Heuristic Communication Support Systems
for Knowledge Management

by

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B. A. Economics
The University of Tokyo, 1989

Submitted to the Sloan School of Management
in Partial Fulfillment of
the Requirements of the Degree of

Master of Science in Management of Technology

at the

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ABSTRACT

Many academicians and business executives believe that we are currently in the middle of an "IT revolution," which is probably as significant as the Industrial Revolution in the last century. In this sweeping transformation, the center of economy has shifted from manufacturing to services, and the most critical resource for organizations has become "knowledge."

I believe that computer-supported "knowledge management" will be a critical factor in ensuring success in the coming knowledge-based economy. The IT revolution has enabled us to develop electronic communication support systems, which can contain more human-based items, more flexible and chaotic processes, and sufficient potential to evolve into "heuristics."

In this thesis, I define these key terms—(1) "communication support systems," (2) "heuristics," and (3) "knowledge management," and discuss the framework of Management Decision Systems by Michael S. Scott Morton in order to analyze communication support systems. In addition, I argue the key characteristics of heuristic communication support systems—(1) interpersonal learning, (2) evolving processes from "redundant learning" to "organizational intelligence stock," and (3) managing mental models.

To enhance my argument, I present two case studies—the Intranet/groupware at Fujitsu Limited as an example of heuristic use of communication support systems, and Capital One Financial Corporation as an example of an agile financial firm which has sufficient potential to evolve into a knowledge-based service enterprise armed with computer-supported knowledge management.

Finally, I discuss the interrelationships among (1) the transformation of the external environment, (2) the development of information technology, and (3) organizational/strategic focus, and conclude my argument by presenting implications, especially for the traditional dinosaur-like styles of financial firms which are struggling with the internal coordination of their knowledge asset.

Title: Jay W. Forrester Professor of Management
Acknowledgments

This thesis is the result of invaluable advice by Professor Michael S. Scott Morton, Jay W. Forrester Professor of Management, MIT Sloan School of Management. I sincerely wish to thank him for all of his continuing considerations and insightful suggestions, as well as for his clairvoyant works on Management Decision Systems, The Corporation of The 1990s, and Inventing The Organizations of The 21st Century.

One of my major objectives at MIT has been to study the latest research concerning strategy and information technology at the Sloan School, especially Professor Scott Morton’s works. Professor Scott Morton gave me a chance to realize my dream, and a series of discussions with him has become an incredibly profound learning process for me.

I wish to thank Ms. Suzanne M. Szwarzewicz, instructor of Harvard Extension School, for her clear-sighted suggestions to improve my writing presentation. She is not only an excellent English educator, but also one of the best friends of my wife. Thanks to her consideration both for me and my wife, I can sufficiently express my ideas in this thesis, as well as enjoy my life in Boston with my wife.

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I wish to express my gratitude to my friend in Fujitsu Limited, who gave resourceful information on Intranet/groupware at Fujitsu, as well as his own perspective as an individual user of these systems. His pertinent observations enabled me to make a more robust argument about communication support systems at Fujitsu.

Finally, I owe a special debt to my wife, Rika, for her patient assistance so that I could devote myself to this thesis study.
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Chapter 1

Introduction

1-1. Scope of Study

Many academicians and business executives currently believe that we are in the middle of an “IT revolution,” which is probably as significant as the Industrial Revolution in the last century. Sweeping changes have been observed in all layers of economic, social, and political frameworks, as well as in technologies. Thomas W. Malone and John F. Rockart describe this phenomenal transformation as follows:

About 150 years ago the economy in the U.S. and Europe began to undergo a period of change more profound than any experienced since the end of the Middle Ages. We call that change the Industrial Revolution. The industrial economies are now in the early stages of another transformation that may ultimately be at least as significant.

There is a critical difference this time, however. Changes in the economies of production and transportation drove the revolution of the last century. The revolution under way today will be driven not by changes in production but by changes in coordination.¹

Michael S. Scott Morton asserts that two distinctive characteristics in the on-going transformation are:

* Movement to a service economy
* Power shift to knowledge workers

¹ Malone & Rockart, 1991 (1)
To illustrate, Scott Morton indicates that in the US over 75% of all employees work for service industries, about 75% of the GDP is generated from service activities, and 75~80% of activities in manufacturing firms are services, such as R&D, marketing, and financing.²

In such a drastic shift from production to a service economy, the most critical resource for organizations has become “knowledge,” rather than physical resources, such as natural resources, plants, equipment, labor, and capital. Many noted academicians and futurists, including not only Malone, Rockart, and Scott Morton, but also Peter F. Drucker, James B. Quinn, Peter M. Senge, Tom Peters, and Lester C. Thurow, indicate the same context. I borrow the words of Thurow:

The classical theory of comparative advantage was developed to explain the geographic location of industry in the nineteenth and twentieth centuries. In the theory of comparative advantage, location of production depended upon two factors—natural resource endowments and factor proportions (the relative abundance of capital and labor)... Countries that were capital-rich (lots of capital per worker) made capital-intensive products, while countries that were labor-rich (little capital per worker) made labor-intensive products...

Today knowledge and skills now stand alone as the only source of comparative advantage (under the condition that man-made brainpower industries are dominant)... Silicon Valley and Route 128 are where they are simply because that is where the brainpower is.³

However, even given that “knowledge” will be critical for the future of organizations, no one has yet found generic answers to the question of how we can successfully manage “knowledge,” or even what “knowledge” is.

I believe that one possible clue to the answer will be computer-supported “knowledge management,” sustained by the recent dramatic improvement in information technology. Although we have already developed computer-aided problem-solving platforms, such as Management Decision Systems, Decision Support Systems, and Expert Systems, I believe that the biggest changes are now being driven by the latest IT revolution, especially in human-to-human communication support information technologies; for example, Internet technologies,

² Scott Morton, 1995 (2)
³ Thurow, 1996 (3)
hypermedia, graphical user interface, object orientation, database manager, and intelligence technology. In my view, we are now inventing new types of Management Decision Systems: communication support systems—which include more human-based items, more flexible and chaotic processes, and sufficient potentials to evolve into "heuristics."

In this thesis, I focus on "heuristic communication support systems" which primarily augment "knowledge management" in organizations. I believe that the latest communication support information technology will play key roles in changing not only workflows, but also organizational forms in the coming knowledge-based economy.

1-2. Purpose of Study

Even though we understand the importance of "knowledge," we still have numerous challenges ahead. We should recognize that "knowledge management" presents a great challenge because it includes highly mental and personal factors which are hard to formalize.

In particular, I am seriously concerned with the inefficiency among the "knowledge workers" in financial firms; for example, workers engaging in product development, credit analysis, asset allocation, sales and negotiation, and insurance underwriting. Although such workers are supposed to be in the most knowledge-based industries, and are the heaviest users of information technology, systematic computer-supported "knowledge management" in their workplaces is still an uncultivated issue. Compared with the highly systematized management schemes in the product development area of manufacturing firms, those of financial firms are virtually non-existent at the corporate level. Non-collaborative culture, high reliance upon individual artisanship, resistance to change, and a deep-rooted perspective that information systems are mere peripheral tools—these are typical detrimental factors which can be observed, especially in the traditional style of dinosaur-like banks and insurance companies.

In fact, in order to pick up relevant examples for this thesis topic, I surveyed all company profiles included in the Interesting Organizations Database—the company database which has been developed by the Inventing the Organizations of The 21st Century project at MIT Sloan School, and which includes 250 world-wide companies considered by Sloan faculty members and researchers to be "something of interest" as harbingers of innovative forms of future organizations. We can find several good examples of computer-supported "knowledge management" in agile consulting firms, law firms, accounting firms, or information technology
companies, but few in financial firms. The central interests of financial firms have been located not in internal coordination to foster innovation, but in efficiency-oriented external coordination with customers.

However, it is obvious that financial firms which can successfully manage their internal knowledge assets will survive in the coming new paradigm. Therefore, one of the main objectives of this thesis is to identify implications for financial firms so that they can develop successful “heuristic communication support systems for knowledge management.”

Because there are few relevant examples in financial firms, I first present an existing example in another industry—Fujitsu Limited in the information technology industry. Second, I extract applicable implications for financial firms from the analysis of Fujitsu. Third, I analyze an example of an agile financial firm which has enough potential to evolve into a knowledge-based enterprise—Capital One Financial Corporation. Finally, I present implications for the traditional dinosaur-like financial firms.

1.3. Thesis Outline

This thesis study is primarily based on the work by Michael S. Scott Morton, my thesis supervisor. I found that Scott Morton’s work about computer-supported problem-solving framework in the 1970s is still an up-to-date issue today; indeed, I believe that it will be an even more critical issue in the upcoming knowledge-based economy. Interestingly, in spite of a decade of rapid improvement of information technology, “unstructured” problem-solving, which is highly affected by human mental models still remains unsolved by computers. However, I believe that the latest communication support information technologies, especially intelligence technology, will shed light on this issue. This is why Scott Morton’s work is the basis of my study, and my central academic effort in this thesis is modifying and reconfiguring his work in the 1970s in terms of the latest communication support information technologies.

In Chapter 2, I start my discussion with conceptualizations and definitions of the key terminology—(1) “communication support systems,” (2) “heuristics,” and (3) “knowledge management.” Because these terms are not explicitly defined and are used in various contexts, I analyze several academicians’ arguments about them, and then present my own definitions. First, in the discussion of “communication support systems,” I focus on electronic communication support platforms for organizational use, and analyze the concepts of “groupware” and
“Intranet.” Second, in the discussion of “heuristics,” I study Herbert A. Simon’s work, as well as several arguments in the context of computer science and artificial intelligence, and present my definition in terms of organizational communication. Finally, in the discussion of “knowledge management,” I mainly argue about Ikujiro Nonaka and Hirotaka Takeuchi’s “tacit knowledge,” and make it clear what “knowledge management” is.

In Chapter 3, I analyze the framework of Management Decision Systems by Scott Morton, which is based on the combination of Herbert Simon and Robert N. Anthony’s work. The key concepts in the framework are Anthony’s management activities (operational control, management control, and strategic planning), Simon’s problem type (programmed and nonprogrammed problem), and Simon’s decision process (intelligence, design, and choice activity). Based on these three dimensions, I formalize my conceptual framework to analyze communication support systems.

Chapters 4 to 6 present the key issues in communication support systems which are extracted from the framework discussed in Chapter 3.

In Chapter 4, I discuss “interpersonal learning” and “knowledge-processing” which are benefited by communication support systems. I argue how the Internet generation of communication support systems are different from the traditional style of mainframe-base Management Decision Systems, and what advantages are provided by communication support systems.

In Chapter 5, I discuss the evolving processes of the organizational intent to communication support systems. I present four motivations to introduce communication support systems—to do things cheaper, better internally, better externally, as well as to do something in an innovative manner. I also discuss how the evolving processes change from an efficiency-oriented view—eliminating “redundant learning”—to an effectiveness-oriented view—creating “heuristics.”

In Chapter 6, I discuss about mental models which may hamper implementation of communication support systems. I present my own experience as an example in which I introduced an information support system in an insurance company, and, by using a system dynamics’ causal loop diagram, analyze how the rigid mental models impede the success of communication support systems.
The next two chapters are case studies. In Chapter 7, I study Fujitsu Limited, a large Japanese player in the information technology industry. Fujitsu has developed corporate-based Intranet and groupware, which clearly aim to manage employees' "knowledge." I discuss why communication support systems at Fujitsu are successful in terms of corporate culture, top management leadership, and implementation, and, in addition, present implications for financial firms.

In Chapter 8, as an example of one such financial firm, I study Capital One Financial Corporation, the top 10 US credit card company. I pick up Capital One not because it has already developed corporate-based communication support systems, but because it represents a successful agile management form as a prototype of the future financial firm. I discuss Capital One's vision concerning its core competencies, and how they are critical to evolving into a knowledge-based service enterprise.

In Chapter 9, I discuss the interrelations among (1) the external transformation, (2) the development of information technology, and (3) organizational/strategic focus, and conclude my argument by presenting implications especially for the traditional dinosaur-like styles of financial firms struggling with the internal coordination of their knowledge asset.
Chapter 2

Conceptualization and Definition

To begin with the discussion about heuristic communication support systems for knowledge management, I need to define each concept of the terminology which I use in this thesis—(1) “communication support systems,” (2) “heuristics,” and (3) “knowledge management.”

These terms are, as far as my observation is concerned, less explicitly defined, and have not yet become established concepts. In addition, in this thesis, I define and use the terms of “heuristics” and “communication support systems” in my own context which may sound a little unusual for some experts. Therefore, in this chapter I first discuss the basic definitions, or arguments, of these terms, and then present my own conceptualizations and definitions of them.

2-1. Communication Support Systems

First of all, I would like to discuss the phrase—“communication support systems.” “Communication support systems,” in a generic sense, are information systems which assist us in communicating. Thus, they may include most common platforms, such as the telephone and facsimile. However, in this thesis, I focus on the latest technologies, such as groupware and Intranet, which allow us to communicate in more visual and flexible electronic formats, and which are mainly used for organizational communication, coordination, and collaboration.

The most critical point which I want to assert is that these “communication support systems” have enough potential not only to convey information, but also to codify “knowledge” and to stimulate us to develop innovative ideas. I regard them as catalysts of innovation, or “heuristic” problem-solving tools, rather than mere substitutions of the telephone. In other words, I am interested in “organizational communication for problem-solving.” In this sense, my
primary research perspective focuses on "communication support systems" as the descendants of Management Decision Systems or Decision Support Systems, which are supposed to assist problem-solving processes in organizations.

**Groupware and Intranet**

Hence, I need to specifically define the terms of "groupware" and "Intranet" as "communication support systems."

According to Robert R. Johansen, the term "groupware" is defined as:

A generic term for specialized computer aids designed for the use of collaborative work groups, such as business teams.¹

Johansen and Christine V. Bullen also discuss "groupware" in the following way:

Groupware is not a thing. Rather it is a perspective on computing that emphasizes collaboration—rather than individual use. Groupware is a step in the transition from the personal computer to the interpersonal computer.²

Setrag Khoshafian and Marek Buckiewicz, experts in database technology and technical communication, define "groupware," as well as its key technologies, as follows:

Groupware is an enabling technology that addresses the vast areas of collaboration, human-computer interaction, and human-human interaction through digital media to bring substantial improvement and transformation to organizations...

Groupware builds upon the latest advances in information technology, utilizing and building upon local and wide area networking, as well as all recent advances in software and hardware technologies to achieve both communication and collaboration goals...

The four main categories of information technologies which are used to build groupware are: multimedia interfaces, communication and information sharing technologies, object-oriented technologies, and artificial intelligence (see [Exhibit 2-1]).³

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¹ Bullen & Bennett, 1990 (1)
² Bullen & Johansen, 1988 (2)
³ Khoshafian & Buckiewicz, 1995 (3)
These descriptions indicate the conceptual variation of “groupware.” Some academicians insist that any platform which supports collaborative work can be characterized as “groupware.” However, here I focus on the electronic platforms which enable us to communicate in digital format; to be more specific, using such products as Lotus Notes and Novel GroupWise.

Moreover, as I will discuss in Chapter 4, one of the most distinctive characteristics of “communication support systems” is, I believe, that they are ubiquitous and interpersonal information systems, rather than single-user computers.

Khoshafian and Buckiewicz, based on Johansen’s work, explicitly illustrate types of “groupware,” by two dimensions of communications: time and place. In this thesis, I am unanimous with their illustration of “groupware,” as shown in [Exhibit 2-2].
Exhibit 2-2: Time/Place Categories of Groupware

On the other hand, the definition of “Intranet” is much less explicit, and sometimes we confuse the terms “groupware” and “Intranet.” Mellanie Hills discusses:

An Intranet is simply a small-scale version of the Internet inside your organization. A firewall keeps out intruders from the outside. The Intranet typically uses World Wide Web (WWW or Web) tools, such as Hypertext Markup Language (HTML), Common Gateway Interface (CGI) programming, and Java. You can get all the functionality of an Internet on your own private Intranet inside your company.⁴

In short, we can say that, “groupware” is the term to define how information technology is used—supporting collaborative works—while “Intranet” is to define what kind of information technology is used—Internet-based platform which is used within an organization. Thus, we cannot discuss “groupware” and “Intranet” as parallel categories; for example, the latest version of Lotus Notes Domino is a “groupware” product which is used on an “Intranet” platform.

My Conceptualization and Definition

In this thesis, I do not cling to the detailed difference of definition between “groupware” and “Intranet.” Rather, I use these terms simply under the definition that “groupware/Intranet” is an electronic “communication support system” for organizational use, which provides the means

---

⁴ Hills, 1997 (4)
to communicate digital information, to display information in a multimedia graphical-user-
interface (GUI) environment, and to search vast warehouses of information.

2-2. Heuristics

My second discussion is about the adjective—“heuristic.” Although “heuristics” is the
most important concept in this thesis, as far as I have observed, the definition of “heuristics” is
also less explicit, and the term is used in a wide variety of contexts in various academic fields.
Therefore, I first survey several definitions in terms of business, as well as cognitive science and
computer science; and, second, present my own definition in this thesis.

Various Definitions

The word “heuristics” is said to originally come from the ancient Greek word
“heuristskein” which means “to find out, to discover.” According to the Random House
Dictionary, the English definition goes as follows:

Heuristics—adj. 1) serving to indicate or point out, stimulating
interest as a means of furthering investigation. 2) (of a teaching
method) encouraging the student to discover for himself.
—n. 3) a heuristic method or argument.5

Apart from these basic definitions, we can find that academicians use the term
“heuristics” in various ways. To illustrate, Matt Ginsberg defines “heuristics” as “rules of
thumb” for deciding what to do.6 This seems to be the most common definition of “heuristics,”
as both Herbert A. Simon and Michael S. Scott Morton use this term in their arguments. On the
other hand, Elizabeth Olmsted Teisberg uses the term as “the way of thinking about problems,”
and argues that “heuristics” can be “cognitive biases” which may mislead managers’ decision
processes.7 Mark Cutkosky, Jay Tenenbaum, and Jay Glicksman, in the discussion of the
Internet-based collaborative design processes, use the term “heuristics” as “inferring connection
between queries and documents.”8 Here, we are still unclear about what “heuristics” is—is it a
“rule of thumb,” “cognitive bias,” or “inferring connection”?

5 Findler, 1995 (5)
6 Ginsberg, 1993 (6)
7 Teisberg, 1993 (7)
8 Cutkosky, Tenenbaum, & Glicksman, 1996 (8)
Herbert Simon’s Definition

We can find a more rigorous definition of “heuristics” in computer science and cognitive science; “heuristic programming” is one of the major themes in artificial intelligence. Herbert A. Simon, prominent cognitive scientist who won the Nobel Prize for his profound analysis of decision-making processes, discusses “heuristic programming” as follows:

In solving problems, human thinking is governed by programs that organize myriad of simple information process into orderly, complex sequences that are responsive to and adaptive to the task environment and the clues that are extracted from that environment as the sequences unfold. Since programs can be written for computers, these programs can be used to describe and simulate human thinking ...

Perhaps the most interesting program of this kind is one labeled GPS (General Problem Solver). It is called GPS not because it can solve any kind of problem—it cannot—but because the program itself makes no specific reference to the subject matter of the problem... GPS does succeed in capturing some aspects of problem solving that have always been thought to be part of its mystery. For example, we can show by comparison with the human protocols that sudden insight of the "Eureka!" type sometimes takes place at the moment at which the subject successfully applies the planning methods and obtains a plan to guide his detailed solution...
Programs which, like GPS, carry out complex information processes by using the same kind of selectivity in exploration, the same sorts of rules of thumb as are used by humans, are coming to be called heuristic programs.9

For example, a computer program for playing chess is an illustrative example of “heuristic” programming. Simon also asserts that “heuristic programming” should not be limited to numerical processes, but be borrowed from the less systematic processes that humans use in handling complex information processing tasks that have not been reduced to algorithm, and that this program will supplement natural intelligence with artificial intelligence in management decision-making.10

9 Simon, 1960 (9)
10 Ibid, (10)
Definition in Artificial Intelligence

The Encyclopedia of Computer Science (1995), based on a description by Nicholas V. Findler, tells us a further specific definition of "heuristics."

Let us now consider a so-called ill-defined problem, and we have many of them in everyday life. For example, say we want to balance our household budget by following a program. Although our basic needs are well known (food, shelter, clothing, medical items, transportation, entertainment, etc.), neither the relative weight of the components nor their unit price are determinable completely. Also, our needs, desires, and tastes change continually. Our interaction with the environment represents a significant modifying factor. Because this problem is terribly ill-defined, no mathematical techniques by itself has a chance to solve it. The computerization of the solution requires all those vague hard-to-quantify ideas that humans in fact make use of doing this problem. The collection of these rules of thumb, something referred to as insight, intuition, or experience with a particular task, represents what computer science call "heuristics" (plural noun). Any one such rule is thus a heuristic (singular noun). 11

Simon and Findler's descriptions help us understand the basic concept of "heuristics."

Finally, I want to cite the Matt Ginsberg's argument in terms of artificial intelligence. In a search problem like the one illustrated in [Exhibit 2-3], Ginsberg indicates that finding the best node to expand next is the critical decision to help us find the optimal way to a goal.

Exhibit 2-3: A Search Problem

Source: Ginsberg, 1993

11 Findler, 1995 (11)
According to Ginsberg, a “blind search” is simply to pick up a node at random, while a “heuristic search” is, first, to expand the entire tree below each node; second, to guess how far each node is from the goal; and finally to progress along the one we thought to be closest. Obviously, there is a trade-off in problem-solving between spending time actually solving the problem and spending time deciding how to solve the problem. Ginsberg refers to the effort expended in actually trying to solve the problem as “base-level activity”; the work spent deciding what to do is called “metalevel activity.” He asserts that in a “blind search,” no time is spent at the “metalevel,” while in an efficient “heuristic search,” time spent at the “metalevel” is recovered by corresponding reductions in the amount of time required to solve the problem at the “base level.”

In summary, in the basic context of computer science and cognitive science, “heuristics” can be defined as a collection of “rules of thumb” which may support the search for the most optimal way in problem-solving through guessing the nearest route to the goal.

As a simple example of a “heuristic search,” Ginsberg discusses an 8-puzzle solution.

Consider the instance of the 8-puzzle shown in [Exhibit 2-4], and suppose that our goal is to arrange the tiles from 1 to 8 clockwise around the edge of the puzzle.

![Exhibit 2-4: Heuristic Search—8-Puzzle](image)

If we estimate the distance to the goal by simply counting the number of misplaced tiles, then we will expect it to take three moves to solve the problem since three are misplaced there (The 6, 7, and 8 are all misplaced). If we move the 6 to the right, then only two tiles are misplaced. Moving the 8 down leaves the heuristic estimate of the distance to the goal unchanged, while moving the 5 to the left actually increase the expected distance. We summarize this below.

<table>
<thead>
<tr>
<th>Blank Moves</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>left</td>
<td>2</td>
</tr>
<tr>
<td>right</td>
<td>4</td>
</tr>
<tr>
<td>up</td>
<td>3</td>
</tr>
</tbody>
</table>
We see from this that if our heuristic search is to move as quickly toward the goal as possible, we will select the move of moving the blank to the left.\textsuperscript{12}

\textit{My Conceptualization and Definition}

The discussion by Ginsberg of a “heuristic search” helps me develop my own conceptualization of “heuristic communication support systems.”

According to Ginsberg, a “heuristic search” process consists of:

(1) Expanding the decision tree
(2) Guessing how far each node is from the goal
(3) Pursuing the one we think to be the closest
(4) Reaching the goal

In my context of “heuristic communication support systems,” these steps can be modified as follows:

(a) Accessing to the “knowledge base,” which includes the results of random information exchange
(b) Searching information by keywords—e.g. counting the number of keywords included in the text data
(c) Selecting most relevant information from the “knowledge base”—e.g. sorting selected information by the number of keywords included in the whole text
(d) Obtaining hints or direct answers—sometimes it may lead us to “Eureka!”-type findings

In a “heuristic search,” step (1), expanding nodes, is the “metalevel activity,” and step (2), guessing, and (3), pursuing, depend on “rules of thumb” which are developed through human insight, intuition, or experience.

In communication support systems, such as groupware and Intranet, we can replicate the same process. In step (a), developing a “knowledge base” through random information exchange can be regarded as the “metalevel activity” of a “heuristic search.” The large benefit of these communication support systems is that, once this “knowledge base” is developed as an

\textsuperscript{12}Ginsberg, 1993 (12)
organizational common intelligence database, individual users do not have to repeat the "metalevel activity" in each search. In steps (b) and (c), Internet technologies such as WAIS (Wide Area Information Server) and Intelligent Agents will help this process almost automatically. In step (d), users can obtain hints or direct answers for their problems, and, as more important benefits, sometimes this problem-solving process via communication support systems may generate totally innovative ideas—the “Eureka!”-type findings described by Simon.

Based on this modification, it may sound that my idea of “heuristic communication support systems” is nothing new from the past context. However, I want to infuse the word “heuristics” with additional meaning: in a “heuristic” process, the learning program itself can continuously evolve. To explain this aspect, I want to cite a discussion by Findler describing the limit of the existing “heuristic” programs.

Except for some introductory efforts, present heuristics are all preprogrammed in artificial intelligence projects. In other word, it is not the machine that discovers, selects, and optimizes the rule that play an increasingly important role in many problem-solving programs. The performance level of these programs is determined by the researcher’s experience, insight, and perhaps even luck. A much more desirable situation would be the one in which heuristic processes are automated. Learning programs, initially inefficient and possibly even random in their actions, would gradually formulate more and more heuristics on the basis of experience. These heuristics assume a flexible, or parametric, format, so that subsequent optimization processes could raise the overall performance.13

This argument illustrates the most critical point which I want to assert about “heuristics” in this thesis. “Heuristics,” in my context, are not automated solution providers, or built-in “rules of thumb,” where performance levels are restricted by past knowledge of experts. I believe that “heuristics” are more flexible support of problem-solving whose functions themselves evolve through random information exchange and learning, and which may sometimes help us create a thoroughly innovative idea—one which does not directly come from past expertise, but from a random combination of on-going human “knowledge.” In this sense, I want to assert that built-in “heuristic” programs are less flexible than the human-to-human communication-based “heuristic” architecture, such as groupware and Intranet. As I will discuss in Chapter 4, one of

13 Findler, 1995 (13)
the outstanding advantages of communication support systems as “heuristics” is that on-going human intelligence can be continuously inputted and accumulated through random information exchange, whereas the traditional single-user Management Decision Systems mainly depend on past data.

According to Khoshafian and Buckiewicz, the existing “groupware” should be regarded as the “first-generation,” because they have not yet sufficiently included intelligence technologies (see [Exhibit 2-1]). The new type of groupware, which they call the “second-generation,” will incorporate artificial intelligence capabilities which have the ability to learn from knowledge, as well as to make proactive suggestions as “Intelligent Agents.”14

My conceptualization of “heuristic communication support systems” is unanimous with Khoshafian and Buckiewicz’s second-generation of groupware. To predict how the second-generation of communication support systems will develop in the near future, the recent research on Intelligent Agents gives us some hints.

Fah-Chun Cheong discusses “Agents,” and cites the definition by Ted Selker, IBM Almaden Research Center: “Agents” are computer programs that simulate a human relationship by doing something that another person could otherwise do for you. He argues that “Agents” can be studied in such dimensions as coordination, knowledge, creativity, and emotion, and presents several examples, such as Conference-support Agents (‘M’ by the AT&T Bell Laboratories, 1994), Teaching Agents (‘COACH,’ Cognitive Adaptive Computer Help by IBM Almaden Research Center, 1994), and Learning Agents (‘CAP,’ Calendar Apprentice by Carnegie Melon University, 1994).15

I expect that these new technologies based on artificial intelligence will enhance the current functionality of communication support systems, and make them evolve into the second-generation, which I call “heuristic communication support systems.”

In summary, I define “heuristics” as functions, typically artificial intelligence-based information systems or computer programs themselves, which can support us in finding the goal based on “rules of thumb” acquired through experience or insight, and which sometimes may lead us to discover something innovative through the random combination of on-going human “knowledge.”

14 Khoshafian & Buckiewicz, 1995 (14)
15 Cheong, 1996 (15)
2-3. Knowledge Management

Finally, I will discuss the term—"knowledge management." Some experts predict that "knowledge management" will be the most popular buzzword, coming after "business process reengineering." I agree with this view because, in such an economy where central activity has shifted from manufacturing to service, the most crucial key factor of differentiation for organizations must be "knowledge."

Peter F. Drucker clearly relates that, in the new economy, "knowledge" is not just another resource alongside the traditional factors of production—labor, capital, and land—but the only meaningful resource today.\(^\text{16}\) James B. Quinn shares the similar view that the economic and producing power of a modern corporation lies more in its intellectual and service capabilities than in its hard assets, such as land, plant, and equipment.\(^\text{17}\) However, although many academicians and business executives use the word "knowledge," I must again confront the less explicit definition of the term.

Some argue that "knowledge" is the same as know-how, which can be codified as a generic rule of organizations. Others insist that "knowledge" is highly personal intelligence or an individual intent which cannot be summarized. The argument here is whether "knowledge" is only that of individual or can be that of organizations, and whether "knowledge" can be shared by organizational members or not. To alleviate this argument, as well as to more clearly understand the concept of "knowledge" and "knowledge management," I want to survey the arguments of several academicians.

The Origin of "Knowledge Management"—Frederic W. Taylor

In my belief, the origin of "knowledge management" can be ascribed to the "scientific management" described by Frederic W. Taylor in the last century. Drucker discusses this issue in the excerpt below:

Before Taylor, the only way to get more output was to work harder and longer. But Taylor saw that the way to get more output was to "work smarter"; that is, more productively. He saw that the productivity of work is not the responsibility of the worker but of the manager. Taylor also saw—although he never formulated the insight into a theory—that productivity is the result of the

\(^{16}\) Drucker, 1993 (16)
\(^{17}\) Quinn, 1992 (17)
application to work of the specific human capital resource, knowledge. Taylor applied knowledge to human labor, and, in accordance with the nineteenth-century realities, to manual labor... Taylor assumed that most people are "average." But his assumption has proved wrong, especially for work requiring skill and knowledge.18

I understand the only conceptual limitation of Taylor was—though a natural conclusion in the 19th century—that he omitted individual worker’s “knowledge,” and focused only on organizational “knowledge” which could be created by a smart manager. However, as Drucker indicates, nowadays in a service economy, it has also become critical for organizations to manage worker’s “individual knowledge,” together with “organizational knowledge.”

Ikujiro Nonaka and Hirotaka Takeuchi, professors of Hitotsubashi University in Japan, assert the same flaw in Taylorism.

Scientific management was founded by Frederick W. Taylor, who tried to eliminate the "soldiering" of workers and to replace "rules of thumb" with science, thereby increasing efficiency in production... The "scientific management" was an attempt to formalize workers’ experiences and tacit skills into objective and scientific knowledge. However, it failed to perceive the experiences and judgment of the workers as a source of new knowledge.19

Nonaka and Takeuchi’s “Knowledge Creation”

Nonaka and Takeuchi—though, as I discuss later, I am not totally unanimous with their arguments—take a very different position from the Western scientific view, as Drucker. They assert that Taylor, as well as cognitive scientists including Herbert Simon, neglected the human perspective of “knowledge.”

Strongly influenced by the development of the computer and cognitive science, Simon investigated the nature of human problem-solving and decision-making, and developed a view of the organization as an "information-processing machine."...

For Simon, implicit knowledge is nothing more than noise, and the logical content of human reasoning and decision-making is far more important than such things as value and meaning.

18 Drucker, 1993 (18)
19 Nonaka & Takeuchi, 1995 (19)
This Cartesian-like rationalist view led him to neglect the human potential for creating knowledge both at the individual and organizational levels; he failed to see human beings as those who actively discover problems and create knowledge to solve them...

In sum, the view of knowledge in the science of strategy is similar to that of Taylorism. Emphasis is put on logical and analytical (i.e., deductive and inductive) thinking, as well as on the use of existing explicit knowledge at the top of the organization. Unquantifiable human factors, such as values, meanings, and experiences, are excluded from formal business planning and deployment of strategic resources.20

As an alternative to Taylorism, or the scientific approach, they propose the management of "tacit knowledge" which, they say, Japanese manufacturing firms understand and control very well, especially in product development phases. They define the concepts of "tacit knowledge," as well as "explicit knowledge" as follows:

Tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or to share with others. Subjective insights, intuitions, and hunches fall into this category of knowledge. Furthermore, tacit knowledge is deeply rooted in an individual's action and experience, as well as in the ideals, values, or emotions he or she embraces.

To be more precise, tacit knowledge can be segmented into two dimensions. The first is the technical dimension, which encompasses the kind of informal and hard-to-pin-down skills or crafts captured in the term "know-how." At the same time, tacit knowledge contains an important cognitive dimension. It consists of schemata, mental models, beliefs, and perceptions so ingrained that we take them for granted...

Tacit knowledge is personal, context-specific, and therefore hard to formalize and communicate. Explicit or "codified" knowledge, on the other hand, refers to knowledge that is transmittable in formal, systematic language.21

20 Nonaka & Takeuchi, 1995 (20)
21 Ibid, (21)
They insist on the importance of individual experience, or "learning by doing," and also assert that Peter M. Senge's system dynamics approach, influential concepts presented in his study on the "learning organization," omits impact by learning from bodily experience.22

Based on this discussion, Nonaka and Takeuchi create the "four modes of knowledge conversion" as illustrated in [Exhibit 2-5].

![Four Modes of Knowledge Conversion Diagram]

Source: Nonaka & Takeuchi, 1995; Modified by Author

Exhibit 2-5: Four Modes of Knowledge Conversion

They assert that the organization cannot create "knowledge" its own without the initiative of the individual, and that "tacit knowledge" of individuals is the basis of organizational "knowledge" creation. This process requires frequent and laborious interactions within the organization, and individual "knowledge" can be amplified or crystallized at the organizational level through intensive dialogue, discussion, experience sharing, and observation—they call this process the "knowledge spiral."

According to their definition, each step can be described as follows:

- Socialization:
  
The process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills. An individual can acquire tacit knowledge directly from others without using language—such as OJT, apprenticeship, and formal/informal camp sessions or drinking sessions. As a good example, they propose the new-product development team members at Canon, who hold camp

22 Nonaka & Takeuchi, 1995 (22)
sessions (gashuku) at a local hotel over a weekend to brainstorm through a critical problem or issue. They insist that the key to acquiring tacit knowledge is experience.

- Externalization:

  The process of articulating tacit knowledge into explicit concepts, taking the shapes of metaphors, analogies, concepts, hypotheses, or models. The leaders’ wealth of figurative language and imagination is an essential factor in eliciting tacit knowledge from project members. They say, as an example, that the concept of the disposable low cost cartridge cylinder of the Canon Mini-Copier came from the analogy of a disposable beer can.

- Combination:

  The process of systematizing concepts into a knowledge system through such media as documents, meetings, telephone conversations, or computerized communication networks. They say that reconfiguration of existing information through sorting, adding, combing, and categorizing of explicit knowledge can lead to new knowledge.

- Internalization:

  The process of embodying explicit knowledge into tacit knowledge. For explicit knowledge to become tacit, it helps if the knowledge is verbalized or diagrammed into documents, manuals, or oral stories. When tacit mental models are shared by most members of the organization, tacit knowledge is re-experienced by the members and becomes part of the organizational culture.

Therefore, based on their discussion, the Western scientific approach deals with only the combination phase, while Japanese manufacturing firms manage all four phases successfully.

**Counterargument to Nonaka and Takeuchi**

Although I share the same cultural context with Nonaka and Takeuchi, I do not feel comfortable with their discussion. In particular, I disagree with their oversimplification and hasty generalization of the contrast between the Western approach, as science and theory-oriented, and the Japanese approach, as mental and human relation-oriented. I do not believe that Japanese ambiguous and highly informal interactions, like drinking sessions, can always be powerful
sources of success; rather, I feel we are facing formidable challenges in which such unsystematic knowledge creation processes have become inefficient encumbrances, especially among “knowledge workers” of financial firms. I believe that in Japanese financial firms, managers who are in charge of knowledge workers need to learn more systematized management frameworks which help them to eliminate useless redundancies.

For example, “system thinking,” one factor of Peter Senge’s “fifth discipline,” helps us to clearly understand even “tacit” mental models. Senge indicates that just as the great improvisational jazz musicians build their capability on years of disciplined music training, so must business groups seeking to manage tacit knowledge develop the discipline in reflection, listening, and conceptualization. He also asserts that when tools like system dynamics are used effectively in real work settings, they serve to enable people to reflect on and conceptualize their tacit knowledge, and to build better theories more collaboratively.23 I agree with Senge’s view, and would like to point out that Nonaka and Takeuchi fail to understand that system dynamics can conceptualize even “tacit” mental models. In Chapter 6, I will analyze an example of rigid mental models in a Japanese insurance firm by using system dynamics.

Moreover, I do not think that, as Nonaka and Takeuchi insist, Herbert Simon omits the tacit aspect of “knowledge.” Simon asserts that theoretically, the human brain mechanism, even “Eureka!”-type findings, can ultimately be broken down into “structured” pieces which can be programmed. At the same time, I believe, he also understands that artificial intelligence will support human intelligence, but will not replace it. Simon never omits the soft mechanism of human thinking.

Although I cannot accept all of the assertions by Nonaka and Takeuchi, I find several important implications in their discussion. First, they clearly define the relationship between “individual knowledge” and “organizational knowledge”; originating as “individual tacit knowledge,” and then through intensive interaction within an organization, including (1) experience, (2) articulation, (3) reconfiguration, and (4) re-experience, it finally becomes “organizational knowledge.”

Second, the existing computer-based communication support systems, like Khoshafian and Buckiewicz’s first generation of groupware, may focus only on the combination phase, and omit the other three phases, which consist of experience, mental models, and the other human

23 Discussion with Senge, 1997 (23)
factors. As Findler discusses, if communication support systems are mere replications of past knowledge of experts, Nonaka and Takeuchi’s argument will probably be accurate. However, I believe that the second generation of communication support systems will move closer to “tacit” knowledge management tools.

Sveiby’s “Intangible Assets” Model

To understand the objective of “knowledge management” more precisely, I would like to look at another approach which clearly illustrates the relationship between “individual knowledge” and “organizational knowledge.”

According to Karl E. Sveiby, a Swedish academician and consultant, the term of “knowledge management” should be defined as “the art of creating value from an organization’s intangible assets.” He presents a model as illustrated in [Exhibit 2-6], and defines “intangible assets” as the summary of “corporate know-how,” “corporate image,” and “individual competence,” which is calculated by the difference between the market value and the net book value of a company. Sveiby asserts that the “intangible assets” are the primary targets of “knowledge management” which enable an organization to create value.²⁴

To be more specific, Sveiby argues that the “intangible assets” consist of:

- Corporate Know-How

  “Corporate know-how” is an internal structure, which consists of professional know-how—systems, rules, programs, manuals, and concepts that have been developed by the professionals as separate R&D projects or in cooperation with their customers—and organizational know-how—strategy making, marketing, planning, accounting, management, etc.

- Corporate Image

  “Corporate image” is an external structure, which includes the reputation gained from solving customers’ problems successfully, brand images, and trademarks.

- Individual Competence

  “Individual competence” is people’s ability to act in various situations, and includes technical skills, education, experience, values, and social skills.

²⁴ Sveiby, 1994 (24)
Sveiby also asserts that these “intangible assets” are measured by the difference between the book value and market value of the balance sheet, which consists of “shareholders’ invisible equity” and unpaid “obligations” to stakeholders.

This illustration by Sveiby helps us understand that “knowledge” encompasses both the organizational level—“corporate know-how” and “corporate image”—and the individual level—“individual competency,” and that they are the targets of “knowledge management” in order to create value. To apply Nonaka and Takeuchi’s argument to Sveiby’s, we can say that “individual competence” can be overlapped with “tacit knowledge.”

**My Conceptualization and Definition**

In summary, and in my definition, “knowledge” consists of two layers: the individual level and organizational level. It originates as an “individual knowledge,” which is highly “tacit,” experience-oriented, and sometimes hard to communicate; and then, through intensive human-to-human interactions within an organization, it becomes an organizational “knowledge,” which can be shared by the members. “Knowledge management” aims at organizing the
processes of (1) creating “individual tacit knowledge,” (2) sharing it among the members, and (3) accumulating it at an organizational level (“explicit knowledge”). However, organizing these processes is very challenging because “knowledge” includes highly personal and soft aspects which are hard to formalize.

2-4. Chapter Summary

Although this thesis is about “heuristic communication support systems for knowledge management,” these terms—(1) “communication support systems,” (2) “heuristics,” and (3) “knowledge management”—are not explicitly defined words. Thus, I have defined these terms based on my conceptualization, as well as the arguments of other academicians.

“Communication support systems” are platforms which allow us to communicate in visual and flexible electronic formats, and which are mainly used for organizational purposes. Typically, in this thesis, I focus on groupware and Intranet as the latest technology. I regard them both, especially the “second generation” which incorporates artificial intelligence technology, as catalysts of innovation through random information exchange, rather than mere substitutions of the telephone.

“Heuristics” are functions, typically artificial intelligence-based information systems or computer programs themselves, which can support us in reaching our goal based on “rules of thumb” acquired through experience or insight, and sometimes may lead us to invent something innovative through the random combination of on-going human “knowledge.” I consider “heuristics” to be unrestricted by past “knowledge” of experts, and capable of including continuous evolving processes through random human-to-human communication.

“Knowledge” consists of two layers: “individual knowledge” and “organizational knowledge.” Originating as the former, “knowledge” evolves into the latter through intensive communication within an organization. “Knowledge management” aims at organizing the processes of (1) creating “individual tacit knowledge,” (2) sharing it among the members, and (3) accumulating it at an organizational level. “Knowledge management” is challenging because it must deal with highly personal items, but it will be a source of creating intangible value for an organization.
Chapter 3

Framework of Analysis

As I discussed in Chapter 2, I am most interested in such aspects of "communication support systems" as the descendants of Management Decision Systems or Decision Support Systems, which assist problem-solving processes within organizations. Thus, in order to examine this aspect, I first present a framework by Michael S. Scott Morton for analyzing Management Decision Systems, and then propose my modification of it for analyzing communication support systems.

Surprisingly, in spite of over 25 years of rapid progress in information technology, Scott Morton's original discussion about computer-supported problem-solving in 1971 is still an up-to-date issue. Although information technology has provided us numerous solutions and improvements, the successful management of "unstructured" decision processes, including tacit knowledge management, is a problem which has yet to be solved by computers. However, the latest technologies like communication support systems, which are more human-based and can deal with softer information, may help us cope with this problem. This is why, in this thesis, I have primarily based my argument on the work by Scott Morton. The argument raised by him in the 1970s will be, I believe, one of the central issues for organizations in the upcoming knowledge-based economy.

3-1. Framework by Scott Morton

Anthony's Management Activity

First of all, I want to survey the framework by Scott Morton as the basis of my argument. Scott Morton developed a two-dimensional framework to understand the evolution
and problems of Management Decision Systems by combining the work of Robert N. Anthony and Herbert A. Simon.

The first dimension proposed by Anthony is management activity: strategic planning, management control, and operational control. Anthony argues that this taxonomy sufficiently represents any kind of organizational activities relating to managerial issues. According to Anthony, these three categories can be defined as follows:

Strategic planning is the process of deciding on objectives of the organization, on changes in these objectives, on the resources used to attain these objectives, and on the policies that are to govern the acquisition, use, and disposition of these resources...

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 control is the process of assuring that specific tasks are carried out effectively and efficiently.¹

Based on this definition, Scott Morton further expands the discussion, and explicitly defines the characteristics of these categories.

Strategic planning is concerned with setting broad policies and goals for the organization. As a result, the relationship of the organization to its environment is a central matter of concern. Also, the nature of the activity is such that predictions about the future are particularly important. In general, then, we can say that the information needed by strategic planners is aggregate information, and obtained mainly from sources external to the organization itself. Both the scope and variety of the information are quite large, but the requirements for accuracy are not particularly significant. Finally, the nonroutine nature of the strategic planning process means that the demands for this information occur infrequently.

The information needs for the operational control area stand in sharp contrast to those of strategic planning. The task orientation of operational control requires information of a well-defined and narrow scope. This information is quite detailed and arises largely from sources within the organization. Very frequent use is made of this information, and it must therefore be accurate.

¹ Anthony, 1965 (1); Anthony, 1965 (2)
The information requirements for management control fall between the extremes of operational control and strategic planning. In addition, it is important to recognize that much of the information relevant to management control is obtained through the process of human interaction.2

Scott Morton also asserts that “strategic planning” is not necessarily restricted to senior executives, and that, similarly, “operational control” is not always made by clerical staff. To illustrate, when a senior executive makes a long-term plan of R&D investment, it must be regarded as “strategic planning”; when he/she considers reallocation of factory managers, it is “management control”; and when he/she checks the figures of monthly sales reports, it is “operational control.”3

Simon’s Programmed and Nonprogrammed Problems

The second dimension is problem types, or decision types proposed by Simon: programmed and nonprogrammed problems. Simon argues that, in problem-solving processes, we can distinguish between “programmed” and “nonprogrammed” decisions regardless of the decision-maker’s position within an organization.

Decisions are programmed to the extent that they are repetitive and routine, to the extent that a definite procedure has been worked out for handling them so that they do not have to be treated de novo each time they occur. The obvious reason why programmed decisions tend to be repetitive, and vice versa, is that if a particular problem recurs often enough, a routine procedure will usually be worked out for solving it. Numerous examples of programmed decisions in organizations will occur to you: pricing ordinary customers’ orders; determining salary payments to employees who have been ill; reordering office supplies.

Decisions are nonprogrammed to the extent that they are novel, unstructured, and consequential. There is no cut-and-dried method for handling the problem because it has not arisen before, or because its precise nature and structure are elusive or complex, or because it is so important that it deserves a custom-tailored treatment. General Eisenhower’s D-Day decision is a good example of a nonprogrammed decision.4

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2 Scott Morton & Gorry, 1971 (3)
3 Discussion with Scott Morton, 1996 (4)
4 Simon, 1960 (5)
Scott Morton uses the terms “structured” and “unstructured” instead of “programmed” and “nonprogrammed,” because they imply less dependence on the computer and more dependence on the basic character of the problem-solving activity in question. Scott Morton discusses the difference between decisions for “structured” and “unstructured” problems as follows:

The basis for the difference is that in the unstructured case the human decision-maker must provide judgment and evaluation, as well as insights into problem definition. In a very structured situation, much if not all of the decision-making process can be automated.\(^5\)

**Combination of Anthony and Simon**

Based on Simon’s work, Scott Morton regards the intermediary zone between “structured” and “unstructured” problems as critically important in the practical business world, and calls it the “semi-structured” problem.

I believe that we do not need any heuristic support to solve *perfectly* “structured” problems, because in such case the problem-solving processes can be completely automated. In addition, heurstics may not work well to *completely* solve “unstructured” problems, like that of Eisenhower’s D-Day decision, in which successful decisions may depend on pure insight by individual genius. Therefore, I am totally in agreement with Scott Morton, and consider that the central focus of organizational problem-solving processes should be on “semi-structured” problems; in other words, we should imagine a spectrum with the “semi-structured” problem as the center, the “structured” and “unstructured” problem as the two ends.

Combining these two dimensions, Scott Morton illustrates an analytical framework of Management Decision Systems as shown in the [Exhibit 3-1].

In 1971, Scott Morton argued that up to that time computers had had almost all of their impact in the “structured & operational” and “structured & management” cells, with some in the “structured & strategic” cells, and virtually none elsewhere. However, from the management standpoint, almost all interesting and important management problems lie in the “semi-structured” and “unstructured” zone.\(^6\)

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5 Scott Morton & Gorry, 1971 (6)  
6 Scott Morton, 1971 (7)
It is surprising to me to find that, in spite of over 25 years of remarkable progress in information technology, the basic problem in computer-supported decision processes, which Scott Morton pointed out in 1971, has essentially been unsolved. Although we have continuously been reinforced by advanced information technologies, we are still struggling to discover successful control in “semi-structured” and “unstructured” decision processes.

Exhibit 3-1: Framework of Management Decision Systems

Source: Scott Morton & Gorry, 1971

Simon’s Decision Process Types

To define the “semi-structured” problems, Scott Morton also cites the classification of decision process types by Simon. Simon claims that all problem-solving processes in any part of a business can be broken up into three phases: intelligence, design, and choice.

Decision-making comprises three principal phases: finding occasions for making a decision; finding possible courses of action; and choosing among courses of action...

The first phase of the decision-making process—searching the environment for conditions calling for decision—I shall call intelligence activity (borrowing the military meaning of intelligence). The second phase—inventing, developing, and analyzing possible courses of action—I shall call design activity.
The third phase—selecting a particular course of action from those available—I shall call choice activity.7

Scott Morton asserts that if one or two of the “intelligence,” “design,” and “choice” phases are “unstructured,” the whole problem can be called “semi-structured.” On the other hand, a fully “structured” problem is one in which all three phases are “structured,” and thus it can be automated or programmed. An “unstructured” problem is one in which none of the three phases is “structured.”8

3-2. Framework of Communication Support Systems

Three Dimensional Framework

In this thesis, my central interest is communication support systems as the descendants of Management Decision Systems, rather than as simple platforms to convey information; in other words, I focus primarily on “organizational communication for problem-solving.” In addition, I consider that communication support systems will provide better solutions for semi-structured and unstructured problems than single-user information support systems through human-to-human random interaction. Thus, it is relevant that my scope for analyzing communication support systems follows that of Management Decision Systems by Scott Morton.

However, formalizing an analytical framework for communication support systems is more challenging because “communication for problem-solving” is less organized than decision processes, and can take place in any layer, any situation, and have any form within an organization. For example, an electronic forum on budgeting can be “operational control” when the issue is about accounting transaction, “management control” when the issue is about monthly plan-do-check-act, and “strategic planning” when issue is about budget setting on R&D. An electronic forum can also deal with either brainstorming for new product development (unstructured) or periodic reporting conferences (structured). Finally, an electronic forum can be held for either market analysis (intelligence activity), new product planning (design activity), or deal authorization (choice activity). In addition, in communication support systems, an electronic forum may be held either formally or very informally, like “chatting.”

7 Simon, 1960 (8)
8 Scott Morton & Gory, 1971 (9)
To alleviate this complexity, I simply combine three dimensions which Scott Morton discusses as key elements for understanding Management Decision Systems: management activity, problem type, and decision process (see [Exhibit 3-2]). In the framework of communication support systems, I use the term “communication type” rather than “problem type,” because some of the information exchanged via communication support systems may include not only “problems,” but also “ideas,” “information,” and “knowledge.”

Exhibit 3-2: Framework of Communication Support Systems

Discussion about The Framework

As presented in the example of an electronic forum, the functions assisted by communication support systems can be found in all cubes in [Exhibit 3-2], but we can recognize a certain spectrum, in which “structured & operational & choice” is more systematized, and “unstructured & strategic & intelligence” is more chaotic.

Scott Morton discusses in his two dimensional framework that, although recent computer technologies have helped the boundary shift a little lower, most Management Decision Systems in organizations have been aimed at supporting affairs around the “structured & operational” and “structured & management” zones (see [Exhibit 3-3]).
To apply Scott Morton’s argument to my three dimensional framework, we can say that most information support systems to date have focused on the “structured & operational & choice” zone of the cubes. To illustrate, as I will discuss in Chapter 8, Capital One Financial Corporation has focused on this structured zone, rather than the more unstructured zone. Its interest in information systems has focused on external coordination in operational control of customer interface, rather than on internal coordination, like knowledge management.

However, more critical problems in organizations today are located in the layers of semi-structured and unstructured, and knowledge management which I define in Chapter 2 is included in these zones. Khoshafian and Buckiewicz’s second generation of groupware is expected to support affairs in the more chaotic zones of the cubes. In Chapter 7, I will present an advanced example, groupware and Intranet at Fujitsu Limited, which is attempting to formalize the semi-structured and unstructured zones with communication support systems.

3-3. Key Issues in Heuristic Communication Support Systems

Based on this three dimensional framework, I want to point out three key issues for understanding the heuristic aspect of communication support systems: interpersonal learning, evolution to heuristics, and mental models.
**Interpersonal Learning**

Different from the single-user computers, communication support systems are *interpersonal* computers. While single-user information support systems provide us interaction with a *hard*, or quantitative, database, communication support systems provide us *softer*, or qualitative, human-to-human interaction in a more visual and flexible format. This chaotic human-to-human interaction can give us a distinctive advantage by supporting the solving of even semi-structured and unstructured problems. In Chapter 4, I will further discuss this issue.

**Evolution to Heuristics**

As Scott Morton points out, most Management Decision Systems are introduced to support more systematized processes—"structured & operational & choice." Communication support systems also tend to be initially introduced so that they can improve efficiency in organizational communication; for example, as far as my observation has shown, one of the major objectives for introducing groupware has been structured administrative workflow management, such as expense approvals, purchase requisitions, and travel requests. These types of groupware can be regarded as Khoshafian and Buckiewicz’s first generation. However, I expect that communication support systems will *evolve* into the heuristic second generation, as managing semi-structured and unstructured problem-solving, in addition to creating organizational intelligence stock, becomes critical in organizations. I will discuss this issue in Chapter 5.

**Mental Models**

Finally, because communication support systems are highly human-based, implementation is another critical factor in ensuring the success of the system. As discussed in Chapter 2, managing tacit knowledge is one of the primary objectives for heuristic communication support systems, but it is very challenging because of the human factors, such as mental models, cultural rigidity, and organizational norms. Even though, Technologically speaking, communication support systems will successfully evolve into the heuristic second generation, failure to manage users’ *mental models* will render the system useless. I will discuss this issue in Chapter 5 by presenting an example of my experience introducing a sales force information support system for a loan business.
3-4. Chapter Summary

I am most interested in communication support systems as the descendants of Management Decision Systems, rather than as the mere platforms to convey information. In other words, I am interested in “organizational communication for problem-solving.” To my surprise, in spite of the recent remarkable improvement in information technology, the issue presented by Scott Morton in the 1970s about computer-aided “semi-structured” and “unstructured” problem-solving processes is still unsolved today; rather, we can say that it will be one of the most critical issues in organizations in the upcoming knowledge-based economy. This is why I primarily use the work of Scott Morton to develop an analytical framework for communication support systems.

To be specific, I combine three dimensions which Scott Morton cited from Robert Anthony and Herbert Simon’s work: managerial activity (operational control, management control, and strategic planning), communication type (structured, semi-structured, and unstructured), and decision process (intelligence, design, choice).

Most Management Decision Systems to date have focused on the most systematized phase, the “structured & operational & choice” zone in the three dimensional framework, but I believe that communication support systems will evolve into heuristics, which can support even the most chaotic phase, the “unstructured & strategic & intelligence” zone.

To understand this heuristic aspect of communication support systems based on the three dimensional framework, I present three key issues which I will discuss in the following chapters: interpersonal learning, evolution to heuristics, and mental models.
Chapter 4

Interpersonal Learning
and Knowledge-Processing

Although I regard communication support systems as the descendants of Management Decision Systems, the distinctive difference between them is that communication support systems are essentially ubiquitous among humans (that is, they are interpersonal computers), while the traditional tools of Management Decision Systems are, in many cases, single-user computers. This interpersonal characteristic of communication support systems will assist us in solving even semi-structured and unstructured problems which have been hard to formalize so far.

In this chapter, I discuss the interpersonal aspect of communication support systems, which I consider to be one of their most important characteristics as heuristic information systems.

4-1. Communication Roles of Management Decision Systems

Typical Features of Management Decision Systems

In this thesis, I define the "traditional styles of Management Decision Systems" as the platforms, in many cases mainframe computers, in which the user can use hard, or quantitative data, and the primary purpose of which is data-processing. In this context, Management Decision Systems to date have been basically single-user computers, which have enabled managers to pursue data-mining processes. Typically, the computer terminals were set upon each manager's desk, and managers could obtain data, or information, from the central database to which their terminals were connected (see [Exhibit 4-1]).

Because Management Decision Systems before the Internet generation dealt with mainly hard data which was formalized by algorithm, these systems helped managers to find and solve
structured problems by providing alternatives to them through sorting and selecting data. Some advanced systems which incorporated complex mathematical models could simulate statistical or stochastic processes, and provided managers optimal solutions based on these simulations.

\[ 
\text{Source: Scott Morton, 1971}
\]

\textit{Exhibit 4-1: Component of a Management Decision System}

\textbf{Communication Roles of Management Decision Systems}

Michael S. Scott Morton discusses the communication roles of Management Decision Systems. He presents two forms of communication: the first is for the individual him/herself, and the second involves communication between individuals. According to Scott Morton, the first style involves managers using the device to clarify a point for themselves, or to search for something they do not know. They also use it for learning; they would on occasion ask themselves a question, develop an answer, and then make some remark to indicate that the answer is not what had been expected. The second style involves managers using the device constantly to make a point to one another. If at some point in the discussion, the other sounded doubtful or did not see the issue, it is the Management Decision System that is used to explain the point. This enables managers to spend less time and effort making their point clear, and to avoid misunderstanding.\(^1\)

As Scott Morton indicates, Management Decision Systems can play a role as an intermediary of communication, navigating managers appropriately so that they do not stray out of the point. In this sense, we can say that up to this point Management Decision Systems had interpersonal aspects; however, compared with the Internet generation of communication support systems, there is no doubt that their impact on organizational communication was limited.

\(^1\) Scott Morton, 1971 (1)
4-2. Personal Learning vs. Interpersonal Learning

As shown in [Exhibit 4-2], the difference between Management Decision Systems and the Internet generation of communication support systems is illustrated in their learning processes.

Source: Created by Author

Exhibit 4-2: Personal Learning and Interpersonal Learning
In Management Decision Systems, learning processes are mainly observed as individual-based "personal learnings" in the forms of data-mining. Management Decision Systems to date have been primarily human-to-machine interface, and a person who discovers a new idea through his/her individual interactions with database will need to interpret the hard data, and to persuade the others. Sometimes Management Decision Systems themselves, as Scott Morton indicates, may assist these persuasion processes, but in many cases, the persuasion will be still made through non-high-tech communication styles, such as oral conversation or written memo. In the real world, most innovative ideas which occur in one's mind are never developed because of the difficulties in the persuasion processes. We can observe many examples where the most time/energy-consuming processes for decision support staff have not been to discover phenomenal ideas, but to persuade decision-makers of their value.

On the other hand, in communication support systems, learning processes are not only individually interactive with the database, but also include human-to-human interaction: interpersonal learning. The database which users access includes not only hard data, but also soft information—more visual and impressive in the formats of documents or graphics—which we can call the "intelligence stock," or "knowledge base." This "knowledge base" includes ideas and knowledge, and is not a mere aggregation of quantitative data.

Khoshafian and Buckiewicz point out the value of hypermedia in developing "knowledge base" in an organization.

By and large, hypermedia represents "associative memory," and information in an organization. Human memory is associative in nature. People associate larger concepts with terms and have a "semantic" network of associations in their memories. Hypermedia more or less captures these nonlinear associations directly. Various anchors in a documents are linked to other documents (or information objects) that provide additional details. These documents can themselves have hypermedia links, and thus the entire "knowledge base" in an organization can theoretically be arranged through a natural hierarchical structure.²

If a user come up with an idea during the interaction with the intelligence stock, he/she can immediately input the idea into the stock, and others can share it through inquiries. This process enables an organization's accumulated intelligence to continuously evolve. Because

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² Khoshafian & Buckiewicz, 1995 (2)
communication support systems can distribute information in more direct formats, documents or graphics, users do not need to interpret it or make great efforts to persuade others. We can expect that through information exchanges via communication support systems, organizational members can synchronize their ideas without any elaborate orchestration.

4-3. Knowledge-Processing

Another critical difference between Management Decision Systems to date and communication support systems is their input processes. While Management Decision Systems depend mainly upon the raw data coming from transactions, communication support systems depend upon direct input from users in the formats of texts, graphics, or sound. As we will see in Chapter 7 and 8, an example of the traditional style of a data-mining systems user is Capital One in the product development phases: this company uses customer information whose source is the result of transactions and direct-mailing. On the other hand, Fujitsu, is an example of a communication support systems user, which uses human ideas and knowledge inputted from all layers within the organization.

The critical limitation of the traditional styles of Management Decision Systems, I believe, was that they omitted the processes in which users were thinking. In other words, Management Decision Systems incorporated material data, but did not have any direct route to accumulate the processes, nor the results, of what users invented by using the data. On the other hand, in communication support systems, users can directly add, modify, and react to accumulated ideas, and, more importantly, these interactions themselves are also incorporated in the systems. Therefore, while the role of Management Decision Systems was primarily data-processing or information-processing, that of communication support systems can be called “knowledge-processing.”

4-4. Management of “Unstructured” Conditions

I consider that while Management Decision Systems were chiefly designed to assist us in reducing the base-level activities in heuristic search processes, communication support systems aid us mainly by reducing the metalevel activities.

To expand the possibilities of innovation, we can say that the more chaotic, the better. One of the risks of the traditional styles of Management Decision Systems is that they may lead
managers to excessively focus on the base-level activities, and to be oriented to the short-term solution.

For example, Merck & Co., the world's largest pharmaceutical company, has introduced analytical decision support models, which are based on a financial engineering module like Monte Carlo simulation, so that it can improve the company's R&D processes, as well as manufacturing and marketing. The first model was introduced in 1982, and, thanks to a series of successes, the originator of the project has advanced to CFO of the company\(^3\).

Although there is no doubt that Merck has been exceedingly successful for over fifteen years, I am still skeptical about the further success of its models. Analytical financial models based on a statistic/stochastic approach basically aim to stabilize volatility as risks, and suggest that the results of simulation of expected return should fall within the 95% confidence interval (see [Exhibit 4-3]).

![Graph showing 95% Confidence Interval](https://example.com/graph.png)

**Exhibit 4-3: 95% Confidence Interval**

I consider that it is a conceptual misjudgment to implement statistic/stochastic models into R&D management, because really interesting innovation will be generated from outside the 95% confidence interval, where there are more chaotic and unstructured conditions. It is true that implementing such analytical financial models into R&D will stabilize return on investment, but

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\(^3\) Luehrman, 1993 (3); Nichols, 1994 (4)
it may spoil radical innovations which will be critical sources of long-standing competitive advantage. I believe that this case demonstrate one of the crucial problems arising when managers rely too much on analytical Management Decision Systems.

According to Eric Von Hippel, users selected to provide input data, for example in the area of market analysis, have an important limitation: their insights into new products, processes, and services needs and potential solutions are constrained by their real-world experience. Users steeped in the present are thus unlikely to generate novel product concepts that conflict with the familiar.4 This is the same limitation that Findler indicates in the artificial intelligence-based expert systems which rely on past knowledge of the experts. Too much reliance on these kind of inhuman, or structured systems may lead us to critical misjudgment in such a turbulent, rapidly changing business environment.

On the other hand, interpersonal communication support systems can provide a greater chance to go beyond the bounds of the 95% confidence interval, and do not solely depend upon a limited personal past experience. A radical innovation can be generated through numerous attempts to combine and exchange ideas, and communication support systems can provide an environment to which even persons outside the team can contribute their ideas. For example, Digital Equipment utilizes an Intranet for its strategy-making process, and allows over 1,200 employees to participate in the process so that it can obtain more innovative ideas from unstructured conditions.5 As another example, the Japanese electronic manufacturer, Pioneer, is planning to utilize an Intranet for CAD (Computer Aided Design), and organizes electronic conferences with design partners to exchange ideas.6

Communication support systems, I believe, can assist us in managing even semi-structured or unstructured conditions, in which we can expect higher possibilities of generating innovation, through encouraging random exchanges of on-going human knowledge, and codifying it.

4 Von Hippel, 1994 (5)
5 Quinn, Interesting Organizations Database, 1994 (6)
6 Nikkei Computer, 1996 (7)
4-5. Chapter Summary

One of the critical differences between the traditional styles of Management Decision Systems and the Internet generation of communication support systems is in their learning processes. While learning processes in Management Decision Systems are mainly individual-based, those in communication support systems are essentially interpersonal.

This interpersonal aspect of communication support systems provides us two distinctive advantages. First, communication support systems enable us to exchange, share, and codify our ideas and knowledge in easier and more intensive ways—I call it “knowledge-processing.” Second, while the traditional Management Decision Systems, which tend to be excessively oriented to structured problem-solving, may present threats to the development of really interesting innovations, communication support systems, which allow chaotic information exchanges, will assist us in managing even semi-structured or unstructured conditions where there are more possibilities of generating innovation.
Chapter 5

Evolution to Heuristics

How to balance efficiency and effectiveness has been a crucial issue in organizations. We need to admit that most information support systems so far have been aiming to support efficiency improvement in the “structured & operational & choice” phases. In addition, as far as my observation goes, existing communication support systems also intend primarily to improve efficiency in organizational communication and workflow. However, I believe that the most critical function, which will be a real gift from communication support systems, will be an augmentation of effectiveness: a support to develop innovative idea.

Khoshafian and Buckiewicz’s second generation of communication support systems armed by artificial intelligence technology will provide us tools with which we can control even semi-structured or unstructured problems. Therefore, in accordance with the development of technology, we can expect that communication support systems will evolve into more heuristic platforms. Moreover, I believe that the evolving processes from the first generation to the heuristic second generation will occur not only in technological development, but also in organizational intent. In this Chapter, I discuss how the motivation to introduce communication support systems will evolve in organizations.

5-1. Efficiency vs. Effectiveness

An organization has a critical dilemma: whether it should create chaos, or kill chaos? In terms of an efficiency-oriented view, killing chaos, or creating structured conditions, is the first priority; whereas in terms of an effectiveness-oriented view, creating chaos, or semi-structured and unstructured conditions, may lead an organization to be more innovative.
As far as I know, in manufacturing firms, chaos should be eliminated in manufacturing processes, while it could be kept in R&D and product development processes. Japanese manufacturing firms’ efforts such as “kaizen (improvement)” and eliminating “muda (waste),” are good examples of an efficiency-oriented view; while their parallel product development paths, in which an organization, like SONY or Honda, assigns the same new-product-development mission to two or more different teams and creates an internal competition between them, are representative illustrations of an effectiveness-oriented approach.

On the other hand, in knowledge-based service industries, even operational control processes can be highly chaotic. For example, loan sales and negotiations in financial firms are purely “operational,” but “unstructured.” However, financial firms, although they are considered to be in one of the most knowledge-based industries, have been more efficiency-oriented. As illustrated in Chapter 8, retail financial service firms, like Capital One, have focused on efficient external coordination with customers, rather than on effective internal coordination which will be a source of innovative product development. This is because traditionally financial firms have been in a more regulated industry, and under the condition that margin per transaction is to some extent protected by the regulation, economy of scale has been a critical success factor in the firms’ competitive advantage; thus, customer interface in mass-sales has been the first priority. Hence, we can say that in financial firms, the prime motivation for introducing communication support systems has been reducing costs. Groupware and Intranet are much less expensive than mainframe computers both in development and maintenance. I can seldom find a good example of financial firms which use communication support systems as heuristic platforms.

However, as I discussed so far, I believe that the real gift from communication support systems is not killing chaos, but managing unstructured condition which will augment innovation. Considering the dramatic change in the business environment for financial firms—deregulation, disintermediation, global competition, cross-border competition, and rising customer expectations—simple mass-sales should no more be the first priority for financial firms. Differentiation by value-added services reinforced by knowledge will be a key to survival. Thus, in my view, most financial firms are in the introductory phase of communication support systems, and have yet to enjoy their real benefit: heuristics.
5-2. Investment Motive of Communication Support Systems

Roger Whitehead discusses the investment motive of groupware.

There are four motives for investing in Notes:
1) to do things cheaper, reducing the cost of outgoings such as manpower, materials or services;
2) to do things better internally, improving organizational capability by introducing greater control, making better decisions or making fewer errors;
3) to do things better externally, improving performance in areas such as customer support, delivery times or product quality;
4) to do new things, enabling innovation in structure or approach.

Cost saving is commonly the first objective for new systems. In some organizations it stays as the only objective.

Then, having made their savings, most organizations look to groupware that helps them improve their internal operations. They wish to be better internally. Both these sets of motives are inward-looking.

Businesses tend to look outwards in their thinking about systems only later. Typically, their first objective then is to improve dealings with customers and trading partners, so being better externally becomes important.

After that (and seldom as a starting point), organizations wish to apply systems to doing something new. They may have been inhibited in this beforehand because the systems did not allow it or were too expensive. Often, it was because the organization simply did not think of these new methods or arrangements.

Whitehead asserts that, as shown in [Exhibit 5-1], this process never ends at the fourth phase and continuously draws a loop, and that the engines which perpetuate this loop are:

1) to do what is mandatory, such as meeting audit or legal requirements (for example, ISO 9000);
2) to improve the infrastructure for the other activities or investments, such as installing a new network;
3) to improve appearance, by enhancing corporate image.1

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1 Whitehead, 1996 (1)
Whitehead illustrates clearly the evolving processes of communication support systems in terms of organizational intent. The first phase, to do things cheaper, is obviously an efficiency-oriented view, and the fourth phase, to do something new, is effectiveness-oriented. To apply Khoshafian and Buckiewicz's arguments, the first generation of communication support systems is mainly focusing on the first through third phases, and the second generation is focusing on the fourth phase. As Whitehead describes, the fourth phase seldom becomes a starting point, and, as illustrated by the case of financial firms, this phase has not yet become the first priority in many organizations.

In my opinion, in the real business situation, these four phases which Whitehead asserts does not necessarily occur in this order. For example, most financial firms have started focusing on the first phase, to do things cheaper, and then on the third phase, to do better externally. As far as my observation are concerned, the second phase, to do things better internally, is less frequently set as their first priority, and they have not yet reached to the fourth phase, to do something innovative. However, Whitehead’s classification itself is very useful in understanding
how organizational intent to introduce communication support systems will change, and I will describe the evolving processes based on his work.

5-3. "Redundant Learning" to "Intelligence Stock"

To expand the discussion by Whitehead, I assert that the evolutionary process in communication support systems is illustrated by the development from "redundant learning" to "intelligence stock."

Practically, to implement communication support systems in an organization, there are two extreme strategies:

- Perfect Control
- Perfect Autonomy

Obviously, "perfect control" is an efficiency-oriented approach, while "perfect autonomy" is an effectiveness-oriented one, and finding balance between them is a critical success factor for communication support systems. In the evolving processes from "redundant learning" to "intelligence stock," we can observe the fluctuation of focus between the two strategies.

**Redundant Learning Phase**

Without any platforms like communication support systems, which assist organizational members to share their information as well as knowledge, there must be "redundant learning" in all layers of an organization—everyone must start his/her learning from point zero. On an individual basis, each member's learning process is entirely new for him/her, and it may be a good learning experience for that person. However, for the organization as a whole, this concurrent learning is extremely inefficient. For example, especially in organizations in knowledge-based industries like financial firms, it frequently happens that a staff member in division 'A' and another staff member in division 'B' do the exactly same analysis without knowing it. Another problematic situation is "organizational amnesia," when an employee who needs an answer to his/her unknown problems has no idea of how to find within his/her organization the relevant experts who know the answer. I call this situation "redundant learning."

Hence, the first motivation for introducing communication support systems tends to be killing these redundancies. Typically, the platforms introduced in this phase are of the first
generation, which regulates, or precisely defines, information flow, workflow, and information content.

**Incentive Control Phase**

Unfortunately, the crucial risk in this phase is that this regulation may spoil active communication throughout the system. If this happens, little information is stocked, or what is accumulated in the system ends up a mere aggregation of pieces of information, and thus useless.

To avoid this unfavorable situation, an organization could introduce a certain incentive system to activate random uses of the system. This is a challenging phase in which an organization needs to keep a balance between restriction and autonomy.

One way is based on “perfect control,” in which information flow and content are further regulated by an infrastructure, such as a systematized incentive system. In Chapter 7, we will observe the examples at Fujitsu: “Information Producer,” who checks and controls information flow and content; and “Information Charging System,” which encourages employees to use the system by evaluating the quantity and quality of inputted information and attaching a money value.

**Cultural Control Phase**

Of course, “perfect control” is not the end of the story because it still holds the risk of spoiling users’ creativity. Another way is based on “perfect autonomy.” This does not mean, however, a totally anarchical situation, but what I call “autonomy with invisible control.”

The ideal situation in which managers control creative chaos is one in which people, particularly knowledge workers, feel entirely free from control and enjoy their autonomy, while at the same time, their activities are kept in a certain order which they do not recognize. Without any order, or marshaling, among staff, an organization may risk their outcomes never satisfying the organizational goals. On the other hand, when staff members are aware that they are under control, their real creativity may discouraged. Thus, the ideal situation is that knowledge workers are controlled by a certain framework of which they are not conscious, that is, “autonomy with invisible control.”

It is my brief that what creates this situation is corporate culture, or norms. When employees feel that the incentive systems implemented by their organization help and encourage
their creativity, it is an ideal condition. Within a culture where autonomy among staff is appreciated by managers, and, at the same time, staff positively or unconsciously accept the marshaling framework which gives them some direction or scope unanimous with organizational goals, communication support systems aiming to control unstructured conditions will succeed. As we will see in Chapter 7, Fujitsu is successfully developing this situation through combining the marshaling incentive systems, Information Producer and Information Charging System, with their extremely flexible “hacker” culture among young system engineers.

**Intelligence Stock Phase**

Once business entity succeeds in creating “autonomy with invisible control,” the full usage of communication support systems will be activated, and the systems will be part of the key infrastructure of the organization. The ideal situation is one in which staff in all layers of an organization input their knowledge in the system, and the accumulated knowledge is shared with all organizational members as a common “intelligence stock.”

Under this phase, the benefits by communication support systems will be:

* Making clear “who knows?”
* Supporting problem-solving by finding solutions from past cases
* Learning from failure
* Enabling unstructured virtual brainstorming with mixed participants
* Enabling random combination of knowledge

This is the stage when communication support systems may assist knowledge workers to invent something new by random interactions with accumulated knowledge throughout the system.

**5-4. Chapter Summary**

As Management Decision Systems to date have focused on the “structured & operational & choice” activities, existing communication support systems, the first generation, are more efficiency-oriented, rather than effectiveness-oriented.

However, technological developments such as intelligence technology will enable communication support systems to evolve into the second generation, which will function as
more heuristic systems. In addition, side-by-side with technological development, we can observe evolving processes in organizational intent to introduce communication support systems.

In these processes, first, managers are motivated to introduce communication support systems in order to eliminate "redundant learning" within the organization. Second, to activate usage of the systems, managers try to introduce some incentive system which controls information flow and content. However, to ensure the real success of communication support systems as heuristics, managers need to take a step further, by creating cultural control, which I call "autonomy with invisible control." The ideal situation for communication support systems is one in which wide latitude of autonomy among knowledge workers is appreciated by managers and, at the same time, staff positively, or even unconsciously, accept the marshaling framework which will give them some direction or scope unanimous with organizational goals. Under such conditions, communication support systems will produce a common "intelligence stock" within an organization, and can control even semi-structured or unstructured conditions.
Chapter 6

Managing Mental Models

One of the major challenges to managing semi-structured or unstructured processes is how to manage mental models. As discussed in Chapter 5, in the evolving processes from an efficiency-oriented view to an effectiveness-oriented one, not only technological development, but also management of human-side issues is critical. To enjoy the real gift of heuristic communication support systems, codifying even tacit knowledge is a key to success.

However, conflicts between individual knowledge-oriented workers and organizational knowledge-oriented ones are critical impediments to the development of communication support systems, especially in the organization with non-collaborative norms, or a closed communication culture. Unfortunately, in knowledge-based organizations, like financial firms, even in Japanese companies which are in general supposed to have a cooperative culture, we more frequently observe a deep-rooted non-collaborative culture.

In this chapter, I discuss the implementation issues in terms of mental models by presenting my own experience, in which I introduced a sales force information support system for a loan business.

6-1. Mental Models

According to the definition by Peter M. Senge, "mental models" can be described in the following way:

"Mental models" are deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action.¹

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¹ Senge, 1990 (1)
Some business executives regard “mental models” as monsters which hamper their management activities. Wanda J. Orlikowski describes how “mental models” can be serious impediments to implement groupware in organizations. A number of organizational elements such as mental models (which affect how people understand and appropriate groupware) and structural properties (reward systems and workplace norms), significantly influence how groupware technology is implemented and used...

In the absence of mental models that appreciate the collaborative nature of groupware, such technologies will be interpreted in terms of more familiar personal and stand-alone technologies such as spreadsheets. Further, in competitive and individualistic organizational culture—where there are few incentives or norms for cooperating or sharing expertise—groupware on its own is unlikely to engender collaboration.2

As Nonaka and Takeuchi assert, “mental models” are highly personal, context-specific, and experience-based, and therefore hard to communicate and formalize.3 Thus, for some organizational members, especially for highly experienced veterans, information support systems which force them to change their traditional working styles are viewed as “electronic gizmos,” or gimmicks, which are nothing less than threats to them. Obviously, in such an organization, implementing communication support systems, even though they are technologically successful, will be disastrous. In fact, most communication within an organization will probably occur outside of communication support systems.

6-2. Case in an Insurance Company

As I mentioned before, implementing information support systems for knowledge management in financial firms has been very challenging. In fact, my own experience in which I developed a sales force information support system in an insurance company is the proof of this—and it is also my primary motivation for studying this thesis topic. In order to understand how mental models influence the success of information support systems requiring changes in organizational workflow, I want to present my experience as an example.

2 Orlikowski, 1992 (2)
3 Nonaka & Takeuchi, 1995 (3)
Mission

My mission was to organize a project in which I developed an information support system for the loan sales force of a Japanese insurance company—the company has US$69 billion of assets, and about 15,000 employees.

The collapse of the bubble economy in Japan in the early 1990s forced the loan division to recognize the importance of the quality of loan assets, rather than the quantity. Under such conditions, the loan division needed a new framework to effectively avoid inferior-credit-risk customers, and, at the same time, to efficiently find good-credit-risk-customers. Motivated by this challenge, I was appointed to organize a project which would develop an information support system for loan sales officers. This project focused on developing as part of the organizational common intelligence stock a customer information database which include not only quantitative financial data, but also softer data, such as customer preference and negotiation history.

Background

In Japanese insurance companies, the loan business, together with bond and equity investment, is one of the major activities of institutional investors. Competition in the domestic loan business has become very intense since the mid-1980s, when all insurance companies started to provide savings-type insurance products. This required insurance companies to acquire superior investment performance to their rivals, so that they could attract insurance buyers. On the other hand, because many large companies have shifted from loans to equity finance or bond issuing as the sources of their funding, terribly severe competition to acquire a share of the shrinking loan demand has occurred among banks and insurance companies.

Thus, sales of savings-type insurance products became the first priority in the company I worked for, and the sales forces of the insurance service division were fiercely pressed to make such deals. As the sales of savings-type insurance products increased, the loan division was also urged to expand the loan asset size so that the company could assure superior investment performance. It was an incredibly tough situation for the loan division, because less than 50 loan sales officers were required to cover the funds acquired by as many as 5,000 insurance sales officers throughout the domestic market.
As late comers in the loan market, the loan officers in insurance companies were forced to take a more aggressive approach for acquiring customers. As a result, they pursued efficiency rather than effectiveness; inclined to rely upon lending to bank-subsidiary nonbanks which borrowed a large amount at one time, but whose credit risks were relatively high. However, at that time, most Japanese companies had no doubt about the assumption that subsidiaries of financial firms would never go bankrupt, and even though some nonbanks were highly leveraged, they would be protected by parent financial institutions, or ultimately the Ministry of Finance.

As we already know, after the collapse of the bubble economy, this turned out to be a totally false assumption, and most Japanese financial institutions suffered from a huge amount of non-performing loans. The company I worked for was not an exception.

Hence, during the sluggish recession beginning in the early 1990s, the company was challenged to restructure its assets: disposing bad debts and acquiring new good credit assets. It meant that the loan division changed its policy in the totally opposite direction; sacrificing efficiency to some extent, and focusing on effectiveness.

To be specific, the loan division started to calculate theoretical “credit risk adjusted return” for each prospect—based on credit ratings and historical default probabilities—and denied virtually all cases, when customers did not accept its target price designed to assure sufficient credit risk premiums. This dramatic change in its strategy led the division to focus on smaller-sized loans with lower credit risk, and to diversify the loan portfolio. This was a complete turnaround from the traditional wisdom of veteran loan officers, who believed in economy of scale.

*Traditional Context in the Loan Division*

Traditionally, the company’s approach to loan sales highly depended on each sales officer’s individual know-how, or artisanship. Because the loan division was required to quite rapidly expand its asset size, formalizing a common methodology did not catch up with the pace of expansion. The traditional workflow of the loan division is illustrated in [Exhibit 6-1], in which there was no organized database or information support system.

At that time, the loan sales officers kept customer information which they collected through their personal contacts with prospects in their individual pocket notebooks. Only when
they agreed with prospects to make loans, was the information passed to the credit analysts and General Manager for authorization. It meant that customer information was not stocked on an organizational basis, but just on an individual know-how basis.

This situation caused the following problems:

- No sales officer could learn from past cases, and each needed to be a “pioneer.” This meant that when veteran officers were replaced with new employees, the division suffered from significant step-backs.
- At the baton-passing accompanied by job rotation, customer information which was collected by predecessors was not sufficiently conveyed to successors because information in their pocket notebooks was sometimes lost.
- Information exchanges were informally organized among veterans in such situations as after-five drinking sessions and weekend socialization activities. Thus, newly assigned, less-experienced sales officers could never “inherit” veteran’s knowledge unless they were admitted to join the informal circle of veterans.
- Creative information combination between veterans never happened because there was no collaborative culture. For example, when one sales officer had information of a retailer who wished to buy land for a new shop, and the other officer knew a landowner who wanted to sell his land for purposes of tax avoidance, introducing them with each other would have created a new opportunity to make loans to the retailer for purchasing land and constructing a new shop, as well as to offer taxation consulting services for landowners. However, because of a lack of formal communication, these officers did not know that their colleagues had useful information.

Therefore, although the veterans’ artisanship can be regarded as effective and efficient for individual veterans themselves, it should be regarded as extremely inefficient in terms of the benefits to the whole organization. In the loan division, redundant learning could be seen everywhere, and tacit knowledge was monopolized by the veteran officers. Although Nonaka and Takeuchi assert the merits of the Japanese style of informal socialization, especially in manufacturing firms,\(^4\) I did not recognize any merit in this division; rather, it was nothing less than an impediment to empowering the division as a whole organizational base.

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\(^4\) Nonaka & Takeuchi, 1995 (4)
Restructuring of Workflow

Confronted with drastic change in the business environment, it was obvious that the loan division could no longer depend upon each veteran’s artisanship. In addition, I believed that the past failure that the division excessively attributed to nonbank-loans could be ascribed to this traditional artisanship without any systematized management framework.

Based on this assessment, I proposed to develop a new information support system, intended to make all sales officers input their customer information into a common database.

My primary objectives in this project were:

- To accumulate customer information—including not only quantitative financial data, but also softer information such as customer preferences and negotiation history obtained by each sales officer—as a common intelligence stock of the division.
- To support or navigate sales officers who did not yet have sufficient expertise in customer information collection, credit analysis, and sales negotiation.
- To stimulate creative information exchange within the division, such as combining needs of the retailer and the landowner as mentioned above.
- To monitor each sales officers’ activities, not only on a quantity basis (how many prospects did they contact), but also on a quality basis (what information did they obtain from prospects).
- To monitor the generic tendencies in loan sales officers’ activities so that the planning section could adjust its target and policy.

We selected a client/server and PC network platform because we considered it to be a more flexible and end-user-oriented infrastructure. In addition, I cannot deny that we wanted to ride on the booming wave of the open systems.

The revised workflow which was accompanied by the new sales force information support system is summarized in [Exhibit 6-1].

The key points in the new workflow were:

- Loan sales staff could access the customer information database consisting of purchased data, such as financial data and stock price data, and our original softer information inputted by each sales officers in text format; for example, the plan of a new investment or restructuring, the due date of the current loans borrowed from the other banks, the interest
rate offered by the other banks, past troubles with any banks, and CEO’s or CFO’s personal preferences.

- Sales officers could obtain “credit ratings” for each prospect through a credit rating system, which calculated our original credit ratings based on the purchased financial data, and determined the credit level of prospects. In addition, sales officers could find out the target loan price in terms of “credit risk adjusted return.” This process was expected to help especially unskilled sales officers pick up prospects.

- Sales officers could interview prospects simply by following the data items in the customer information database, which were defined by knowledgeable veteran officers’ rules of thumb and included all key issues for loan authorization. This process was aimed to prevent less-experienced sales officers from losing business opportunities because of unskilled interviews with prospects.

- The General Manager of the loan department could monitor this information on an individual basis, as well as in summary in terms of section, geography, industry, and so on.

This system could be classified as a traditional style Management Decision System, which included an expert-system-like aspect. In this concept, codifying qualitative data or knowledge collected through our own interaction with customers was the central objective of the system, and at the same time, the biggest challenge.

Data available to the public was easy to control in the information system, but could not help us differentiate ourselves. On the other hand, data obtained by ourselves would give us a chance at new opportunities; but it was hard to maintain its quality. I should have been concerned with whether qualitative data collected by loan sales officers might benefit the division or actually threaten the creditability of the information support system, because of the risks that qualitative data might be biased by the staff who gathered it, especially when the data was used for evaluation of their own performance.
Exhibit 6-1: Workflow BEFORE and AFTER the System
**Project Team**

I obtained enough sponsorship from the General Managers of both the loan department and the information system division to start the project. Thus, the project was accomplished by a cross-divisional project team which consisted of three staff members from the information system division, two staff members from the sales support section of the loan department, and myself from the planning section of the loan department. In addition, two system engineers from a contracted software house participated in the project (see [Exhibit 6-2]).

**Exhibit 6-2: Organizational Chart of the Project**

My primary responsibility was controlling the overall schedule of the project, as well as coordinating communication between the information system division and the loan division. The responsibility of the two staff members from the sales support section was both designing and implementing the new system, including the education of users, because they were supposed to be closer to the end-users: loan sales officers. In reality, almost all the basic concepts of the new
system came from myself because the sales support staff did not have any background in information technology, and the information division staff were not familiar with the loan business.

This was a problematic situation because it made the responsibility of the sales support staff ambiguous. The staff of information system division and myself were extremely enthusiastic about this project because this new information system was regarded in the company as the “pilot case” for an information support system based on a client/server and PC network. If our project was successful, the company would decide to replace the existing mainframe-based infrastructure with a new client/server-based network system. However, the sales support staff remained skeptical about the project because they had a strong reaction to standardized sales workflow. Before being assigned to the sales support section, they were the top level artisans in the division, and because they were opinion leaders, the General Manager of the loan department expected them to lead the other loan officers.

Outcome of the Project

The project started in 1993, and took two years to be completed. After the new information system was released, I found that my original scenario did not work successfully. Our project had two primary problems both in implementation and technical development, which, I believe, were mainly caused by inappropriate mental models.

The problems we met were:

- Cultural Rigidity in Users
  
  * Most sales officers, especially the over-30’s generation, felt a fierce resistance to using computers; even though we introduced a user-friendly Windows-based screen and mouse combination. They regarded the computer terminal which was placed on their desks as an “electronic gizmo.”
  
  * The veteran sales officers regarded inputting and accessing the database as mere clerical work and a waste of their time. Their perception was that sales person should spent their time not inside, but outside the office.
  
  * The veteran sales officers had no sympathy with the General Manager’s administration-oriented policy, and hated to be supervised transparently. They felt particular resistance to their sales processes being monitored by the new system.
* The sales support staff were not sufficiently energetic in implementing the new system, and the education on the new system was not sufficient; being held only for young clerical staff and new employees of each section.

* I was regarded as an “enemy” who had a direct link with the General Manager and the information system division, rather than a colleague inside of the loan division’s socialization circle.

• Cultural Rigidity in Technical People

* Because of the budget limitation, at first, only five terminals were introduced for 35 users, and, even worse, no terminal was introduced in the local branches. Information was sent from the branches by paper, and the sales support staff members inputted it. The information division members did not understand how this inconvenience seriously damaged the implementation of the system.

* The information division staff members were accustomed to developing mainframe computers, but it was the first experience for them in designing a client/server and PC system. They were not familiar with the PC because they were not “hackers” who used the PC for their personal fun, but “salary-men.” Thus, they could not take leadership in deciding relevant technologies for the project without consulting contracted system engineers.

* The contracted system engineers did not have sufficient experience in developing a client/server and PC network system. Actually, I believe that no software house in Japan had enough expertise in client/server and PC systems at the time. Based on the engineers’ advice, our project chose UNIX server installed ORACLE ver. 6.0 and IBM PC with WINDOWS ver. 3.1. The application of client PCs was mainly developed by Microsoft ACCESS ver. 1.0. This choice was based on the policy that selecting the hardware and software which had the top share in each market was the best solution because the maintenance would be easier. However, we soon realized that partial optimization did not guarantee total optimization: the total harmonized performance turned out to be awfully slow, and it took almost one year to fix the problem.
* Other staff in the information system division who were responsible for maintenance and administration of the corporate network were very skeptical of client/server systems. They were the most rigorous "mainframers." Our project team from the information system division could not gain any technical help from them.

* Although the General Manager of the information division understood the importance of client/server systems, he imposed upon his staff the traditional mainframe-based system development style: a "waterfall" approach, rather than a flexible "spiral" approach which was more applicable to client/server and PC network systems. Thus, once the system design was completed, it was very hard to adjust the design to satisfy continuously changing user needs.

What most discouraged me was that although all loan sales officers, including veterans, officially agreed with the concept of the new system in a series of review sessions before we entered in the system development phase, in their own minds they still resisted to the concept. As a result, during the introductory phase, the new information system was mainly used by new employees and younger staff. At last, the veterans reluctantly agreed to input their data because I defined the new workflow in which internal memos authorized by the General Manager should be outputs of the new system. However, as far as I was able to observe, some of them inputted only favorable information, and unsuccessful cases which would have been most beneficial lessons for the division were still kept in their pocket notebooks. Thus, I must admit that the data accumulated in the new information system were biased, and hard to use in actual decision-making.

6-3. Analysis of Failure

Analysis of Mental Models

The ill coordination between the sales support staff and myself was very unfortunate, and obviously a primary causal factor of failure. However, the most essential mistake which I made was that I did not take seriously the strong existing culture of both the users and technical people—veteran loan officers' artisanship and IT people's faith in the mainframe.

For veteran sales officers, the new information system was noting less than a nuisance, which threatened their traditional working style; and for people in the information system
division, including the General Manager, the client/server system was essentially a doubtful infrastructure compared to the mainframe. It was viewed as just a platform to experiment with in order not to miss the booming fashion. Although I naively thought that the change was good in such an turbulent environment, the mental models resisting change were much stronger than I imagined.

To enhance this argument, I want to use the system dynamics' causal loop diagram, and explain the mental models of loan sales officers as shown below.

*Exhibit 6-3: Loan Officers' Mental Models*

* Reinforcing Loop (Positive Feedback Loop)
  * Loan officers' commitment to the information support system is enhanced by management leadership, as well as training and education.
  * Quality of the stocked information is raised by higher commitment of users.
  * Performance of the information support system becomes favorable because the useful stocked information stimulates active usage among users.
  * Loan officers are empowered by benefits of the information system.
  * Loan officers are satisfied with their work, and feel that they have more job ownership or autonomy.
  * Loan officers’ commitment is further enhanced.
* Balancing Loop (Negative Feedback Loop)
  - Requirement of the new workflow imposed by management is enhanced by the introduction of the new information support system.
  - Highly experienced loan officers fear that they may lose their job ownership because their traditional wisdom will be replaced by the system.
  - Cultural rigidity, or resistance to change, occurs deep in the mind of loan officers.
  - Loan officers become skeptical of the new information support system, and thus the quality of stocked information deteriorates.
  - Performance of the information support system is spoiled, and thus creditability of the system is lost.
  - Management requires improvement of the quality of the stocked data, and imposes another pressure to implement the new workflow.

Reflecting now, based on this system dynamics model, I must admit that I primarily focused on the reinforcing loop which was an ideal condition for the new system, and neglected the balancing loop which was a vicious cycle of negative forces caused by mental models. Consequently, the vicious cycle was dominant.

*Replace or Augment?*

Why do mental models often lead to such a vicious cycle? This question can be explained by the framework of Michael S. Scott Morton and Josep Valor, as illustrated in [Exhibit 6-4].

According to Scott Morton and Valor, roles of information support systems are defined by two dimensions: physical/mental and replace/augment. To illustrate, most information technologies applied to manufacturing processes are in the “physical & replace” zone; while those which aim to manage knowledge are in the “mental & augment” zone. They argue that the product development processes of Boeing 777 and the credit approval processes of American Express are good examples of “mental & augment.”

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5 Lecture by Scott Morton & Valor, 1997 (5)
Based on this framework, obviously information support systems for knowledge management should be regarded in the "mental & augment" zone. However, in the case discussed above, most loan sales officers considered the new system to be in the "mental & replace" zone. Too much emphasis on the navigating function of the less-experienced staff led veterans to think that their job ownership would be endangered by the new system, and that their knowledge would be replaced by computers.

However, as Herbert Simon discusses, we should recognize that artificial intelligence technology can support human intelligence, and cannot replace it. Because communication support systems are interpersonal systems, they can never replace humans. Making this point clear was what I should have done in the project.

**Problems in Management Leadership**

Moreover, although I was assured of enough sponsorship from both General Managers, it did not work well. Their support was superficial because they failed to culturally control the tacit mental models among veterans.

In addition, they themselves did not understand how to take on leadership in the new technical paradigm of an open-networked business environment. This uncertainty made them less responsible for the project: the General Manager of the loan division regarded the system as a "magical tool" and believed that the mere introduction of the new system would be the ultimate solution, whereas the General Manager of the information system division felt no responsibility if the project failed because of implementation.
Implications to Communication Support Systems

These lessons I learned are very applicable to designing and implementing a successful communication support systems. Since the success of communication support systems, which are by nature interpersonal systems, chiefly depends on the end-user's enthusiasm for the system, determining how to motivate end-users is a key to success; otherwise, communication support systems might spoil creative internal communication within an organization.

In the next chapter, I will present a successful example of development and implementation of communication support systems—Intranet and groupware at Fujitsu Limited—and discuss why the case is successful compared with my project at the insurance company.

6-4. Chapter Summary

Even while technologically successful, information support systems like communication support systems which require significant changes in workflow will fail when managing mental models is unsuccessful.

There are two types of cultural rigidity: among users and technical people. For end-users, especially for highly experienced staff, new information support systems are nothing less than threats which may force them to lose their sense of job ownership. To ensure the success of the systems, it should be made clear that the system does not replace knowledge workers, but augments them.

For IT people who are accustomed to mainframe computers, client/server systems are a doubtful platform for an infrastructure. In some case, they are just lacking in know-how, and in the other cases, they are reluctant to work on the new architecture. In addition, in such organizations as financial firms, in which information systems tend to be regarded as mere peripheral tools, the understanding of technology is insufficient, and the lack of technical leadership leads to a tragedy.
Chapter 7

Case Study: Fujitsu Limited

As an example of a heuristic communication support system based on Intranet and groupware, whose primary objective is knowledge management, I choose Fujitsu Limited, Japan. To promote its network products, like groupware, in the market, Fujitsu has developed and internally used such communication support systems for years. In my opinion, Fujitsu started it early enough to accumulate sufficient know-how for successful implementation of such systems.

7-1. Company Profile

Founded in 1935, Fujitsu is one of the leading companies in the global information technology industry; Fujitsu is the world's second largest computer manufacturer, only behind IBM, and one of the top ten suppliers of telecommunications equipment, such as digital switching systems and optical transmission systems, and electronic components, such as IC and compound semiconductors. Currently, Fujitsu has over 47,000 employees, and, as a consolidated entity worldwide, over 165,000 employees work for the Fujitsu group.

Owing to the sluggish demand for mainframe computers, accompanied by the collapse of the bubble economy in Japan and the worldwide semiconductor slump, Fujitsu suffered a 32 billion yen net loss in 1992 (consolidated base): the first loss record since being listed on the Tokyo Stock Exchange in 1949. To cope with this predicament, Tadashi Sekizawa, President and Representative Director, cut 10% of employees and moved vigorously into the PC market. Fujitsu's new range of PCs is made in Taiwan (for example, Acer Group), and up to 90% of parts are brought from suppliers in Southeast Asia. These changes have enabled Fujitsu to cut

1 Fujitsu Home Page (1)
manufacturing costs by 20-30%. Sustained by the booming PC market in Japan and emerging demand for cellular phones in the Asia/Pacific, Fujitsu has recovered quickly and marked a 63 billion yen net income in 1995².

Like all the other competitors in the information technology industry, Fujitsu is now confronting a big challenge brought on by the world-wide Internet wave. Compared to its Japanese rivals, Fujitsu has started the Internet business earlier enough. To illustrate, Fujitsu is one of the founders of Nifty Serve, the largest Japanese Internet provider (founded in 1986), and the first Japanese license contractor of Mosaic (1994), the innovative browser which was developed by students at the University of Illinois, NCAS.

7-2. Why is Fujitsu Interesting?

In this chapter, I focus on how Fujitsu uses information technology, especially Intranet and groupware, to ensure successful knowledge management of the system engineers³. As regards this issue, Fujitsu has several interesting characteristics relating to (1) corporate culture, (2) sponsorship by the top executive, and (3) implementation of the information systems. In summary, the interesting points I find in Fujitsu are:

- Network-based corporate culture
- High commitment to communication support systems by the top executive
- “Information Producer” and “Information Charging System” as implementation tools

**Network-based Corporate Culture**

Although Fujitsu is one of the traditional large Japanese firms with a hierarchy and lifetime employment system—items which are negatively discussed today in terms of an innovative knowledge management—its corporate culture is not that of bureaucrats. Especially among the system engineers and R&D people, Fujitsu has a unique culture which appreciates people who are enthusiastic about something unusual in terms of routine work, and which allows such people to autonomously pursue their interests.

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² The Economist, Nov. 23-26, 1996 (2)
³ Yoshimura, 1996 (3); Nikkei Business, 1996 (4); Nikkei Information Strategy, 1997 (5); Interview with a sales manager at Fujitsu, 1997 (6)
Fujitsu’s system engineers also have a culture that organizes a number of informal communication networks where information is exchanged at random. As I discuss later, the Intranet today at Fujitsu was originally developed from unofficial networks by young system engineers who were in their 20’s and had a “hacker” culture, which is similar to that of Microsoft, as Cusumano and Selby discussed in their recent book.4

**High Commitment to Communication Support Systems by the Top Executive**

Sekizawa, originally telecommunication engineer and now President and Representative Director, was one of the originators of internal information shearing frameworks, such as a facsimile-based network and a Closed User Group (CUG) network based on a client/server system. Thus, the Intranet at Fujitsu which was originally developed informally by young system engineers was able to secure enough sponsorship from the top executive to become an official infrastructure.

Moreover, Sekizawa encourages his employees to activate usage of the Intranet and groupware both officially and informally, for example, he sometimes asks to managers who come to his office: “This information is interesting. By the way, is it already registered in our Intranet?”

**“Information Producer” and “Information Charging System” as Implementation Tools**

Even though Fujitsu has a unique corporate culture, it is still extremely challenging to activate heuristic communication support systems among all layers of employees, including those of its 35 system engineering subsidiaries.

To ensure the success of the Intranet, Fujitsu organizes two innovative methodologies of implementation. First, it appoints the “Information Producers” who are responsible for filtering and categorizing information, most of which is soft information in text or graphic formats and comes from everywhere at random. The Information Producers play a significant role in maintaining the quality and usability of the information stocked in the database. Second, it organizes the “Information Charging System,” in which an information originator can decide the “price” of his/her own information, and when someone else wants to cite that information, they need to “purchase” it from the originator. Once the “price” is registered in the Intranet, the

4 Cusumano & Selby, 1995 (7)
charging transaction is automatically processed. Twice a year, all transactions are aggregated, and the division which marked the largest “sales” amount receives awards. Several system engineering subsidiaries regard this internal information “sales” as one of their main businesses, and in the first half year of 1996, the top subsidiary marked 4,680,000 yen in total amount of “sales.” Fujitsu has finally found this system to be the most effective incentive framework to encourage random information exchange and to improve the quality of information.

7-3. Intranet/Groupware at Fujitsu

Overview

Based on this background, Fujitsu has engaged in developing communication support systems for knowledge management, at first informally and now as a corporate base.

Fujitsu announced its first Intranet, named FIND2, based on Mosaic in 1994; probably the first “Intranet” in the world—though there was no such a word at that time. As illustrated in [Exhibit 7-1], now Fujitsu organizes several kinds of Intranet frameworks.

Source: Yoshimura, 1996; Modified by Author

Exhibit 7-1: Intranet at Fujitsu
Because these information systems are originally developed in a bottom-up style, each system is operated and maintained by individual divisions, and only the network infrastructure (FNET) is maintained on a company-wide basis. In addition to these corporate-based systems, each division can develop its own WWW server, and now more than 300 WWW servers are activated. Currently, the corporate-based Intranet at Fujitsu are:

- **FIND2**: Information sharing system for the system engineers
- **The Q&A System**: Database of FAQ (Frequently Asked Question)
- **SARFIN**: Information support system for the sales forces
- **JKI**: Information support system for the R&D dept. and overseas plants
  (JKI = *Joho* (Information) Knowledge Infrastructure)

In this thesis, I focus on FIND2 and the Q&A System, which, I believe, include the most heuristic aspects as communication support systems. I will present the outline of SARFIN and JKI in [Appendix].

*Groupware*

Fujitsu feels that Intranet and groupware can coexist in the organization. As shown in the [Exhibit 7-2], Fujitsu defines each mission of Intranet and groupware clearly. Both are appropriate for non-routine work, but Intranet is used on a corporate basis and groupware is used on a division, or smaller team, basis.

![Exhibit 7-2: Domains of Information System Architecture](image)

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5 Fujitsu, 1996 (8)

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To illustrate, groupware has clear advantages on team-based tasks such as schedule adjustment, administration of authorizing processes, and exchange of confidential information. In addition, most of the system engineers at Fujitsu regard Intranet as an “encyclopedia,” while groupware is seen as a “flash news bulletin.” In most cases, the content of the Intranet at Fujitsu consists of the accumulated results of past activities. That is why most forward-thinking engineers use the Intranet for exploring the stocked intelligence, while they use the groupware for exchanging on-going issues.

In June 1996, Fujitsu released its groupware software, named TeamWARE, which can be used in WWW browser, and announced that it would continue to engage in both Intranet and groupware development.

7-4. Overview of FIND2

Although both SARFIN and JKI are interesting examples of communication support systems, I found FIND2 and the Q&A System more fascinating because they include the interesting characteristics of Fujitsu which I discussed above; for example, the Information Charging System is currently only applicable to FIND2.

Objective

Fujitsu unhesitatingly claims that the objective of FIND2 is not only to improve the efficiency of workflow of the system engineers, but also to reinforce their expertise, so that they can provide more innovative system planning, system development, and consulting services to customers. Thus, information sharing among 9,000 system engineers in Fujitsu and 13,000 in subsidiaries and the development of know-how as a common intelligence stock are the primary motivation behind FIND2.

Contents

FIND2, the most knowledge management-oriented platform at Fujitsu, has the following contents:

- Basic Information
  - Notification & Report:
    Announcements about regulations and company policy, and urgent information.
Software Information:

Information on software products, and catalogue information.

Know-how Support Information

* SE Library:

Reports and programs registered by the system engineers, and SE Handbook. Users can search information by keyword.

* SE Support Information:

IKB (Integration Knowledge Base), and Expert SE Information. IKB provides know-how about system integration for a total solution service, recommended product combinations, and checklists for design configuration. Users can also find Expert SEs who are qualified by the company and who have high technical expertise in a particular field. Experts SEs have responsibility to answer questions via FIND2.

* Project Information:

"Case Bank" (Cases of negotiation, promotion and failure in past sales activities), SE convention theses, project information, and journal articles.

**Information Flows**

The typical information flow of FIND2 is illustrated in [Exhibit 7-3].

Each system engineer who wants to post his/her information needs to send it through either e-mail or LAN to the WWW server of the Information Center, which is responsible for providing information support to the system engineers. Some engineers who are not comfortable with the electronic information processing still send it by paper. The originator of information needs to include his/her name, abstract, category, and "price" of the information together with the body of information.

At the center, Information Producers check each batch of information for validity of category, price, level of confidentiality, and add a thesaurus tool to keywords. In addition, Information Producers set hyper-links between the abstract and the body, as well as with other related information in the database. The body of information is accumulated in a relational database, where HTML format is automatically produced. Additionally, information which
rarely accessed is deleted when Information Producers check the “inventory” of FIND2 once a year.

Source: Yoshimura, 1996; Modified by Author

Exhibit 7-3: Information Flow of FIND2

**Exploitation**

In a survey done in September 1996, as shown in [Exhibit 7-4], the total information stocked in FIND2 was 84,245 items: Journal articles - 31,990; Project information - 24,223; SE Library - 10,975; Software information - 7,493; and Expert SE Information - 4,123. On average,
200 new information entries are registered monthly. FIND2 is accessed about 1,100 times daily, and about 420 documents are downloaded per day. On the other hand, about 2,000 information entries are deleted annually.

**Intelligent Stock in FIND2**

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
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<td>Generic Notification</td>
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</tr>
<tr>
<td>SE Handbook</td>
<td>2,464</td>
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<tr>
<td>Program</td>
<td>970</td>
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<td>Theses</td>
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<td>SE Reports</td>
<td>901</td>
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<tr>
<td>Generic Reports</td>
<td>85</td>
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<tr>
<td>Product Information</td>
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</tr>
<tr>
<td>Expert SE Information</td>
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</tr>
<tr>
<td>Journal Articles</td>
<td>31,990</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>84,245</strong></td>
</tr>
</tbody>
</table>

**Exhibit 7-4: Exploitation of FIND2**

7-5. **Overview of the Q&A System**

Another important communication support system for the system engineers is called the Q&A System, which was activated in 1993.

Prior to this, the Information Center was asked numerous questions from all parts of the company, as well as its subsidiaries. Because most questions were similar in content, the Center considered it inefficient to answer each question one by one; instead, it realized that developing a database of Q&A where users could search relevant answers would save the Center many working hours.

Driven by this motivation, the Q&A System was developed, and now includes the whole context of past Q&A cases between the system engineers and the Information Center, or the other divisions. Users can search applicable Q&A cases based on artificial intelligence technology. The Q&A information is stocked in categories, such as “questions regarding the identification of a certain condition,” “questions regarding what to do in a certain condition,” and
“questions regarding causes of a certain condition.” When users input question category, as well as that of a related system platform or software, the system displays the most applicable cases sequentially.

In the September 1996 survey, the total number of Q&A cases stocked in the system was 63,000, and the number of times the system was accessed was about 12,000 per month, with 60% of the inquiries being solved by this automatic answering system. If a user cannot obtain a satisfying answer, he/she can send the question to a relevant division; this Q&A process is also recorded in the Q&A System. Fujitsu regards both FIND2 and the Q&A System as the infrastructure of knowledge management of its system engineers.

7-6. History of FIND2

As we saw so far, Fujitsu has developed well-organized communication support systems and implementation methods. Why and how was such a successful communication support system like FIND2 developed in Fujitsu? How did Fujitsu’s corporate culture affect the development of FIND2? To understand these questions, I want to review the history of FIND2.

Mainframe-based FIND

Traditionally at Fujitsu, the system engineers were regarded as cost-centers which were supposed to support the sales forces. However, in the mid-1970s, in order to catch up with increasing customer expectations, customer interface needed to be reinforced by technical expertise for more value-added services. Reflecting this trend, senior executives felt that the system engineers should become profit-centers based on system planning, system development, and package software sales.

Although the system engineers used much information which could have been shared throughout the organization as a whole—for example, product information and technology development information—information among the system engineers was stocked separately in each division, and there was no coordination between them. Every system engineer had to start learning from point zero. This caused redundant learning on an individual system engineer basis, which was extremely inefficient on an organization-wide basis.

In 1978, Fujitsu started to develop a new information sharing system, named FIND, in order to support the system engineers in the sharing of information, and to eliminate redundant
learning within the organization. In 1986, the Information Center was founded, and was responsible for information support of the system engineers and maintenance of FIND. At that time, the Center was armed with 5,500 cases and hand-outs, 600 software programs, 600 manuals, and 4,000 books and journals.

However, FIND was an architecture in which only index and abstracts were registered in the database, and the system engineers needed to request copies of the full-text or graphics by mail delivery. Soon, resulting from the increase in requests, this caused a panic in the logistics of the Information Center, and, as a result, information flow became confused and delayed.

Revised FIND

In 1992 when Fujitsu suffered its first net losses since being listed on the Tokyo Stock Exchange, the company recognized the necessity of making the system engineering division more profitable. It proposed three objectives for the restructuring of its system engineering processes: efficient information shearing among the system engineers, reduction of the software development cycle time, clarifying of the system engineers’ work flow.

Senior executives at Fujitsu ordered the Information Center to organize this restructuring, and expected it to renew FIND. As a solution, the Center invented three plans to improve the functionality of FIND: (1) improvement of information quality, (2) improvement of the searching function, and (3) reduction of costs.

First, the Information Center appointed Information Producers, who were responsible for filtering and categorizing information which was registered in FIND. The information in FIND was originally registered by each system engineer, and he/she decided an information category. The Information Producers checked the validity of the categories, and, if necessary, re-categorized them into several groups; for example, information for system planning, for system development, for testing, or for trouble-shooting. In addition, the Information Producers added their own comments concerning the contents. Second, one of the major complaints about FIND was that users could not obtain relevant information because of a low hit ratio in searching. Thus, the Information Center provided a thesaurus which contained keywords of the same meanings; for example, “PC” and “Personal Computer.” Third, the Information Center decided to charge fees for copying and delivery to those who requested information through FIND. This had the effect of eliminating redundant requests to FIND.
At this time, the key revisions to the FIND system were mainly related to implementation, rather than technical improvement. However, as discussed later, these revisions became the key frameworks for the current Intranet at Fujitsu.

**FIND2 Gopher Version**

Thanks to the revisions, FIND seemed to be used successfully among the system engineers. However, the Information Center was not completely satisfied with the revised FIND. First, it was still a mainframe-based system. The Information Center was confronted with the upcoming wave of downsizing to the client/server system, and felt that their information shearing architecture should be more open so that it could stimulate more active information exchange. Second, because the revised FIND still did not include the full-text information, information distribution processes remained inefficient. Third, the searching function of FIND was just based on a keyword finding method. To make the system more heuristic, the Information Center wanted to evolve FIND into an artificial intelligence-based system. To illustrate, users could obtain answers from FIND to questions such as “What is the price of type X?,” but could not get responses to questions such as “Why did this computer have this kind of trouble?” and “What is the optimal system integration for this particular case?”

When the Information Center was occupied with such thoughts, a young system engineer named Watanabe, a UNIX expert, introduced WAIS to the Center. WAIS, Wide Area Information Server, was developed by Thinking Machines Corporation in 1991, and enabled a user to search a keyword from several different databases. The most particular characteristic to impress the Information Center was the WAIS function of counting and scoring how many times the selected keyword was included in the document, and then displaying the relevant documents sequentially by score. Although this is not artificial intelligence technology, it was innovative enough to make the Center enthusiastic. This was the starting point, from which time on the Information Center paid particular attention to the Internet as an architecture of its communication support system for knowledge management.

However, the Information Center found that if it depended solely upon WAIS, usability would be difficult. Therefore, it decided to try another Internet navigation tool, Gopher, which was developed by the University of Minnesota in 1991, and was also brought to the Center by Watanabe.
Because it was not long after the release of the revised FIND, the Information Center encountered much resistance to the further revisions. In addition, many mainframe-oriented engineers regarded a UNIX-based system as less reliable and inappropriate for the company's infrastructure. In spite of such doubts, the revised FIND, named FIND2 Gopher version, was released in June 1993. The Center decided to use both Gopher and WAIS for FIND2; for a searching tool, it used the function of WAIS.

In addition, when the FIND2 Gopher version was released, the Information Charging System was implemented. Now, not only a fee for copying and delivery, but also a fee for information itself was charged to users, and the fee for information was counted as a “sale” by the originator.

However, because there were not yet so many system engineers who could use UNIX, the old FIND remained together with FIND2.

**FIND2 Mosaic Version**

This was not the end of the whole story. In April 1993, Watanabe again approached to the Center with news of an innovative Internet navigator tool, Mosaic by the University of Illinois, NCSA, which was released in the US. The Information Center was really shocked to see how Mosaic was successful and applicable to its needs. Although it was right after the release of the FIND2 Gopher version, the center decided to switch to Mosaic in order to develop its communication support system without any compromise. Fortunately, because the users of FIND2 were still limited, switching from Gopher to Mosaic had little adverse effect on users. Hence, after the license agreement with the University of Illinois, NCSA in May 1994, the first license agreement for NCSA with Japanese company, the Center released FIND2 Mosaic version. Thus, the current version of FIND2, Intranet which is made with Mosaic, WWW, and WAIS over a UNIX server platform (now with Windows PC) was completed.

**7-7. Lessons Learned from FIND2**

**“Hacker” Culture**

When we survey the history of the development of FIND2, we are struck by Fujitsu’s remarkable flexibility, as well as by the fact that every trigger to move to a better solution was driven by a young system engineer.
Yoichi Watanabe, now 29 years old, engaged in a project relating to OEM of a UNIX work station at Sun Microsystems in 1988, and became a specialist of UNIX. In this project, about 30 young system engineers of the Fujitsu group, including Watanabe, were gathered from various areas of Japan, and organized as a team. When the project was completed, the members were split up again; however, they unofficially connected themselves with each other through a PC network in order to continue informal "chatting."

When this unofficial network was revealed, those young engineers were scolded by their bosses, but the network itself survived. Because their activities via the network became extremely energetic and innovative through random information exchange, the manager of the corporate network administration finally agreed to back them up in their attempts to evolve their network into an official corporate infrastructure. At that time, Watanabe was only 23 years old!

WAIS, Gopher, and Mosaic, all were found through this private "chatting," and tried by these young engineers. Thus, Watanabe played a major role in introducing the Internet navigation tools to Fujitsu, and in developing FIND2 as an Intranet. In addition, although now FIND2 is maintained officially on a corporate basis when FIND2 was released for the first time, the team members of Watanabe’s network were in charge of maintenance and administration of the network on a voluntary basis.

What kind of personality does Watanabe have? Watanabe’s manager stated that Watanabe always seemed to be "playing" with a computer, but also added that Watanabe was a kind of "genius" about computer networking. In fact, Watanabe has established a reputation at Fujitsu with his unusual savvy for finding creative software solutions.

Aside from Watanabe, Fujitsu has a number of such young system engineers with a "hacker" culture. Their work is based on random information exchange in a "chatting room." They just do what they want to do, or what enables them to work more effectively without orders from their senior managers. Watanabe says that he himself now considers FIND2 to need further improvement, and that he will just do what is needed to make his work better.

Obviously, one of the keys to the success of FIND2 is the imagination of Watanabe as an individual, but I believe that more important aspects are the corporate culture which gives sufficient autonomy to the young "hacker" generation, and the flexibility of a senior management which adopts suggestions of by those creative "hackers." Kenichi Ohmae, former representative of McKinsey & Co., Tokyo, indicates that, in the near future, a new type of
business leader for the 21st century will emerge from the computer game generation, which is now under 30 and has grown up with “Super Mario.”

**Sponsorship by the Top Executive**

What enables Fujitsu to keep such a remarkably flexible corporate culture, I believe, is Sekizawa, President and Representative Director, himself.

In 1986, when the Information Center was founded, Sekizawa, General Manager of the East-Japan division, released his first facsimile-based information sharing network. He said that the most typical and critical failure of the system engineers was a communication gap between engineers and customers, and that these failures were critical learning processes which could become part of an intelligence stock to increase the engineers’ power. In 1987, when Fujitsu released the PC network, Nifty Serve, Sekizawa evolved his facsimile-based network into the electronic Closed User Group (CUG) network. Because Sekizawa himself had been engaged in developing knowledge sharing frameworks, it was a natural conclusion that the informal but creative network by young engineers obtained sufficient sponsorship.

Sekizawa mentioned that a company which provides network products should use them itself first, so as to understand customer needs, and that Fujitsu wishes to be a leading user and, at the same time, a leading provider of the network business. This vision provides a very important background to the Fujitsu’s Intranet today.

**Implementation**

Another critical success factor of FIND2 is its implementation methods: Information Producer and Information Charging System.

Fujitsu’s senior executives recognize that the most significant key to success of communication support systems for knowledge management is implementation. One senior executive says that the challenging task for FIND2 is how to absorb the know-how of creative system engineers; according to him, system engineers tend to want to obtain know-how from the others, but do not want to provide open access to their own know-how. As I myself was stuck with the rigid mental models in the loan division of the insurance company, I am fully aware that

6 Ohmae, 1997 (9)
a heuristic communication support system does not make any sense when users do not input their knowledge. I found that Fujitsu successfully copes with this problem.

As mentioned above, the Information Producers play key roles both in increasing the quantity of information and in maintaining the quality of information. Initially, three Information Producers, who were middle-level managers, were assigned to the Information Center. Currently, one Information Producer is assigned to the Center, and each key system engineering division and subsidiary has its own Information Producer.

Because the work of the Information Producers looks laborious and humble, maintaining their motivation is another challenging task. One Information Producer of a subsidiary who won the first prize for information “sales,” says that if his role were merely the inputting of data delegated by system engineers, he could not keep his motivation. However, he is inspired when seeing how the work of the engineers is changed by knowledge sharing. In fact, many system engineers admit that their working styles have been changed by FIND2; without FIND2 they cannot obtain critical information to proceed in their daily tasks. This same Information Producers says that his job is not one of a regulator who restricts the entry of information, but a supporter who encourages the random entry. He indicates that, even though poor information is registered, it will soon be eliminated because no one uses it, and that those who ultimately judge the quality of information are not the Information Producers, but the users.

Another critical success factor is the Information Charging System. In FIND2, generic notification is “free,” but about 40% of the information is “priced”—the price range is on average between 1,000-3,000 yen. In the first half of 1995, the total amount of “sales” in the whole group was up to 90,000,000 yen, and, at the same time, as mentioned above, the top “sales” subsidiary in the first half of 1996 marked 4,680,000 yen. Information with the least “sales” is deleted annually by the Information Producers: a process of “natural selection” by users.

In conclusion, the secrets of success in control of both quantity and quality of information in FIND2 is keeping entrance wide enough and having built-in mechanism of “natural selection” of information.
Challenge Ahead

One senior executive in charge of FIND2 says that his satisfaction with usage of FIND2 is still 30%. Since most nimble system engineers of Fujitsu still regard Intranet as an "encyclopedia," the contents of which are the results of past activities, FIND2 has more to do in order to evolve into Khoshafian & Buckiewicz's second generation of communication support systems. In fact, some senior executives expect further evolution of FIND2 into an artificial intelligence-based system. I can say that FIND2 is in the middle of the process of evolving from the first generation to the second generation of communication support systems.

Security is also a challenging issue for FIND2 because many users want to expand FIND2 to link it with the databases outside the company.

7-8. Further Analysis

Application of the Framework of Communication Support Systems

Based on the framework of communication support systems discussed in Chapter 3, the Intranet/groupware in Fujitsu, chiefly represented by FIND2, can be categorized as follows.

- Management Activity
  * Primarily, they are used for "operational control."
    Users of the Intranet/groupware in Fujitsu are the system engineers for FIND2, the sales people for SARFIN, and the R&D and product development staff for JKI. As the menu of each system illustrates, most activities supported by the Intranet have a more specifically defined scope and routine-type work.
  * In addition, they are indirectly used for "strategic planning."
    As Sekizawa mentioned, the internal use of Intranet/groupware has a strategic significance as a network products provider. Fujitsu is trying to understand the needs of customers by experiencing a customer position by itself.

- Communication Type
  * Basically, communication is "unstructured."
    Some of the contents, such as notification and report, are "structured" communication which have one-way communication streams from information originators to readers. However, critical contents, such as the SE Library, IKB, and the Q&A System, have two-way random communication streams in which anyone
can be an originator. The contents are soft information which have wide latitude of freedom, rather than hard quantitative data.

- Decision Process
  
  * Primarily, they are used for “intelligence activities.”
  
  The main objective of FIND2 is to develop the knowledge assets of the system engineers. In this sense, it obviously supports “intelligence activities.”

  * In some sense, they are also used to support “design” and “choice activities.”
  
  To illustrate, planning a system integration by IKB is an example of a support of “design” process, and the price and product information will support “choice” process.

*Heuristic Communication Support Systems*

As it may sound controversial, I want to assert that FIND2 is a basic style of a heuristic communication support system for knowledge management. Obviously, it is a communication support system based on an Intranet architecture, and, as Fujitsu says, its objective is knowledge management of the system engineers. But how about the argument of whether it is a heuristic or not?

Going back to the definition by Herbert Simon, a heuristic program, using the same kind of “rules of thumb” as are used by humans, succeeds in capturing some aspects of “Eureka!”-type of problem-solving. My definition in this thesis is that “heuristics” are functions which can support us in finding our goal based on “rules of thumb” acquired through human experiences or insights, and which sometimes may lead us to invent something innovative through the random combination of on-going human “knowledge.”

In terms of my definition, FIND2 can be called “heuristics.” Of course, though, it is not precisely a “heuristic program” in terms of computer science, but it can help the system engineers to obtain “Eureka!”-type findings through technically-assisted “rules of thumb” like WAIS. To illustrate my point, Fujitsu system engineers may find a direct answer from the SE Library, Case Bank, or the Q&A System, and obtain indirect advice from Experts SE. If the problem a system engineer is facing has a simple answer which may already be written in a textbook, I cannot call the system: “heuristics”; however, if the problem is totally unexplored, and

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7 Simon, 1960 (10)
users can obtain hints from FIND2 for creating their own new solution, the system can be called a "heuristic" information system.

Because FIND2 is not yet based on artificial intelligence technology, I cannot yet claim it to be Khoshafian & Buckiewicz’s second generation of communication support systems. However, as the Q&A system is already based on artificial intelligence technology, it is obvious that Fujitsu’s ultimate goal is to enhance FIND2 into an artificial intelligence-based system.

Moreover, FIND2 and the Q&A system at Fujitsu are based on interpersonal learning processes, where the information system is an intermediary of human-to-human communication. The system engineers find a clue to “Eureka!” not from the results of computing simulations, but from human intelligence stocked in the database. Hence, as I discussed in Chapter 4, FIND2 is essentially a place where users can find a clue to innovation from electronic human-to-human interaction, which enables them to communicate more unstructured ideas, concepts, or problems.

Using my definition, “rule of thumb” based on past knowledge is a necessity to "heuristics,” and "an evolving process through continuous learning” is a sufficient condition. Armed with Internet technologies like WAIS, FIND2 technically organizes rules of thumb. At the same time, through successful implementation of such function as Information Producers and an Information Charging System, it realizes the continuous input of human knowledge, and thus the continuous evolution of the stocked intelligence. This is why I regard FIND2 as a basic example of a “heuristic communication support system for knowledge management.”

_Evolving Process from an Efficiency Enabler to a Heuristic_

FIND2 also represents a typical evolving process of communication support systems: from an efficiency enabler to a heuristic.

As I discussed in Chapter 5, in most cases, communication support systems such as Intranet and groupware start with an efficiency-oriented objective. Without functional communication support systems, there may be redundant learning because everyone in an organization, especially knowledge workers, may have to start learning from point zero. The initial motivation of communication support systems in many organizations is to eliminate this redundancy.

FIND2 at Fujitsu also started from this point. The primary objective of the mainframe-based FIND, the origin of FIND2, was efficient information sharing among the system engineers.
in order to improve their productivity. However, in accordance with the evolution from a mainframe-based system to an Intranet-based system, and inspired by the young “hacker” generation, random information exchange which may generate something innovative was identified as a key role of FIND2. Apparently, senior executives at Fujitsu today regard the heuristic aspect of FIND2 as more significant, rather than cost reduction due to paperless communication or time-saving.

**Implications for Financial Firms**

Even though what Fujitsu has done with Intranet/groupware gives us an informative guideline for developing heuristic communication support systems, it does not mean that the other companies could easily do the same thing.

As I indicated in Chapter 1, the main objective of this thesis is identifying implications for financial firms so that they can develop successful heuristic communication support systems for knowledge management. Interestingly, although most critical work in financial firms consists of knowledge-based tasks, and such firms are the heaviest users of information-processing products, corporate based, or even division based, computer-aided knowledge management is still an uncultivated issue. In fact, there are critical differences in environments between financial firms and Fujitsu.

- **Mission:**
  
  Developing better information processing products is absolutely the main mission for IT-based companies like Fujitsu, whereas for financial firms, there are still deep-seated beliefs that information technology is just a support tool of the financial business.

- **Culture:**

  Innovation is definitely a crucial issue for high-tech-based manufacturers like Fujitsu, whereas in financial firms, innovation tends to be regarded as a secondary priority compared with efficiency.

- **People:**

  Creative young engineers with “hacker” culture are relatively easily accepted in IT-based companies like Fujitsu, whereas in financial firms, there is little chance for such people to obtain good opportunities within the organization.
Of course, I understand that these arguments are relatively hasty generalizations, and that there are many advanced financial firms aware of the magnitude of information technology and creative knowledge workers. However, I want to assert that traditional-minded financial firms are still in the majority. According to a November 1996 survey by Nikkei Business Publications Inc., among 518 large Japanese companies, including major banking and financial companies, most of which are listed on the domestic stock exchange markets, only 31.5% of “white-collar” employees, most are likely knowledge workers, can use the e-mailing systems, and only 8.6% of them can use the Internet!8

7-9. Chapter Summary

FIND2, the Intranet at Fujitsu, is a good example of a heuristic communication support system for knowledge management. Its objective is to develop a common intelligence stock of the system engineers, so that they can enhance their creativity in knowledge-based tasks. The key element of knowledge management at Fujitsu depends on human-to-human random information exchange through an open network.

The critical success factors of FIND2 are, first, its flexible corporate culture that encourages the creative young “hacker” generation; second, its clear strategic vision that a leading user of network can be a leading product/service provider to customers; and third, successful implementation methods which stimulate random information exchange and, at the same time, maintain the quality of information stocked.

However, these success factors are hard to apply to the other industries whose primary mission is not information technology. Even financial firms, heavy users of information-processing products, still have a large gap to close before adopting the Fujitsu way.

8 Nikkei Information Strategy, 1997 (11)
Chapter 8

Case Study: Capital One Financial Corporation

Although the central theme of this thesis is to identify implications which will assist financial firms in developing successful heuristic communication support systems for knowledge management, in the financial industry there have been few relevant examples of such information systems. As discussed in Chapter 7, different from IT-based companies like Fujitsu, financial firms have not yet given first priority to developing computer-supported knowledge management frameworks. Their interests in information technology have mainly focused on external coordination with customers and markets, rather than internal coordination within organizations.

Capital One Financial Corporation is a remarkably successful credit card company which utilizes an intensive information-based marketing strategy. Although Capital One has been among those which focus on external coordination by information technology, and does not have any established corporate-based groupware or Intranet, I believe that Capital One has enough potential to evolve into a knowledge-oriented enterprise armed with computer-supported internal coordination.

8-1. Company Profile

Capital One Financial Corporation is a financial services company whose primary business is offering credit card products through its subsidiary, Capital One Bank. Capital One was launched as a division of Signet Bank in 1991, when two banking strategy consultants, Richard D. Fairbank and Nigel Morris, offered their plan for revamping of the credit card business. Starting from less than $1 billion in credit card receivables, Capital One now ranks among the top 10 US card issuers, with $12.8 billion of managed receivables (on-balance-sheet
loans plus securitized loans), and among the largest providers of MasterCard and Visa credit cards in the USA. In 1996, it noted the record earnings of $155.3 million, up 22.8% from 1995; managed receivables of $12.8 billion, up 23% from 1995; accounts of $8.6 million, up 41% from 1995; and revenue of $1.5 billion, up 63% from 1995 (see [Exhibit 8-1]).

![Exhibit 8-1: Capital One—Managed Receivables and the Number of Accounts](source)


Capital One has its corporate headquarters in Falls Church, VA, and operation centers in Richmond and Fredericksburg, VA; Tampa, FL; and Dallas/Ft. Worth, Texas. Currently, it employs approximately 6,000 people.¹

**8-2. Why is Capital One Interesting?**

Capital One has enjoyed remarkable success in acquiring a new business opportunity by understanding characteristics of the “industry structure.” While the credit card business has traditionally been regarded as the extension of banking business—credit risk underwriting—Capital One approaches it in an innovative way; as an information-based marketing business.

¹ Capital One Annual Report, 1995 (1); Moody’s Bank & Finance Manual, 1996 (2); PR Newswire, 1997 (3); Capital One Fact Sheet, 1996 (4)
Revamping Plan By Two Ex-Consultants

In the late 1980s, two banking strategy consultants, Fairbank and Morris, offered to many large commercial banks their innovative plan, which regarded the credit card business as information-gathering business. However, virtually no banks showed any interest in their plan; some banks said that they were already doing information-technology-based strategy, and the others said that they did not want to do it either because Fairbank’s and Morris’ plan was totally different from their vision, or simply because they could not afford to introduce new information systems.

Finally, Signet Bank, a regional bank in Richmond, accepted the offer by Fairbank and Morris, and invited them in as marketing strategists. In 1991, Fairbank made a drastic prediction about Signet Banks’ profitability—although the net income of Signet Bank was $25 million in 1989 and $35 million in 1990, Fairbank asserted that it would be, at best, zero (!) in 1992 unless Signet Bank changed its traditional strategy. In fact, owing to the rise in personal bankruptcies, the delinquency rate of Signet Bank’s assets increased from 2.9% in 1989 up to 8.1% in 1991. Although, Fairbank and Morris encountered much skepticism and resistance at first, their proposal finally awakened senior executives of Signet Bank, and Fairbank took over the responsibility of marketing manager, introducing thousands of tests to better understand the market.

Through intensive data-mining of customer information databases which were collected by thousands of direct mailing tests, Fairbank discovered the “industry structure” of the credit card business. Although, deterioration in consumer credit quality had become worse as a whole, there were bunches of “dream customers” who remained good credit risks and maintained monthly balances.

When he analyzed customer behaviors, such as credit line utilization and response to solicitation, Fairbank found that behaviors of “dream customers” could be clearly distinguished from those of undesirable customers who had higher delinquency rates. In order to improve both efficiency and effectiveness, Fairbank then started to promote intensive customer targeting.

Thanks to this dramatic change in Signet Bank’s strategy, the total credit card portfolio has grown from just $200 million in 1988 to a market value for Capital One of $2.4 billion in 1996!
*Information as Life Blood*

Although Fairbank and Morris were not professionals in the credit card business—rather they knew almost nothing about the “traditional wisdom” of the business—they invented an innovative way to manage the credit card business as an information-gathering business. In Fairbank’s view, the strategies of the large banks, which said they had already established information system-based credit card business, still clung to the “traditional wisdom” of bankers—they used customer information for credit scoring, but not for marketing or understanding the “industry structure.”

Capital One tested thousands of different credit card offers—varying rates, card fees, payment options—to tens of millions of customers and potential customers, all supported by computer-based scientific testing. Capital One used its bulging database to calculate the net present value of cardholders’ likely future business, based mainly on their historical card balances, repayment profiles, credit reports, and their background information. It also estimated the likelihood, based on the behavior of similar customers, that the customer would stay loyal. Capital One has intensively invested in solicitation and information system, and spent $206 million in marketing in 1996; it is the second largest direct mailer behind only Citibank (see [Exhibit 8-2]).

![Graph](image)


*Exhibit 8-2: Capital One—Net Income and Solicitation & IT Expense*
Armed with this marketing research, Capital One offered “balance transfer” plans to prospects (proposal which would encourage clients to switch from competing cards by tailoring cards to meet the specific needs of each market and by offering specialized options, such as secured and unsecured cards, student cards, joint accounts and varied fees, interest rates and terms), and better-than-promised deals to existing best customers in order to keep their accounts.

In 1996, Capital One won the 12th Annual Excellence in Technology Award given by Gartner Group in appreciation of its executive leadership in the area of information technologies and their contributions to corporate business strategy².

8.3. Capital One—Surfer of the Transforming External Environment

What is the most impressive in Capital One is its innovative idea that credit card business is a mass customization business—providing the right products, at the right time, in the right place, to the right customers.

This mass customized approach is in total opposition to the traditional philosophy of commercial banks, which sees relationship banking, including intensive face-to-face contacts with customers based on the expanded branch network, as the essence of the business. However, for Capital One, all customers are “faceless,” and the database is its primary customer interface. Capital One depends on the massive database to indicate who wants what products, rather than on the power of an individual sales person.

As shown in [Exhibit 8-3], on Capital One’s home page, we can see the surfing Capital One card. I found this image to be a great illustration of Capital One’s current situation because their strategy has been exactly one of “riding on the wave” of external transformation. Fairbank says that in such a turbulent environment, everything is opportunity—and he found it!

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² Fairbank, 1997 (5); Brown & Krug, 1996 (6); Mencke, 1996 (7); Hotchkiss, 1996 (8); Henderson, 1995 (9); Novack, 1995 (10); Credit Card Management, 1995 (11); Anthes, 1995 (12)
Exhibit 8-3: Capital One—Surfer of External Transformation

The external transformation which has enabled Capital One to obtain successful business opportunities can be summarized as follows.

Credit Card as a Transaction Enabler and Loan Vehicle

Motivation for holding credit cards so far has been availability, security, assurance in emergency, and, perhaps most importantly, status enhancement as a proof of creditability. However, as the number of card holders increases, regardless of social status, occupation, income, and age, the significance of the credit card as a status enhancement has diminished. This implies that the primary usage of credit cards has become a more commoditized transaction enabler, which would replace cash and check. In addition, the recent “dis-saving” trend in US consumers has opened the window to the credit card as a more convenient loan vehicle. Fairbank was enough of a visionary to understand the further growth potential of the credit card as a commodity, best managed through the mass customization process.
Increasing “Dream Customers”

As Lester C. Thurow indicates in his recent book, “The Future of Capitalism,” the world is developing a new class of people—a very large group of elderly, relatively affluent people, most of whom do not work, and who are dependent upon government social welfare payments for much of their income. The increase of these affluent people must have been a good news for Capital One because they could be “dream customers” who are good credit risks, and who do not pay off their balances in full every month. Various options offered by Capital One would attract these customers, who are relatively sophisticated and demanding of flexibility in payment schedule.

As discussed above, the objective of Capital One’s intensive information-based marketing is selecting these “dream customers,” and improving both efficiency and effectiveness by focusing on them as the targets. Compared with less than 2% of the banking industry’s recent response rate in direct mailing, the average rate for credit card specialists, like Capital One, is as much as 10%.

Deregulation as Opportunities

Although the credit card business has basically not been regarded as a rosy one because of the recent high delinquency rate, monoline credit card specialists, including Capital One (e.g. MBNA, First USA (acquired by Banc One in 1997), and Advanta), have enjoyed remarkable success. Compared with the largest credit card issuer, Citibank with 40 million customers, Capital One is still a small player with about 8.6 million customers. However, by focusing on good-credit-risk customers through information-based marketing, it has continued over 20% growth in the past five years. If larger credit card issuers, mostly commercial banks, have lost money owing to the increasing delinquency rate, why has Capital One kept such a remarkable growth rate? One of the clues to the answer is in the deregulation in the US banking industry.

After the deregulation in the late 1980s, most money center banks such as Citibank and Bank of America fell into a severe predicament primarily because they held inferior-credit-risk assets resulting from their full-line policies and throat-cutting competition. Their credit ratings dropped into “Baa,” only one notch above junk bonds! It was at this time that Fairbank and

3 Throw, 1996 (13)
4 Hotchkiss, 1996 (14)
Morris launched Capital One in Richmond; they caught the tail wind of deregulation, when severe competition at a lower interest rate awakened customers’ price-sensitivity. By offering competitive prices only to good-credit-risk customers, the monoline credit card specialists, including Capital One, gained shares from money center banks who reduced their market scope under drastic restructuring.

**IT Which Can Deal With “Knowledge”**

One of the major impacts of information technology is a codification of “knowledge” and its heuristic usage under low costs. A company reinforced by information technology can understand customer preference through intensive data-mining and simulations, as well as through accumulating “knowledge” of the market. Hence, through data-warehousing and statistical analysis, service firms can eliminate the need for direct contacts between providers and customers.

In the credit card business, this shift has forced credit policy departments to change their mission from shutting out all inferior-credit-risk customers to controlling the portfolio’s total default probabilities within an affordable range.

Despite the fact that Fairbank and Morris encountered much resistance among “traditional wisdom” believers, especially within the credit department, Capital One was nonetheless able to use this trend shift by IT revolution to change its corporate culture, and finally achieved a power shift to IT people in its organization. In the new paradigm, the competitive advantage of credit card companies will depend on how much information they have, and currently Capital One is among the top runners.

**8-4. Information and Knowledge as Core Competencies**

*Challenge Ahead*

The most critical issue which now faces Fairbank is how to sustain Capital One’s remarkable success as a “growth machine.” He recognizes that, in the US, the proportion of companies which sustain over 20% growth in EPS (Earnings Per Share) for five years is below 1%, and is concerned that Capital One may hold the risk of “regression to mean.”

In fact, many analysts indicate that the credit card market is no more a promising one. According to Standard & Poor’s Credit Card Quality Indexes, which monitor the performance of
about $220 billion of publicly rated bank-issued credit card securities, the monthly charge-off rate of the industry average rose up to 6.5% in January 1997, while it was 3.8% in January 1995, and 4.7% in January 1996\textsuperscript{5}.

As shown in [Exhibit 8-4], although the delinquency rate of Capital One once dramatically dropped after Fairbank's restructuring, it has recently turned again into a rising trend, and, in January 1997, reached 6.65%, a 0.47% increase from the previous month. Moreover, in February 1997, Fitch Investors Service announced that it changed the rating outlook of Capital One from "stable" to "negative." The other monoline credit card specialists, MBNA and Advanta, have also moved into negative ratings\textsuperscript{6}. Severe competition has caused a flood of credit card solicitation in the mailboxes of good-credit-risk customers—the total amount spent on solicitation was $2.4 billion in 1996—and the market pie has almost been cultivated\textsuperscript{7}.

These unfavorable facts prove the limitation of Capital One's growth strategy in the credit card business. In fact, Fairbank himself admits that balance transfer offerings have become saturated in the market.

\begin{center}
\includegraphics[width=0.5\textwidth]{chart.png}
\end{center}


\textit{Exhibit 8-4: Capital One—Delinquency Rate}

\textbf{Capital One's Answer}

Fairbank sees the core competence of Capital One as having evolved from that of credit card specialist to financial service provider thanks to information-based marketing. In the face of

\textsuperscript{5} Reuters, 1997 (15)
\textsuperscript{6} PR Newswire, 1997 (16)
\textsuperscript{7} Credit Card News, 1997 (17)
current market collapse, Fairbank has taken this evolution of core competence to the next level; Capital One's core competencies of both "smart people" and a customer information database provide the infrastructure which will flexibly enable Capital One to obtain new business opportunities, including nonfinancial services, such as telecommunication, catalogue services, health care, and so on.

To maintain such a remarkably high growth rate, his answer is not to cling to the credit card business, but to discover new opportunities based on knowledge and database, and to continuously expand Capital One's business horizon through spin-offs to new business. In fact, Capital One recently established a division to resell cellular phone services.

Some analysts are very skeptical about this diversification, which has actually become a new trend among monoline credit card specialists—MBNA founded an auto-insurance agency to expand its auto-leasing business, and Advanta started home loans. Analysts doubt the effectiveness of diversification because the advantage these companies had was their focused monoline policies, which made them more careful lenders than the other full-line commercial banks. In addition, these analysts do not believe that these monoline credit card companies have enough capabilities for successful cross-selling of diversified products.

In my opinion, the diversification moves of Capital One and those of the other monoline credit card specialists are essentially different. The approaches of MBNA and Advanta are clearly to gain synergy between the credit card business and new businesses, and they still consider their core competencies to be in the credit card business. On the other hand, Capital One diversifies its business because it can apply its core competencies—database and knowledge—to the new businesses, rather than because it wants to gain synergy.

In the upcoming new paradigm in which knowledge assets will be a key to success, Fairbank's vision seems to be appropriate; however, I do question how he will be able to continuously discover promising business opportunities. This will be the true challenge. I have no doubt that the huge customer information database, which can be a heuristic information system, will give Capital One an outstanding competitive advantage. Thus, I have particular interest in how Fairbank and Morris will nature and develop Capital One's core competencies so that it can survive and flourish in the 21st Century.

8 Frank, 1997 (18)
Developing Core Competencies (1) - Flexible In-house Data-mining

Some analysts say that one of Capital One’s most valuable assets, which does not show up on the balance sheet, is its millions of pieces of customer information built up from years of credit-card transactions and direct mailing. Armed with this huge database, Capital One can target a product even at the individual account level.

One basic, and now strictly maintained, policy of Capital One is that it will never outsource information data processing. Credit card companies with “traditional wisdom” tend to consider simple information processing, such as mailing and statement preparation, as peripheral works to be outsourced, while Capital One finds opportunities in these processes. For example, the sorting sequence of customer information by several variables helps the company to discover certain characteristics which may point of the need for new value-added products or services. The flexible data-mining processes which have a function of heuristics will not be available if these processes are outsourced. In 1994, Capital One went on a reverse course of the booming outsourcing trend, and insourced its data processing from Electronic Data Systems Corporation with $49 million of termination costs. This move is a clear indication that Capital One’s awareness that information processing was its core competence.

Now that many competitors are following the same approach as Capital One’s, and given the recent unfavorable conditions in the credit card market, Capital One is mining the data so that it can obtain new business opportunities as the first mover again. Currently, Capital One is trying over 10,000 tests per year in order to find new business opportunities.

Developing Core Competencies (2) - Recruitment of Intellectual Assets

Even though Capital One has gathered terabytes of millions of pieces of customer information through its thousands of market tests, its database will be useless if the company does not have sufficiently “smart people” with the appropriate abilities not only in data processing, but also in creating innovative products or new business ideas through intensive data-mining. Thus, Capital One regards recruitment as a significantly critical process.

When we access the home page of Capital One, we notice that Capital One elaborates its recruitment announcements in particular. The following list, though a little too long to cite in full, is description of the career opportunities at Capital One9.

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9 Capital One Home Page, 1997 (19)
Recent College Graduates

* Business Analysts:
  Business Analysts are analytical-driven marketing professionals who work within a team-based, consulting-like framework and are responsible for charting product strategy and leading project teams.

* Financial Analysts:
  Financial analysts are those who have a strong background in finance, management or accounting as well as with strong interpersonal and organizational skills.

* Human Resource Consultants:
  Human Resource Consultants are those who can rise to the challenge of developing and implementing new human resources strategies. They are supposed to be excellent communicators and problem-solvers who can utilize an information-based approach.

* Marketing Specialists:
  Marketing Specialists act as liaisons among Business Analysts and production teams, as well as data processing and operational units, and play a part in copywriting for a variety of direct mail projects.

* MIS/Data Analysts:
  MIS/Data Analysts support accounts management marketing strategies, including account selection, market segmentation, product re-pricing, and product solicitation through market segmentation techniques and database manipulation.

* Operations Analysts:
  Operational Analysts are members of a team which will help coordinate, manage and implement key strategies. Selected candidates participate in an intense 9-week training program to enhance understanding of the work flow, organizational structure, and career paths.

* Statisticians:
  Statisticians work directly with business decision-makers to create key decision processes that impact the product line and future direction of the company.
* Management Trainees:

Management Trainee will develop critical skills while learning about future opportunities, which include leadership, coaching and development, project management, troubleshooting, and leading/managing a team of professionals.

- Information Technology Career Opportunities
  * IT Information Integrity - Network Security Engineers
  * Information Integrity Manager - Training Managers
  * Quality Engineers (IT quality control specialists)
  * Development Associates (developers of Oracle, SQL, UNIX, etc.)
  * Business Application Analysts (analysts of business model with data-mining skills)
  * Data Center Support Analysts (analysts of job flow language)
  * Programmers (programmers of COBOL, Unisys, etc.)
  * Object-oriented Technologists (programmers of CORBA, C/C++, UNIX, Oracle, etc.)
  * Software Quality Assurance Testing Developers (testers)
  * Others (Client/Server, Imaging, Telecommunications, Data Networks, Internet/Intranet, etc.)

- Professional Career Opportunities
  * Site Managers (managers of 400-500+ people)
  * Operations Managers (managers of 100-200 people)
  * Industrial Engineers (managers of TQM, operations, and productions)
  * Senior Customer Service Managers (managers of customer service at centers)
  * Senior Operations Analysts (analysts of operational efficiencies, project implementation)
  * Project Analysts (consultants for management to identify problems)
  * Credit System Specialists (specialists of credit information systems)
  * System Control Specialists (specialists of monitoring and auditing of IT)
  * Management Recruitment Researchers/Management Recruiters
  * Team Readers
* Human Resource Consultants
* Technical Trainers
* Technical Writers
* Investigative Analysts (investigators of statistical analysis of loss reporting)
* Quality Assurance Managers (managers of process improvement)
* Unit Managers/Unit Coordinators (supervisor of 20-60+ people)
* Development Analysts (developers of GUI programming, telecommunication systems)
* Senior Training Managers
* Data Analysts (analysts of marketing programs)
* Regulatory Accountants (individuals handling calls regarding direct mailing of offers)
* Staffing Analysts (administrators of call center volume)
* Performance Support Project Coordinators (supporters of risk operation)
* Network Information Support Specialists (supporters of general system maintenance)
* Financial Analysts (analysts of forecasting and reporting for customer service)
* SAS Programmers (programmers of SAS to support marketing analysts and statistician)
* MIS Analysts (analysts of new database marketing tests)

One remarkable characteristic in this list is that Capital One mainly focuses on information technologists and human resource managers, rather than customer relationship managers, sales managers, or credit analysts, positions which are common in financial firms with “traditional wisdom.” This list illustrates that Capital One recognizes well what its core competencies are.

8-5. Further Analysis

Application of the Framework of Communication Support Systems

Capital One has not yet established an advanced corporate-based Intranet or groupware, and its organizational communications chiefly depend upon human-to-human interface, phone,
and e-mail. Based on the framework of communication support systems discussed in Chapter 3, Capital One’s case can be described as follows:

- **Management Activity**
  - The information system at Capital One is primarily used for “operational control” in making customer statements and solicitation.
  - At the same time, we can say that it is used for “strategic planning,” allowing Capital One to develop new credit card products, as well as find new windows of opportunity, through data-mining processes.

- **Communication (Information) Type**
  - Information contents which are processed in Capital One are mainly *hard* data, such as repayment profiles and credit balances histories. In this sense, its information type is “structured” information.
  - However, its data-mining processes for finding new products are random, and may be regarded as “semi-structured” information processing.

- **Decision Process**
  - Primarily, customer information is used as an stock for “choice,” which will improve efficiency in marketing.
  - At the same time, it is used as a support of “design” activities in new product development.

**Heuristic Communication Support System?**

The information system at Capital One depends on human-to-machine interface as a data-mining enabler. In addition, its database is acquired through transactions of the credit card business, rather than information exchange between humans. Thus, information system at Capital One cannot be regarded as a communication support system, but as a traditional style of Management Decision System. Moreover, the original objective for developing the information system was not managing knowledge, but gathering and accumulating customer information. Therefore, I cannot say that the objective of the information system at Capital One is above all knowledge management.

However, the reason why I choose Capital One as an example for this thesis is that I believe Capital One has enough potential, as well as strategic intent, to evolve into a knowledge-
based enterprise sustained by information technology. Its policy regarding flexible in-house data-mining process as a key to success represents the belief that the existing customer information database can be heuristics for inventing new business opportunities. The list of Capital One’s recruitment policy also illustrates its strong ambitions to be a knowledge-based service company, as well as its recognition that knowledge management sustained by well-organized collaboration frameworks will be a critical success factor (in the recruitment policy announcement, we find many words such as “team-based,” “coordination,” “understanding of work flow,” “leadership/coaching,” and “human resource consulting,” as well as “decision of the future direction of Capital One.”)

Evolving Process at Capital One

Based on the discussion in Chapter 5, Capital One is now in the third stage (having skipped the second stage) of the evolution process of communication support systems—the first stage intends to do things cheaper, the second is to do things better internally, the third is to do things better externally, and the final stage is to do something innovative.

Like that of other financial firms, Capital One’s focus has been set mainly on efficiency improvement and external coordination with customers, rather than internal coordination and innovation. However, its policy for continuing success in the future clearly indicates that Capital One also needs to focus on internal coordination and innovation. Thus, I find enough possibilities, or necessities, at Capital One for developing computer-supported frameworks for internal coordination and innovation.

Implications for Capital One

As discussed in Chapter 7, the given situations at Fujitsu is quite different from that of Capital One. Nonetheless, I believe Fujitsu’s case can serve as a good guide for Capital One to develop a successful heuristic communication support system which will ensure its future growth strategy. The following items are implications for Capital One which intends to evolve into a knowledge-based enterprise.

• Develop corporate norm as an IT-oriented company

  * Obviously, financial service itself is no more the first priority for Capital One. I believe that this vision will bring significant advantage to Capital One, compared to
that of other financial firms which are clinging to "traditional wisdom" of bankers. If Capital One unhesitatingly develops its mission, culture, and people as those of an information technology-based company with an agile and creative "hacker" culture, it could find it easier to evolve into a knowledge-based service company. I understand that its recruitment policy, which focuses on IT people and excellent team workers, is in accordance with this view.

- Develop an organizational common intelligence stock
  * Capital One needs to develop a liaison between its customer information database and human ideas—a well-organized communication support system. "Eureka!"-type findings through data-mining by every knowledge worker should be catalogued in a common intelligence stock, so that they can be shared among employees and to stimulate them to generate further "Eureka!"-type findings.

- Develop an implementation framework
  * As we saw so far, a heuristic communication support system will never succeed if there is no effective implementation, particularly because of out-dated mental models and resistance to change. Because Capital One, armed with smart people, has sufficient potential to establish autonomy without invisible control, it needs to develop a relevant framework similar to the Information Producer and Information Charging System at Fujitsu to encourage computer-supported collaborative work.

**Implications for Financial Firms**

In most cases, information system departments in financial firms have been regarded as peripheral cost-centers, rather than profit-centers or strategic central. However, many analysts and consultants currently insist that the balancing of business strategy and IT strategy is a critical success factor for a winning organization in the 21st century. Some larger financial firms are aware of this, and are trying to foster their IT people and establish a robust IT strategy. However, as far as my observations are concerned, among the traditional money center banks, there are still few which have succeeded in elevating the status of IT strategy to a "core" strategy-level.

It is interesting to note that while traditional money center banks have been struggling with their internal resistance to change, new entrants, like Capital One, coming from totally different places, have successfully developed their position in the retail financial service market.
in totally new ways. It is obvious that these nimble new entrants have the advantage of establishing IT strategy as their core strategy more quickly than those which are defending their past heritage.

Fairbank says that one of the critical implications for a successful strategy is a "strategic beacon"—making the importance and correctness of the strategy clearer. In my understanding, Capital One has sufficient strategic intent to be a knowledge-based enterprise. In this sense, Capital One serves as a good example of an agile organization for senior executives from traditional financial firms who are considering how their organizations should look in the coming knowledge-based economy.

To maintain its successful performance in the future under the challenging market conditions, Capital One must develop systematic communication support frameworks supported by practical implementation, so that it can truly activate its core competencies—database and knowledge.

8-6. Chapter Summary

Capital One has enjoyed outstandingly successful growth in the credit card business; starting from $200 million assets, it has grown to a $2.4 billion company in eight years. Capital One’s critical success factors can be summarized as follows:

- Understanding of "industry structure" to secure new business opportunities
- Innovative approach based on intensive information-based marketing
- Targeted mass customization sustained by thousands of tests and simulations
- Flexible in-house data-mining which will be heuristics
- High commitment in recruitment to hiring "smart people"
- "Strategic beacon" by the top management

Despite this success, the recent rise in delinquency rate clearly points out that Capital One should worry about the risk of "regression to mean"—losing its extraordinarily successful growth power. There are many imitators entering the credit card market, and traditional larger players, such as Citibank, are still formidable. In order to maintain Capital One’s high growth rate, Fairbank is continuously finding new windows of opportunity for the company, including non-financial business. It is evident that Fairbank considers the core competencies of Capital
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One not to be know-how of the credit card business or financial services, but rather customer information and knowledge workers which together continuously and flexibly generate innovative ideas.

Although the information system in Capital One has focused mainly on efficiency improvement and external coordination with customers, now it is time that Capital One focus on internal coordination and innovation so that it can evolve into a knowledge-based service enterprise. I believe that Capital One has the potential for this evolution, if it develops a successful heuristic communication support system, as well as an effective implementation framework to encourage its “smart people.” In addition, Capital One’s agile approach provides a good guide to senior executives in traditional financial firms who are struggling to find out how their organizations transform in the coming knowledge-based economy.
Chapter 9

Conclusion—Knowledge and IT

To conclude my discussion, I first summarize what “heuristic communication support systems” are, as well as what the implications of these systems are for financial firms. In addition, I discuss the “spiral model,” in which I describe the interrelations among (1) external transformation, (2) the development of information technology, and (3) organizational/strategic focus. Finally, I present what is happening outside of an organization and how the future will look in the upcoming knowledge-based economy.

9-1. Knowledge-Processing and Information Technology

What are Heuristic Communication Support Systems?

The remarkable development of information technologies to date has led to great improvement in speed, volume, and precision in data-processing and information-processing. In my view, in the upcoming paradigm of a knowledge-based economy, we need to expect yet a further step—coordination of the more unstructured and human-based items: knowledge and intelligence. I call this “knowledge-processing.”

Although recently emerging information technologies, such as Internet technology and hypermedia, have helped us codify knowledge in more systematized and visual ways as the first generation of communication support systems, I believe that we need to expect further critical impact of intelligence technology as the second generation emerges in the form of heuristic communication support systems. Managers in the new context will be required to coordinate increasingly unstructured, tacit, and intellectual problems in more systematized ways, and managing creative interpersonal interactions will be a critical success factor for future organizations.
If these changes do not take place, as Khoshafian and Buckiewicz state below, organizations will suffer from unpredictable setbacks.

There are pitfalls. The temptation to invent the future in terms of the past is immense. We tend to define the tomorrow within the limitation of yesterday. Society has inertia. Decision makers who "earned their spurs" on the basis of obsolete ideas and fading paradigms resist change...

The idea of connection applies not only to the interrelation of pieces of information, but also to the interactions between people. New technologies will change our sense of identity and behavior as well as our sense of shared space and how we work together within that space.¹

In such an enormously uncertain environment, we should no longer expect that a single competent manager can invent the future based on his/her individual expertise; rather, a highly decentralized “adhocracy” will have better chances of creating an innovative vision so that an organization can adapt to the continuously transforming paradigm. The Intranet at Fujitsu is an example of an organization which is, technologically speaking, in the middle of evolving first generation to second generation communication support systems, and successfully managing its corporate culture to activate creative interpersonal interactions.

*How Should Financial Firms Alter Themselves?*

In contrast, in the financial field, we currently find few relevant examples of firms pursuing this evolving path as their critical priority. However, under the new paradigm in which economy of scale is no more guaranteed, financial firms must learn how to develop successful frameworks for corporate-based knowledge management, so that they can assure their value-added services to customers.

*The Economist* magazine describes a typical flaw in the traditional information system strategies of large financial firms.

The first mistake that everybody made was to suppose that their existing model was the right one and that computers could be used in some way to make it more efficient... Yet they built huge, expensive systems that simply dealt with processes and transactions, with no effect on how their firms captured and

¹ Khoshafian & Buckiewicz, 1995 (1)
monitored information. Although this meant greater speed and fewer errors, it profoundly limited the impact of technology on managers' business.²

Capital One is a nimble new entrant in the financial service industry, espousing a very different view from that of the larger established financial firms. Although the remarkable success of Capital One so far still depends upon the traditional data-mining approach, the company also recognizes that managing its knowledge assets with information technology will be the critical factor in ensuring its continuing success. In my opinion, the success of this smaller agile player must be a good admonition for the dinosaur-like financial firms currently struggling to coordinate their internal intelligence.

9-2. External Pressures, IT, and Organizational Focus

External Turbulence

To understand why knowledge and information technology are so critical for organizations in the future, we need to understand the interrelations among (1) external transformation, (2) the development of information technology, and (3) organizational/strategic focus. According to Michael S. Scott Morton, we are now undergoing an increased rate of change in the level of turbulence across virtually the entire gamut of the external environmental factors: economic, social, political, and technical.³ To illustrate, the following new trends can be observed in each dimension:⁴

- Economic Transformation
  
  * External pressures such as globalization, rising customer expectations, and increased pressure from shareholders have reinforced competition on a global scale, as well as expanding global economic interdependence. Time to market, mass customization, and value-added services have become more critical in organizations.

  * Economy has shifted from manufacturing to services—in the US over 75% of all employees work for service industries, about 75% of the GDP is generated from service activities.

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² The Economist, Oct. 26, 1996 (2)
³ Scott Morton, 1995 (3)
⁴ Lecture by Scott Morton & Valor, 1997 (4)
• Social Transformation
  • The trends of aging societies in industrialized countries, changing and diversifying of values in society and among individuals (e.g. changes in life style, family life, and work environment), as well as environmental pressures have increased.
  • Wealth gap, as well as knowledge gap, between the haves and have nots, particularly in the area of societal infrastructure has been widening.

• Political Transformation
  • Deregulation/re-regulation, the changing role of government, redefinition of military roles, increasing social deficit, and the evolution of Asian countries has yielded new paradigm.

• Technical Transformation
  • Information technology has significantly improved and become less expensive.
    Based on the taxonomy by Scott Morton, the dimensions of key information technologies are:5
      ♦ Hardware: continuing reduction in cost/size, increases in speed
      ♦ Software: open systems, de facto standard, and heuristics
      ♦ Communications: telecommunication, wide bandwith, video communication, groupware, Internet/Intranet, etc.
      ♦ Workstations: three dimensional graphics, touch sensitive screens, modeling language, etc.
      ♦ Robotics: continuing reduction in size, increases in memory and computation
      ♦ Smart Products: products with built in “intelligence”
        e.g. emission control, bar-codes, and smart cards

New Ways of Working and Organizing

These external transformations have had enough impact to alter our working styles, as well as the organizational forms. Scott Morton asserts:

The external business environment has become more turbulent over the last several years, and this is likely to continue. At the same time, the functionality and cost of information technology has been

5 Scott Morton, 1995 (5)
improving steadily. The combination of these two forces can give rise to a quite different new organization—the flexible organization.

It can be seen that IT will not impact a firm's strategy and performance unless there is a corresponding investment in:

(1) People with their skills, attitudes, and level of commitment
(2) Management systems: compatible incentive, reward structures, human resource policies.
(3) Organizational structure: a reconfigured structure to reflect external demands for shortened time, quality and cost.

When these significant investments are made, then it becomes possible to get the systemic, broad, impacts that come from an IT-enabled new form of organization, one that we have called the "flexible organization."

It is not an organization caused by IT. Rather, it is an organization responsive to the new demands from the business environment and alert to the opportunities of new ways of working and organizing that are enabled by IT.6

Scott Morton illustrates his perspective as shown in [Exhibit 9-1].

Source: Scott Morton, 1995

*Exhibit 9-1: Dynamic Tension Between External Forces and Internal Dimensions of the Organization*

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6 Scott Morton, 1994 (6)
9.3. Spiral Model

Description of the Spiral Model

Based on the Scott Morton's model, as well as my discussion in this thesis, I describe the "spiral model" as shown in [Exhibit 9-2], using my perspective on how (1) external pressures, (2) the development of information technology, and (3) organizational focus have been interrelated.

Exhibit 9-2: Spiral Model—Internal and External Coordination

It is obvious that the central engines which have driven organizations to change are external pressures in the economic, social, political, and technical areas. These pressures have threatened organizations with loss of their established benefits, while at the same time offering them new windows of opportunity. These pressures also have changed the expectations of customers, as well as competitors. Hence, these changes require organizations to continuously shift their strategic focus. Interestingly, information technology has played a critical role in
organizations, not only as a driving force for change, but also as a solution provider to cope with the external transformation.

In my perspective, in accordance with the improvement in information technology, the strategic focus of organizations has been fluctuating between internal and external coordination, and external pressures are key driving forces which have continuously enhanced the significance of information technology within organizations. I describe this process as shown in [Exhibit 9-2], and call it a “spiral model” between internal and external coordination.

To be more specific, the traditional styles of mainframe-based Management Decision Systems, as discussed by Scott Morton in the 1970s, chiefly focused first on internal coordination, so that managers could find and solve problems efficiently.

Second, the information technology which enabled organizations to do better internally was applied to external coordination with customers, as the Whitehead model discussed in Chapter 5 demonstrates. In the early 1980s, this external coordination system was called “Strategic Information Systems (SIS).” An illustrative example of Strategic Information Systems was SABRE, an airline ticket reservation system of American Airlines. Through SABRE, American Airlines established an exclusive network with travel agents, and encouraged these agents to place priority on American Airlines’ tickets in their sales processes to end-users.

Third, the information technology of the client/server generation enabled organizations to develop an intensive end-user computing environment. As a means of internal coordination, organizations introduced the first generation of groupware and e-mailing systems so that they could improve efficiency in workflow and communication. The main objective in this phase was structured coordination. Electronic forums, electronic bulletin boards, and administrative workflow controls, such as expense approvals and travel requests, are examples of this phase.

Fourth, as a means of external coordination, by using client/server platforms, organizations could devote themselves to intensive data-mining processes to analyze customer information; of course, Capital One is a representative example. “Data-Warehouse,” “Relational Database,” or “Marketing Information Systems” were key words in this phase. This step can be said to have evolved from the SABRE generation because information technology enabled organizations to realize a more flexible and enumerative mass customization approach.

Finally, technologies of the Internet generation—the most significant impact among the IT revolution currently underway—have enabled organizations to be more flexible and agile, and
to coordinate information both internally and externally with reduced cost. For internal coordination, the client/server-based groupware has evolved into a more flexible Intranet-based product, like Lotus Notes Domino and Fujitsu TeamWARE. For external coordination, we can observe numerous emerging examples in Internet advertising, Internet marketing, and Extranet. To illustrate, Nissan has started user-interactive car design processes on the Internet, by which Nissan car designers exchange ideas with users through the Internet, and decide the design modules based on users' suggestions.  

Moreover, I expect that intelligence technology embedded into the Internet generation, probably the most phenomenal technology in the coming new age, will enable organizations to manage even unstructured and highly human-based problems. Internally, we can observe this as heuristic computer-supported knowledge management, as I have discussed in this thesis, and externally, as Internet-based virtual organizations and electronic commerce sustained by an Intelligent Agent. To illustrate, "Firefly" and "Bargain Finder" are good examples of Intelligent Agent-based Internet shopping support services.

**What Does a Spiral Model Imply?**

Fujitsu is climbing up this spiral path from the first generation to the second generation of communication support systems. Its key vision is that experience in internal coordination as a network user will give the corporation sufficient insight in external coordination needed for the company to be a competitive network products provider. At the same time, Capital One is now located in the intensive information-based external coordination phase, and has just recognized that there is a direction ahead to be a knowledge-based service enterprise armed with the computer-supported knowledge management.

In my view, this evolving path draws a spiral form because organizations which have achieved better internal coordination wish to apply it externally in their relations with customers, and again, because severe external competition and rising customer expectations continuously require further improvement in internal coordination in order to be more innovative.

Of course, I do not say that this spiral is a single path for any kind of organization, and that virtual organizations and electronic commerce are the ultimate goals of organizations. However, I believe that in order to invent the future, this simple illustration helps an organization

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7 Nikkei Multimedia, 1997 (7)
to understand where its current position is, what is happening outside in the IT revolution, and what its relevant vector is in the future. Although I do not believe that all companies will change into virtual organizations, nor that all products/services will be absorbed into electronic commerce, these phenomena described well illustrate the characteristics of the softer knowledge-based economy. Perhaps, the most important, but difficult, implications for dinosaur-like financial firms are the need, first, to understand the overall view of the spiral model itself, and second, to climb up the path as quickly as their nimble newly-emerging rivals are.

9-4. Wrap up

Tom Peters describes the on-going transformation as follows:

In sum, the definition of every product and service is changing. Going soft, softer, softest... "Soft" is the emphasis on industrial design and user-friendliness, and... it is the "entertaining" of everything.8

In the coming knowledge-based economy, we need to recognize that "knowledge" in the context of traditional wisdom may not necessarily work. As Kenichi Ohmae asserts, the “Super Mario” generation may play a major role in the new “entertaining” society, as the young system engineer played a core role in developing the Intranet at Fujitsu.

We should be aware that really innovative ideas may come not from highly educated knowledge workers who are supposed to be the “elite” in the traditional context, but from the “hacker” culture’s new type of knowledge workers who have been considered hard to manage in the traditional hierarchical organization. Truly successful heuristic communication support systems will allow any kind of worker on the inside, as well as working partners, including the creative “hacker” generation, to randomly exchange their knowledge, and to support organizations in the quest for continuous innovation in a turbulent and constantly transforming external environment.

Tom Peters also says:

Company chiefs become "managers of intellectual systems," moving away from "functional" management and toward "coordination and conceptual" management.9

8 Peters, 1992 (8)
9 Peters, 1992 (9)
As organizations move up to the spiral path, roles of both organization and managers have to change. Under conditions where no one can predict what will be correct in the future, active interactions of knowledge which are random but still coordinated so that they are unanimous with organizational goals must be powerful resources for organizations in the 21st century. In conclusion, heuristic communication support systems are, I believe, the most promising tools to augment these creative processes.
Appendix:

The Other Intranet at Fujitsu

1. SARFIN

SARFIN is an information support Intranet for the sales forces, which was launched in 1995 based on the architecture of FIND2.

Previously, as many as 750,000 pages of paper notifications were sent to 6,000 sales people per month. The primary motivation to develop SARFIN was problems caused by this information flood.

SARFIN currently includes the following contents, which are similar to those of FIND2, but are more structured.

- Basic Information
  - Notification & Report:
    - Announcements about regulation and company policy, and urgent information.
  - Product Information:
    - Supports for searching from 15,000 software products, and catalogue information.
  - Price Information:
    - Support for checking the most current prices of products.
  - Competitors Information:
    - News released by competitors, such as new products, new technology, and price changes.
  - Customer Information:
    - Generic customer profile, trade history, and market share information.
• Know-How Support Information
  * "Case Bank":
    Cases of negotiation, promotion, and failure in past sales activities. Currently, 5,500 cases are registered.
  * IKB (Integration Knowledge Base):
    Know-how database for the system engineers.
  * Promotion Tool:
    Visual presentation tools made by PowerPoint.
  * FIND2:
    Overall technical information support for the system engineers.

In the September 1996 survey, the total number of times access SARFIN has been to date is more than 160,000. The Case Bank is accessed 2,000-3,000 times per month; and 97% of sales people respond they have used SARFIN at least one time, while 50% of them say that they use it every day. As the direct/indirect effects by SARFIN, Fujitsu officially reports the following:
  * Shorter Delay in Information Flow:
    2 weeks => daily
  * Reduction in Cost Due to Paperless Communication (reduction in printing and distribution costs):
    150 million yen/year
  * Reduction in Failing Space Costs:
    Four Rockers x 100 service centers
  * Sales Power Up:
    About 220 people/year by eliminating redundant working hours
2. JKI

JKI (JoHo (= Information) Knowledge Infrastructure) project started in 1994 for the R&D and product development divisions, in a different stream from those of FIND2 and SARFIN.

Compared with the motivation of FIND2 and SARFIN which aimed at improving knowledge management of either the system engineers or the sales forces, the primary motivation of JKI was the need for business process reengineering and global coordination in product development, both was driven by severe price competition in the PC market.

As mentioned in Chapter 7, Fujitsu aggressively expanded its PC business by outsourcing almost all parts from Southeast Asia. Hence, most key centers of supply control and manufacturing moved to overseas. At the same time, in order to reduce the manufacturing costs to as little as possible, Fujitsu aimed to shorten its manufacturing cycle time. To meet with this demanding plan, Fujitsu developed a global coordination network, based on the Internet.

Fujitsu regarded the peripheral tasks of R&D people, such as meetings, information search and filing, and response to inquiry from sales people, as a primary target of its business process reengineering. Previously, 30% of the R&D staffs’ works was occupied with these peripheral tasks; thus, the target was set to reduce it to 5%.

Currently, the contents of JKI include technical information, vendor information, product quality information, product costs information, CAD (Computer Aided Design) support information, and Q&A. Although JKI is now used mainly for information sharing among R&D people, Fujitsu is considering evolving it into CALS (Computer-aided Acquisition and Logistics Support), which will manage the overseas supply chain control.¹

¹ Yoshimura, 1996 (1)
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Chapter 1. Introduction

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**Chapter 7. Case Study: Fujitsu Limited**


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Chapter 8. Case Study: Capital One Financial Corporation


Chapter 9. Conclusion—Knowledge and IT


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Appendix: The Other Intranet at Fujitsu

THESIS PROCESSING SLIP

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