.	1	2	3	4	5

## E. Knowledge and Experience with Information Systems Concepts

Please indicate the average level of knowledge and experience of <u>yourself and direct reports</u> responsible for the relationship with manufacturing for each of the specified topics. Please score your knowledge and experience level on a scale of 1 to 5, where: 1=Not at all knowledgeable and 5 = extremely knowledgeable.

1.	Computer hardware and technologies such as personal computers, client/server computing, local area networks and imaging.	1	2	3	4	5
2.	Computer software and applications such as electronic mail, internet, electronic data interchange, enterprise resource planning and customer relationship management.	1	2	3	4	5
3.	<ol> <li>The application development process including traditional system development life cycle, end- user development, and prototyping.</li> </ol>				4	5
4.	IS management processes such as outsourcing, software selection and project management.	1	2	3	4	5

For this survey, the manufacturing unit refers to the organization(s) responsible for production of the primary product line and the IS unit refers to the organization(s) providing information systems services.

# F. Understanding of Objectives, Practices and Procedures

Please indicate the extent to which you agree with the following statements.

*Not at all* = 1 *A little* = 2 *Moderately* = 3 *Greatly* = 4 *Very Great* = 5

1.	The manufacturing unit understands the operational procedures and practices of the IS unit.	1	2	3	4	5
2.	The manufacturing unit understands the IS unit's resources (financial, personnel, assets).	1	2	3	4	5
3.	The manufacturing unit understands the operational strengths and limitations of the IS unit.	1	2	3	4	5
4.	The manufacturing unit recognizes IS as a tool to increase their productivity (efficiency).	1	2	3	4	5
5.	The manufacturing unit recognizes IS as a tool to increase their product and process quality.	1	2	3	4	5
6.	The IS unit understands the improvement objectives of the manufacturing unit.	1	2	3	4	5
7.	The IS unit understands the operational procedures and practices of the manufacturing unit.	1	2	3	4	5
8.	The IS unit understands the manufacturing unit's resources (financial, personnel, assets).	1	2	3	4	5
9.	The IS unit understands the operational strengths and limitations of the manufacturing unit.	1	2	3	4	5
10.	The IS unit understands the manufacturing unit's strategic decision making approach.	1	2	3	4	5
11.	There is a common understanding between the IS unit and the manufacturing unit regarding the role of IS in meeting new manufacturing objectives.	1	2	3	4	5
12.	There is a common understanding between the IS unit and the manufacturing unit regarding the role of IS in supporting current manufacturing operations.	1	2	3	4	5

#### **G. Organizational Performance**

Please assess the performance of your organization for each of the following areas.Very Poor = 1Poor = 2Fair = 3Good = 4Very Good = 5

1.	The company's financial performance relative to your competitors over the past three years.	1	2	3	4	5
2.	The company' profitability relative to your competitors over the past three years.	1	2	3	4	5
3.	The company's market share growth relative to your competitors over the past three years.	1	2	3	4	5
4.	Manufacturing quality relative to your competitors.	1	2	3	4	5
5.	Manufacturing flexibility relative to your competitors.	1	2	3	4	5
6.	Manufacturing costs relative to your competitors.	1	2	3	4	5
7.	Manufacturing cycle relative to your competitors.	1	2	3	4	5
8.	Overall manufacturing performance relative to your competitors.	1	2	3	4	5
9.	The impact of information systems on the productivity of the manufacturing unit.	1	2	3	4	5
10.	The impact of information systems on the quality of the manufacturing unit.	1	2	3	4	5
11.	The impact of information systems on the overall performance of the manufacturing unit.	1	2	3	4	5
12.	The quality of the work produced by the IS unit	1	2	3	4	5
13.	The efficiency of the IS unit.	1	2	3	4	5

For this survey, the manufacturing unit refers to the organization(s) responsible for production of the primary product line and the IS unit refers to the organization(s) providing information systems services.

### **H.** Organizational Information

Please provide the following information about your organization.

1.	What is your company's primary product line?
2.	If you know, what is the SIC code for the primary product line?
3.	What is the total number of employees in the company?
4.	How long has the senior IS team been in place?
The	following questions refer specifically to your primary product line.
5.	What is the total number of employees in the manufacturing unit?
6.	What percentage of manufacturing unit employees are unionized?%
7.	What is the cost of goods sold as a percentage of sales?%
8.	What is the manufacturing scrap rate?%
9.	What percentage of deliveries do customers receive at the time requested?%
10.	How long is your production schedule frozen?
11.	What is the average age of your manufacturing facilities?
12.	How many days from receipt of raw materials to customer receipt?
13.	How many suppliers provide raw materials for this product line?
14.	How many operations are performed to change raw materials to finished goods?
15.	How many stock keeping units are created for this product line?
16.	Which of the following is the focus of your company's business strategy for your primary product line:
	low cost production high quality products
	targeted consumer segments other, please specify

- 17. How are IS services predominantly provided to the manufacturing unit:
  - \_\_\_\_\_ from a central IS unit servicing multiple organizations
  - \_\_\_\_\_ from a specialized IS unit focused on the manufacturing unit
  - \_\_\_\_\_a combination of central and specialized IS units

Thank you very much for your participation in this survey. The completed survey may be returned in the included business response envelope, or faxed to Prof. Waleed Muhanna at 614-292-2118, or sent to: Prof. Waleed Muhanna, 420 Fisher Hall, Fisher College of Business, 2100 Neil Avenue, Columbus, OH 43210. Thank you.

# **APPENDIX C**

# **ITEM LOADINGS**

The following tables provide the correlations between the items on the IS and the manufacturing survey components with the latent variables. The individual items load highest on the latent variable that they represent.

	a1	a2	a3	a4
cc_strategy	0.808	0.811	0.793	0.759
exec_support_is	0.472	0.495	0.545	0.500
Alignment	0.538	0.520	0.524	0.495
joint is management	0.318	0.357	0.310	0.357
mfg_metrics	0.275	0.276	0.173	0.173
is_metrics	0.487	0.510	0.459	0.572
info_intensity	0.232	0.260	0.164	0.163
is_dependence	0.246	0.313	0.247	0.479
formal_interface	0.330	0.375	0.347	0.333
mutual_trust	0.476	0.515	0.561	0.367
org. learning culture	0.279	0.336	0.382	0.337
overlap_knowledge	0.166	0.169	0.271	0.214
firm_perf	0.520	0.521	0.488	0.437
is_quality	0.311	0.274	0.379	0.311
mfg_perf	0.334	0.322	0.316	0.261
it_impact	0.187	0.222	0.253	0.125
shared_ops	0.348	0.378	0.398	0.302
shared_strat	0.500	0.555	0.534	0.469
Construct loading onto:	cc strategy	cc strategy	cc strategy	cc strategy

	a5	a6	a7	a8	a9
cc_strategy	0.553	0.504	0.562	0.411	0.407
exec_support_is	0.822	0.811	0.794	0.795	0.746
alignment	0.532	0.510	0.531	0.399	0.473
joint is management	0.409	0.379	0.481	0.307	0.300
mfg_metrics	0.213	0.134	0.227	0.188	0.146
is_metrics	0.455	0.521	0.515	0.340	0.284
info_intensity	0.298	0.335	0.339	0.264	0.409
is_dependence	0.356	0.277	0.260	0.318	0.273
formal_interface	0.289	0.240	0.413	0.232	0.268
mutual_trust	0.422	0.507	0.552	0.447	0.471
org. learning culture	0.525	0.406	0.439	0.419	0.415
Overlap_knowledge	0.226	0.362	0.391	0.118	0.263
firm_perf	0.372	0.267	0.328	0.319	0.337
is_quality	0.328	0.366	0.440	0.229	0.292
mfg_perf	0.224	0.262	0.270	0.224	0.226
it_impact	0.265	0.260	0.288	0.225	0.302
shared_ops	0.366	0.432	0.513	0.315	0.378
shared_strat	0.593	0.548	0.667	0.509	0.578
Construct loading onto:	exec_support	exec_support	exec_support	exec_support	exec_support

	a10	a11	a13	a14
cc_strategy	0.623	0.528	0.588	0.515
exec_support_is	0.474	0.604	0.414	0.477
alignment	0.657	0.718	0.704	0.711
joint is management	0.316	0.494	0.467	0.532
mfg_metrics	0.117	0.172	0.265	0.160
is_metrics	0.432	0.452	0.435	0.521
info_intensity	0.297	0.419	0.398	0.371
is_dependence	0.142	0.274	0.259	0.425
formal_interface	0.355	0.448	0.430	0.531
mutual_trust	0.488	0.533	0.334	0.453
org. learning culture	0.237	0.302	0.358	0.326
Overlap_knowledge	0.322	0.327	0.329	0.423
firm_perf	0.380	0.271	0.288	0.262
is_quality	0.432	0.476	0.496	0.474
mfg_perf	0.287	0.197	0.349	0.279
it_impact	0.341	0.286	0.222	0.272
shared_ops	0.393	0.574	0.385	0.504
shared_strat	0.441	0.605	0.505	0.577
Construct loading onto:	alignment	Alignment	alignment	alignment

	b1	b3	b4	b5		
cc_strategy	0.230	0.371	0.216	0.305		
exec_support_is	0.307	0.376	0.278	0.371		
alignment	0.374	0.483	0.301	0.399		
joint is management	0.529	0.734	0.616	0.756		
mfg_metrics	0.017	0.324	0.100	0.260		
is_metrics	0.435	0.540	0.360	0.371		
info_intensity	0.177	0.484	0.334	0.388		
is_dependence	0.382	0.360	0.339	0.455		
formal_interface	0.262	0.425	0.355	0.424		
mutual_trust	0.230	0.381	0.201	0.312		
org. learning culture	0.045	0.303	0.128	0.334		
overlap_knowledge	0.047	0.256	0.114	0.215		
firm_perf	0.034	0.124	0.047	0.070		
is_quality	0.219	0.314	0.264	0.185		
mfg_perf	-0.109	0.257	0.093	0.091		
it_impact	0.081	0.262	0.164	0.189		
shared_ops	0.335	0.514	0.403	0.426		
shared_strat	0.349	0.568	0.404	0.542		
	joint IS	joint IS	joint IS	joint IS		
Construct loading onto:	mgmt	mgmt	mgmt	mgmt		
	b6	b7	b8	b9	b10	b11
-------------------	------------	------------	------------	-----------	-----------	-----------
cc_strategy	0.382	0.364	0.354	0.333	0.199	0.450
exec_support_is	0.346	0.236	0.395	0.347	0.296	0.521
alignment	0.305	0.263	0.454	0.477	0.364	0.479
joint is						
management	0.337	0.293	0.515	0.475	0.347	0.379
mfg_metrics	0.204	0.140	0.259	0.362	0.171	0.220
is_metrics	0.856	0.815	0.787	0.297	0.224	0.244
info_intensity	0.174	0.205	0.236	0.741	0.610	0.710
is_dependence	0.241	0.116	0.358	0.252	0.282	0.336
formal_interface	0.305	0.229	0.502	0.433	0.109	0.358
mutual_trust	0.276	0.395	0.307	0.468	0.364	0.518
org. learning						
culture	0.249	0.127	0.232	0.239	0.175	0.341
overlap_knowledge	0.131	0.200	0.353	0.111	-0.018	0.224
firm_perf	0.300	0.250	0.125	0.252	0.213	0.307
is_quality	0.182	0.238	0.360	0.260	0.160	0.248
mfg_perf	0.098	0.131	0.247	0.095	0.195	0.141
it_impact	0.116	0.236	0.272	0.373	0.485	0.361
shared_ops	0.204	0.241	0.461	0.293	0.158	0.260
shared_strat	0.266	0.248	0.419	0.425	0.292	0.500
Construct loading				Info.	Info.	Info.
onto:	is_metrics	is_metrics	is_metrics	Intensity	Intensity	Intensity

	b12	b13	c1	c3
cc_strategy	0.341	0.391	0.331	0.349
exec_support_is	0.176	0.339	0.151	0.150
alignment	0.281	0.370	0.311	0.290
joint is management	0.521	0.386	0.331	0.424
mfg_metrics	0.080	0.192	0.179	0.063
is_metrics	0.244	0.289	0.344	0.389
info_intensity	0.293	0.303	0.159	0.123
is_dependence	0.923	0.923	0.064	0.379
formal_interface	0.330	0.246	0.678	0.666
mutual_trust	0.177	0.236	0.224	0.304
org. learning culture	0.323	0.316	0.237	0.218
Overlap_knowledge	0.017	0.058	0.293	0.064
firm_perf	0.016	0.135	0.076	0.105
is_quality	-0.004	0.084	0.350	0.275
mfg_perf	-0.063	0.090	0.118	0.030
it_impact	0.178	0.265	0.103	0.135
shared_ops	0.291	0.259	0.362	0.385
shared_strat	0.383	0.394	0.302	0.409
	IS	IS	Formal	Formal
Construct loading onto:	Dependence	Dependence	Interface	Interface

	1					
	c4	c5	c6	c7	c8	c9
cc_strategy	0.448	0.418	0.281	0.279	0.477	0.542
exec_support_is	0.392	0.421	0.349	0.373	0.399	0.484
alignment	0.240	0.285	0.383	0.291	0.419	0.501
joint is management	0.160	0.186	0.383	0.322	0.415	0.529
mfg_metrics	0.176	0.177	0.090	0.036	0.046	0.108
is_metrics	0.298	0.231	0.208	0.309	0.401	0.431
info_intensity	0.195	0.148	0.300	0.376	0.312	0.325
is_dependence	0.073	0.074	0.111	0.169	0.212	0.362
formal_interface	0.106	0.120	0.312	0.269	0.357	0.413
Mutual_trust	0.580	0.571	0.639	0.565	0.571	0.629
org. learning culture	0.258	0.255	0.256	0.221	0.212	0.369
Overlap_knowledge	0.060	0.086	0.195	0.190	0.198	0.283
firm_perf	0.374	0.368	0.212	0.099	0.314	0.356
is_quality	0.302	0.267	0.301	0.364	0.213	0.272
mfg_perf	0.195	0.124	0.192	0.095	0.023	0.131
it_impact	0.122	0.043	0.345	0.207	0.254	0.301
Shared_ops	0.122	0.206	0.369	0.272	0.403	0.514
Shared_strat	0.313	0.397	0.426	0.382	0.398	0.565
	Mutual	Mutual	Mutual	Mutual	Mutual	Mutual
Construct loading onto:	Trust	Trust	Trust	Trust	Trust	Trust

	d1	d2	d3	d4	d5	d6	d7
cc_strategy	0.383	0.369	0.346	0.434	0.515	0.372	0.413
exec_support_is	0.260	0.420	0.525	0.297	0.539	0.327	0.531
alignment	0.174	0.355	0.331	0.357	0.408	0.337	0.366
joint is management	0.316	0.396	0.310	0.404	0.300	0.334	0.353
mfg_metrics	0.199	0.234	0.271	0.279	0.245	0.193	0.133
is_metrics	0.269	0.372	0.285	0.218	0.364	0.143	0.269
info_intensity	0.209	0.271	0.213	0.172	0.159	0.086	0.236
is_dependence	0.502	0.319	0.246	0.559	0.251	0.185	0.207
formal_interface	0.189	0.328	0.355	0.434	0.333	0.347	0.277
Mutual_trust	0.183	0.360	0.383	0.230	0.445	0.285	0.444
org. learning							
culture	0.602	0.624	0.619	0.622	0.698	0.552	0.619
Overlap_knowledge	-0.015	0.212	0.213	0.275	0.302	0.215	0.285
firm_perf	0.265	0.244	0.118	0.152	0.332	0.250	0.326
is_quality	-0.061	0.218	0.193	0.209	0.141	0.170	0.266
mfg_perf	-0.003	0.232	0.099	0.138	0.152	0.050	0.168
it_impact	0.101	0.269	0.264	0.269	0.171	0.139	0.208
Shared_ops	0.136	0.284	0.255	0.352	0.357	0.211	0.296
Shared_strat	0.357	0.468	0.426	0.419	0.480	0.366	0.486
	org						
Construct loading	learn.						
onto:	culture						

	e1	e2	e3	e4	e5
cc_strategy	0.299	0.379	0.231	0.361	0.382
exec_support_is	0.240	0.329	0.281	0.235	0.373
alignment	0.346	0.392	0.245	0.326	0.354
joint is management	0.144	0.197	0.078	0.164	0.168
mfg_metrics	0.014	0.104	0.067	0.019	0.066
is_metrics	0.357	0.284	0.187	0.203	0.350
info_intensity	0.123	0.103	0.043	0.194	0.243
is_dependence	-0.001	0.182	0.029	0.068	-0.005
formal_interface	0.285	0.226	0.179	0.161	0.274
mutual_trust	0.169	0.216	0.116	0.298	0.421
org. learning culture	0.127	0.254	0.175	0.144	0.189
Overlap_knowledge	0.659	0.746	0.566	0.764	0.719
firm_perf	0.106	0.045	-0.051	0.060	0.158
is_quality	0.376	0.443	0.350	0.325	0.432
mfg_perf	0.244	0.301	0.282	0.279	0.291
it_impact	0.011	0.128	0.142	0.184	0.167
shared_ops	0.251	0.313	0.272	0.360	0.426
shared_strat	0.175	0.304	0.182	0.265	0.374
	Overlap	Overlap	Overlap	Overlap	Overlap
Construct loading onto:	Knowledge	Knowledge	Knowledge	Knowledge	Knowledge

	f1	f2	f3	f4	f5	f11
cc_strategy	0.453	0.348	0.429	0.530	0.430	0.451
exec_support						
_is	0.340	0.313	0.472	0.673	0.583	0.475
alignment	0.424	0.459	0.541	0.586	0.446	0.544
joint is						
management	0.573	0.551	0.426	0.531	0.498	0.679
mfg_metrics	0.185	0.317	0.102	0.248	0.279	0.237
is_metrics	0.407	0.304	0.297	0.339	0.373	0.407
info_intensity	0.221	0.294	0.235	0.424	0.296	0.427
is_dependence	0.166	0.183	0.263	0.326	0.346	0.451
Formal						
_interface	0.491	0.398	0.465	0.438	0.375	0.495
Mutual_trust	0.353	0.245	0.401	0.566	0.417	0.361
org. learning						
culture	0.260	0.243	0.146	0.454	0.427	0.471
Overlap						
_knowledge	0.325	0.119	0.386	0.325	0.188	0.285
firm_perf	0.077	0.166	0.069	0.304	0.296	0.204
is_quality	0.361	0.355	0.453	0.438	0.293	0.455
mfg_perf	0.182	0.327	0.240	0.287	0.195	0.313
it_impact	0.192	0.265	0.215	0.229	0.210	0.338
Shared_ops	0.714	0.584	0.733	0.510	0.413	0.590
Shared_strat	0.514	0.497	0.543	0.738	0.702	0.754
Construct	Shared	Shared	Shared	Shared	Shared	Shared
loading onto:	Operational	Operational	Operational	Operational	Strategic	Strategic

	g1	g2	g3	g4	g5
cc_strategy	0.376	0.410	0.362	0.264	0.163
exec_support_is	0.337	0.315	0.192	0.279	0.194
alignment	0.266	0.256	0.239	0.272	0.308
joint is management	0.042	0.065	0.114	0.093	0.198
mfg_metrics	0.171	0.209	0.195	-0.019	0.059
is_metrics	0.306	0.253	0.162	0.141	0.123
info_intensity	0.216	0.199	0.207	-0.022	0.058
is_dependence	0.140	0.117	0.138	-0.093	-0.018
formal_interface	0.119	0.191	0.162	0.288	0.200
Mutual_trust	0.203	0.216	0.179	0.159	0.094
org. learning culture	0.175	0.207	0.157	0.157	0.172
Overlap_knowledge	0.028	-0.001	-0.123	0.305	0.242
firm_perf	0.862	0.887	0.761	0.156	0.036
is_quality	0.004	0.019	0.006	0.589	0.560
mfg_perf	0.170	0.193	0.179	0.152	0.197
it_impact	0.053	0.081	0.040	0.082	0.001
Shared_ops	-0.103	-0.087	-0.051	0.237	0.216
Shared_strat	0.174	0.189	0.168	0.314	0.284
Construct loading onto:	firm_perf	firm_perf	firm_perf	is_quality	is_quality

	al	a2	a3	a4
cc_strategy	0.706	0.745	0.640	0.548
exec_support_is	0.405	0.409	0.310	0.422
alignment	0.633	0.587	0.529	0.523
joint is management	0.296	0.251	0.273	0.315
mfg_metrics	0.314	0.331	0.342	0.441
is_metrics	0.206	0.166	0.029	0.080
info_intensity	0.317	0.288	0.298	0.350
is_dependence	0.358	0.332	0.290	0.061
formal_interface	0.314	0.257	0.401	0.425
mutual_trust	0.395	0.333	0.331	0.363
org. learning culture	0.358	0.412	0.453	0.384
overlap_knowledge	0.247	0.269	0.295	0.370
firm_perf	0.227	0.329	0.187	0.123
is_quality	0.305	0.237	0.345	0.350
mfg_perf	0.320	0.414	0.365	0.357
it_impact	0.270	0.191	0.193	0.272
shared_ops	0.374	0.323	0.427	0.418
shared_strat	0.392	0.369	0.450	0.391
Construct loading onto:	cc_strategy	cc_strategy	cc_strategy	cc_strategy

	a5	a6	a7	a8	a9
cc_strategy	0.378	0.450	0.491	0.546	0.403
exec_support_is	0.744	0.783	0.689	0.714	0.732
alignment	0.475	0.609	0.512	0.645	0.518
joint is management	0.243	0.380	0.180	0.373	0.327
mfg_metrics	0.348	0.439	0.258	0.405	0.389
is_metrics	0.113	0.244	0.204	0.158	0.133
info_intensity	0.327	0.327	0.146	0.381	0.344
is_dependence	0.123	0.143	0.110	0.119	0.110
formal_interface	0.249	0.346	0.196	0.262	0.433
mutual_trust	0.377	0.451	0.455	0.419	0.352
org. learning culture	0.294	0.471	0.339	0.467	0.376
overlap_knowledge	0.284	0.400	0.330	0.358	0.295
firm_perf	0.086	0.248	0.163	0.152	0.186
is_quality	0.328	0.366	0.341	0.417	0.397
mfg_perf	0.262	0.393	0.275	0.413	0.229
it_impact	0.239	0.276	0.291	0.356	0.295
shared_ops	0.317	0.432	0.368	0.461	0.412
shared_strat	0.392	0.543	0.382	0.534	0.512
Construct loading onto:	exec_support	exec_support	exec_support	exec_support	exec_support

	a10	a11	a13	a14
cc_strategy	0.535	0.361	0.577	0.491
exec_support_is	0.336	0.387	0.580	0.525
alignment	0.685	0.643	0.789	0.717
joint is management	0.374	0.414	0.517	0.483
mfg_metrics	0.491	0.440	0.505	0.467
is_metrics	0.120	-0.074	0.249	0.214
info_intensity	0.434	0.348	0.485	0.359
is_dependence	0.258	0.246	0.204	0.173
formal_interface	0.278	0.378	0.407	0.328
mutual_trust	0.363	0.249	0.454	0.401
org. learning culture	0.375	0.428	0.411	0.425
overlap_knowledge	0.201	0.341	0.344	0.272
firm_perf	0.217	0.076	0.234	0.286
is_quality	0.326	0.311	0.373	0.366
mfg_perf	0.464	0.348	0.458	0.417
it_impact	0.408	0.398	0.445	0.450
shared_ops	0.325	0.464	0.454	0.408
shared_strat	0.438	0.503	0.553	0.468
Construct loading onto:	alignment	alignment	alignment	alignment

	b1	b3	b4	b5
cc_strategy	0.396	0.328	0.333	0.173
exec_support_is	0.331	0.309	0.335	0.152
alignment	0.583	0.505	0.533	0.322
joint is management	0.688	0.617	0.778	0.646
mfg_metrics	0.405	0.341	0.426	0.247
is_metrics	0.289	0.185	0.255	0.049
info_intensity	0.385	0.409	0.435	0.323
is_dependence	0.220	0.341	0.281	0.345
formal_interface	0.431	0.499	0.437	0.300
mutual_trust	0.424	0.417	0.513	0.234
org. learning culture	0.403	0.451	0.457	0.347
overlap_knowledge	0.304	0.321	0.246	0.046
firm_perf	0.140	0.014	0.065	-0.042
is_quality	0.242	0.255	0.388	0.050
mfg_perf	0.185	0.061	0.293	0.091
it_impact	0.463	0.346	0.463	0.319
shared_ops	0.486	0.476	0.506	0.345
shared_strat	0.518	0.559	0.617	0.355
	joint IS	joint IS	joint IS	joint IS
Construct loading onto:	mgmt	mgmt	mgmt	mgmt

	b6	h7	b8	b9	b10	b11
aa atrotaati	0.221	0.204	0.244	0.004	0.062	0.252
cc_strategy	0.521	0.294	0.544	0.094	0.005	0.235
exec_support_is	0.322	0.168	0.376	0.225	0.001	0.256
alignment	0.380	0.299	0.465	0.380	0.169	0.326
joint is						
management	0.308	0.232	0.463	0.271	0.341	0.220
mfg_metrics	0.862	0.801	0.770	0.310	0.233	0.367
is_metrics	0.147	0.289	0.164	-0.041	0.167	0.096
info_intensity	0.312	0.310	0.393	0.664	0.574	0.690
is_dependence	0.126	0.010	0.228	0.132	0.059	0.220
formal_interface	0.294	0.349	0.411	0.262	0.236	0.274
mutual_trust	0.161	0.212	0.330	0.165	0.193	0.249
org. learning						
culture	0.387	0.356	0.450	0.076	0.128	0.214
overlap_knowledge	0.162	0.053	0.170	0.283	0.044	0.266
firm_perf	0.281	0.327	0.247	0.013	-0.041	0.094
is_quality	0.175	0.091	0.263	0.257	0.031	0.157
mfg_perf	0.422	0.441	0.440	0.146	0.003	0.225
it_impact	0.222	0.156	0.506	0.170	0.147	0.240
shared_ops	0.291	0.134	0.412	0.262	0.097	0.264
shared_strat	0.405	0.245	0.532	0.231	0.170	0.286
Construct loading	MFG	MFG	MFG	Info.	Info.	Info.
onto:	Metrics	Metrics	Metrics	Intensity	Intensity	Intensity

	c1	c3
cc_strategy	0.320	0.345
exec_support_is	0.324	0.438
alignment	0.503	0.459
joint is management	0.502	0.315
mfg_metrics	0.522	0.407
is_metrics	0.238	0.220
info_intensity	0.502	0.358
is_dependence	0.254	0.178
formal_interface	0.717	0.749
mutual_trust	0.370	0.389
org. learning culture	0.361	0.379
overlap_knowledge	0.366	0.301
firm_perf	0.180	0.168
is_quality	0.292	0.370
mfg_perf	0.178	0.148
it_impact	0.432	0.291
shared_ops	0.469	0.415
shared_strat	0.506	0.496
Construct loading onto:	formal_interface	formal_interface

	c4	c5	сб	c7	c8	c9
cc_strategy	0.320	0.253	0.452	0.407	0.278	0.144
exec_support_is	0.382	0.340	0.236	0.390	0.344	0.213
alignment	0.371	0.250	0.499	0.522	0.314	0.239
joint is management	0.205	0.126	0.390	0.460	0.216	0.263
mfg_metrics	0.154	0.132	0.347	0.254	0.268	0.327
is_metrics	0.303	0.219	0.203	0.114	0.203	0.009
info_intensity	0.318	0.277	0.367	0.298	0.383	0.341
is_dependence	-0.021	0.049	0.222	0.201	0.138	0.081
formal_interface	0.282	0.258	0.351	0.311	0.348	0.281
mutual_trust	0.627	0.653	0.640	0.591	0.729	0.585
org. learning culture	0.126	0.161	0.259	0.412	0.294	0.352
overlap_knowledge	0.399	0.294	0.263	0.300	0.158	0.134
firm_perf	0.106	0.080	0.160	0.084	0.144	-0.043
is_quality	0.500	0.355	0.435	0.451	0.311	0.257
mfg_perf	0.211	0.134	0.327	0.319	0.080	0.134
it_impact	0.328	0.271	0.474	0.279	0.488	0.509
shared_ops	0.452	0.309	0.529	0.583	0.409	0.360
shared_strat	0.346	0.283	0.513	0.574	0.420	0.378
	Mutual	Mutual	Mutual	Mutual	Mutual	Mutual
Construct loading onto:	Trust	Trust	Trust	Trust	Trust	Trust

	d1	d2	d3	d4	d5	d6	d7
cc_strategy	0.192	0.072	0.172	0.109	0.298	0.271	0.353
exec_support_is	0.336	0.044	0.178	0.307	0.253	0.295	0.410
alignment	0.379	0.135	0.333	0.247	0.270	0.335	0.388
joint is management	0.340	-0.038	0.268	0.203	0.136	0.331	0.239
mfg_metrics	0.509	0.041	0.449	0.410	0.371	0.423	0.402
is_metrics	0.041	-0.207	0.057	0.117	0.044	0.156	-0.027
info_intensity	0.215	-0.018	0.164	0.170	0.096	0.354	0.190
is_dependence	0.137	-0.010	0.034	0.178	-0.026	0.206	0.174
formal_interface	0.347	-0.016	0.352	0.220	0.126	0.236	0.169
mutual_trust	0.210	0.056	0.216	0.168	0.251	0.221	0.237
org. learning culture	0.707	0.468	0.579	0.604	0.621	0.656	0.669
overlap_knowledge	0.337	0.193	0.346	0.248	0.179	0.268	0.268
firm_perf	0.029	-0.038	-0.006	-0.077	0.193	0.152	0.273
is_quality	0.267	0.152	0.335	0.182	0.094	0.211	0.167
mfg_perf	0.317	0.305	0.362	0.178	0.411	0.322	0.436
it_impact	0.441	0.108	0.318	0.297	0.232	0.237	0.273
shared_ops	0.334	0.103	0.332	0.207	0.136	0.255	0.232
shared_strat	0.471	0.151	0.346	0.297	0.262	0.389	0.377
	org						
	learn.						
Construct loading onto:	culture						

	e1	e2	e3	e4
cc_strategy	0.048	0.188	-0.096	0.058
exec_support_is	0.127	0.237	0.139	0.165
alignment	0.150	0.301	0.171	0.195
joint is management	0.053	0.194	0.167	0.327
mfg_metrics	0.073	0.092	0.217	0.188
is_metrics	-0.094	0.003	0.063	0.077
info_intensity	-0.023	0.032	0.166	0.308
is_dependence	-0.069	0.011	-0.142	0.140
formal_interface	0.108	0.176	0.252	0.311
mutual_trust	0.034	0.229	0.115	0.278
org. learning culture	0.186	0.270	0.309	0.408
overlap_knowledge	0.433	0.514	0.545	0.481
firm_perf	-0.053	0.008	-0.016	0.057
is_quality	0.196	0.175	0.082	0.068
mfg_perf	-0.015	0.075	0.055	-0.056
it_impact	-0.163	0.044	0.111	0.173
shared_ops	0.247	0.373	0.217	0.223
shared_strat	0.187	0.294	0.180	0.239
	Overlap	Overlap	Overlap	Overlap
Construct loading onto:	Knowledge	Knowledge	Knowledge	Knowledge

	f6	f7	f8	f9	f10	f11
cc_strategy	0.511	0.263	0.231	0.339	0.430	0.421
exec_support_is	0.504	0.376	0.280	0.339	0.291	0.495
alignment	0.572	0.411	0.403	0.457	0.490	0.558
joint is						
management	0.507	0.448	0.449	0.424	0.409	0.521
mfg_metrics	0.462	0.356	0.377	0.364	0.432	0.457
is_metrics	0.232	0.210	0.158	0.148	0.116	0.188
info_intensity	0.370	0.344	0.229	0.179	0.282	0.305
is_dependence	0.247	0.259	0.215	0.185	0.221	0.260
formal_interface	0.475	0.353	0.405	0.393	0.437	0.478
mutual_trust	0.618	0.546	0.374	0.491	0.414	0.563
org. learning						
culture	0.555	0.367	0.332	0.420	0.347	0.441
overlap_knowledge	0.487	0.347	0.281	0.373	0.217	0.271
firm_perf	0.098	-0.077	-0.156	-0.072	0.057	0.204
is_quality	0.549	0.416	0.379	0.450	0.335	0.467
mfg_perf	0.444	0.215	0.201	0.345	0.312	0.386
it_impact	0.568	0.511	0.426	0.563	0.479	0.575
shared_ops	0.602	0.744	0.662	0.739	0.650	0.663
shared_strat	0.735	0.648	0.571	0.673	0.707	0.757
Construct loading	Shared	Shared	Shared	Shared	Shared	Shared
onto:	Strategic	Operational	Operational	Operational	Strategic	Strategic

	g1	g2	g3
cc_strategy	0.471	0.435	0.359
exec_support_is	0.289	0.227	0.215
alignment	0.353	0.341	0.265
joint is management	0.123	0.049	0.032
mfg_metrics	0.423	0.402	0.314
is_metrics	0.242	0.236	0.133
info_intensity	0.181	0.204	0.013
is_dependence	0.015	0.015	-0.046
formal_interface	0.168	0.169	0.113
mutual_trust	0.315	0.340	0.228
org. learning culture	0.269	0.199	0.248
overlap_knowledge	0.102	0.124	0.177
firm_perf	0.813	0.835	0.667
is_quality	0.198	0.104	0.137
mfg_perf	0.594	0.500	0.580
it_impact	0.311	0.207	0.157
shared_ops	0.180	0.068	0.011
shared_strat	0.370	0.251	0.150
Construct loading onto:	firm_perf	firm_perf	firm_perf

	g4	g5	g6	g7	g8
cc_strategy	0.439	0.296	0.278	0.262	0.485
exec_support_is	0.230	0.056	0.392	0.309	0.401
alignment	0.366	0.265	0.409	0.366	0.514
joint is management	0.169	0.162	0.188	0.097	0.197
mfg_metrics	0.329	0.407	0.477	0.391	0.485
is_metrics	0.088	0.095	0.193	0.187	0.181
info_intensity	0.127	0.148	0.253	0.111	0.169
is_dependence	0.055	0.102	0.096	-0.100	-0.059
formal_interface	0.092	0.086	0.099	0.126	0.243
mutual_trust	0.107	0.127	0.266	0.183	0.332
org. learning culture	0.321	0.265	0.238	0.233	0.364
overlap_knowledge	0.296	0.181	0.123	0.157	0.281
firm_perf	0.419	0.176	0.406	0.276	0.466
is_quality	0.273	0.332	0.290	0.435	0.430
mfg_perf	0.778	0.716	0.658	0.816	0.904
it_impact	0.288	0.351	0.347	0.429	0.439
shared_ops	0.182	0.209	0.196	0.306	0.382
shared_strat	0.314	0.228	0.379	0.324	0.459
Construct loading onto:	mfg_perf	mfg_perf	mfg_perf	mfg_perf	mfg_perf

	g9	g10	g11	g12	g13
cc_strategy	0.285	0.282	0.220	0.420	0.307
exec_support_is	0.320	0.348	0.310	0.401	0.349
alignment	0.456	0.469	0.427	0.505	0.450
joint is management	0.276	0.433	0.422	0.346	0.270
mfg_metrics	0.344	0.269	0.344	0.205	0.285
is_metrics	0.218	0.278	0.180	0.260	0.300
info_intensity	0.359	0.418	0.429	0.301	0.354
is_dependence	0.021	0.371	0.249	0.116	0.076
formal_interface	0.272	0.340	0.331	0.352	0.383
mutual_trust	0.401	0.448	0.471	0.563	0.568
org. learning culture	0.248	0.396	0.389	0.264	0.189
overlap_knowledge	0.198	0.133	0.086	0.398	0.282
firm_perf	0.137	0.126	0.195	-0.005	0.084
is_quality	0.508	0.297	0.383	0.814	0.731
mfg_perf	0.568	0.292	0.424	0.424	0.417
it_impact	0.868	0.868	0.943	0.485	0.533
shared_ops	0.510	0.411	0.429	0.598	0.454
shared_strat	0.441	0.490	0.530	0.521	0.424
Construct loading onto:	it_impact	it_impact	it_impact	is_quality	is_quality