Knowledge Management

Systems and Processes

Second Edition

Irma Becerra-Fernandez and Rajiv Sabherwal

Knowledge Management

This page intentionally left blank

Knowledge Management

Systems and Processes

Second Edition

Irma Becerra-Fernandez and Rajiv Sabherwal

Routledge
Taylor & Francis Group
NEW YORK AND LONDON

First published 2015
by Routledge
711 Third Avenue, New York, NY 10017

and by Routledge
2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

Routledge is an imprint of the Taylor & Francis Group, an informa business

Library of Congress Cataloging in Publication Data
Becerra-Fernandez, Irma, 1960–
Knowledge management : systems and processes / by Irma Becerra-Fernandez and Rajiv Sabherwal. —
Second edition.
pages cm
Includes bibliographical references and index.
1. Knowledge management. 2. Information technology. I. Sabherwal, Rajiv. II. Title.
HD30.2.B438 2015
658.4’038—dc23

ISBN: 978-0-7656-3915-8 (hbk)
ISBN: 978-1-315-71511-7 (ebk)

Contents

This page intentionally left blank

Preface

Knowledge Management: Systems and Processes is for students and managers who seek detailed insights into contemporary knowledge management (KM). It explains the concepts, theories, and technologies that provide the foundation for KM; the systems and structures that constitute KM solutions; and the processes for developing, deploying, and evaluating these KM solutions. We hope this book will help readers acquire the relevant suite of managerial, technical, and theoretical skills for managing knowledge in the modern business environment.

The purpose of this book is to provide a thorough and informative perspective on the emergent practices in knowledge management. Information technology has been, and will continue to be, an important catalyst of this innovative field. Web-based technologies including Web 2.0 and Web 3.0, artificial intelligence, expert systems, analytics, and collaborative technologies continue to support and transform the field of KM. However, these technologies would not be effective without the day-to-day social aspects of organizations such as "water-cooler conversations," brainstorming retreats, and communities of practice. To further complicate matters, the current business environment renders new skills obsolete in years or even months.

Knowledge management is defined in this book as *doing what is needed to get the most out of knowledge resources.* KM is an increasingly important discipline that promotes the discovery, capture, sharing, and application of the firm's knowledge. Indeed, we are witnessing a new era with advanced industrial economies being revolutionized with the advent of the knowledge age and highly skilled knowledge-based workers replacing industrial workers as the dominant labor group. Although the benefits of KM may be obvious, it may not necessarily be so obvious to know how to effectively manage this valuable resource. In this book, the discussion of KM reflects the intimacy the authors have with this topic from a theoretical as well as a practical standpoint and through their substantial and diverse experiences.

The book is divided into three parts:

Part I, Principles of Knowledge Management—This part provides a more detailed discussion of the concepts of knowledge and knowledge management and describes the key constituents of KM solutions including infrastructure, processes, systems, tools, and technologies. The four types of KM processes are described and illustrated: knowledge application, knowledge capture, knowledge sharing, and knowledge discovery systems. The section also examines and provides examples of the ways in which KM impacts contemporary organizations.

Part II, Knowledge Management Technologies and Systems—This section is devoted to a discussion of the underlying technologies that enable KM systems associated with the four types of KM processes. The four different types of KM systems are described: knowledge discovery systems, knowledge capture systems, knowledge sharing systems, and knowledge application systems. The mechanisms and technologies to support these KM systems are discussed, and case studies related to their implementation are presented.

Part III, Management and the Future of Knowledge Management—Some of the issues related to management practices and the future of knowledge management are presented here. The section describes how KM can benefit from emergent practices and technologies, including social networks, communities of practice, wikis, and blogs. It also examines the factors that affect KM and identifies the specific effects of these factors. Moreover, the overall leadership and evaluation of KM are described here. This section and the book conclude by examining aspects that are likely to be important in the future of KM, including crowd sourcing or collective intelligence and concerns related to privacy and confidentiality.

This book may be adapted in several different ways, depending on the course and the students. It can be used as a one-semester course on KM for graduate MIS students by covering selected topics from Parts I, II, and III. An instructor teaching a course for engineering or computer science students may opt to concentrate on KM technologies and systems by covering Chapters 1, 6, 7, 8, 9, and 10. Alternatively, if the course is being taught to MBA students, a number of case studies could be assigned to complement the discussions presented in the book, and the discussion of Chapters 6, 7, 8, and 9 could be emphasized less.

To complement the text and enhance the learning and pedagogical experience, we provide the following support materials through the instructor's Web site:

1. Solutions to the end-of-chapter problems.
2. PowerPoint slides for each chapter that describe the key concepts explained in the text.
3. Sample syllabus and sample student projects.
4. List of relevant accompanying case studies.
5. References to KM software providers.

In addition, instructors adopting the book are encouraged to share with the authors any relevant material that could be included on the Web site to reinforce and enhance the students' experience.

ACKNOWLEDGMENTS

We have so many people to acknowledge! First, we want to recognize our families who were so supportive during the time we spent with our heads buried in our laptops.

We further thank those organizations that provided us with the fertile ground to develop many of our ideas about KM: NASA-Kennedy Space Center, Goddard Space Flight Center, Ames Research Center, Navy Center for Advanced Research in

Artificial Intelligence, and the Institute for Human and Machine Cognition, among others. We especially thank the individuals at these organizations who made it possible for us to formalize some of the concepts and techniques presented in this book. We also thank all the authors that individually contributed to the many vignettes and case studies presented throughout.

We also thank our administrators, who supported this effort, including President Mark Rosenberg and Provost Doug Wartzok at Florida International University and Dean Eli Jones at the University of Arkansas. Our sincere thanks are also directed to Avelino Gonzalez of the University of Central Florida, who coauthored an earlier edition of this book and selflessly contributed to some of the material contained in this book.

We gratefully acknowledge the contributions of the students who collaborated in the development of some of the KM systems and the material described here. We are also grateful to Sayed A. Maleknia from University of Arkansas and John Glynn, Soundarya Soundararajan, and Mouna Yerra from Florida International University for their editorial assistance with the book.

Finally, we are deeply indebted to many individuals at M.E. Sharpe, Inc., who enabled us to publish this book, especially the two individuals with whom we have directly worked: our editor, Harry Briggs, and associate editor, Elizabeth Parker.

This page intentionally left blank

Knowledge Management

This page intentionally left blank

1 Introducing Knowledge Management

The scientific endeavor that culminated on July 20, 1969, with the first American walking on the moon is considered one of the most significant accomplishments in the history of humankind. What is especially noteworthy about this undertaking is that when President John F. Kennedy issued the promise in 1961 that the United States would land a man on the Moon and return him safely to Earth before the end of that decade, most of the scientific and technological knowledge required to take this "one small step for man, one giant leap for mankind" did not exist. The necessary science and technology knowledge had to be discovered and developed in order to accomplish this extraordinary task. However, many of those technological advances now have permanent presence in the landscape of our lives, from cordless tools to cellular phones. These first missions to space carried less computer power on board than what some of us typically lug around airports on our portable computers. The computers on board Apollo 11, considered "state-of-the-art" in the 1960s, had 4 KB of RAM, no disk drive, and a total of 74 KB of auxiliary memory! From the knowledge management (KM) perspective, how did they manage the extraordinary quantities of knowledge that had to be developed in order to accomplish the task? The required knowledge about space travel, rocketry, aerodynamics, systems, communications, biology, and many other disciplines had to be developed and validated prior to being used in the space mission. From the knowledge creation perspective, this was an extraordinarily successful endeavor. On the other hand, a closer look reveals that attempts to elicit and capture the knowledge resulting from these efforts may have been largely unsuccessful, and some studies even suggest that NASA may have actually lost that knowledge. In fact, in the words of Sylvia Fries, who was NASA's chief historian between 1983 and 1990 and who interviewed 51 NASA engineers who had worked on the Apollo program:

> The 20th anniversary of the landing of an American on the surface of the Moon occasioned many bittersweet reflections. Sweet was the celebration of the historic event itself. . . . Bitter, for those same enthusiasts, was the knowledge that during the twenty intervening years much of the national consensus that launched this country on its first lunar adventure had evaporated . . . a generation of men and women who had defined their lives to a large extent in terms of this nation's epochal departure from Earth's surface was taking its leave of the program they had built. (Fries 1992)

In this book, we hope to impart what we know about the important field of knowledge management—what it is and how to implement it successfully with the tools provided by the technological advances of our times. The book presents a balanced discussion between theory and application of knowledge management to organizations. The reader will find an overview of knowledge management theory and implementation, with a special emphasis on the technologies that underpin knowledge management and how to successfully integrate those technologies. The book includes implementation details about both knowledge management mechanisms and technologies.

In this chapter, we first discuss what knowledge management is and what the forces are that drive it. We also discuss organizational issues related to knowledge management. Specifically, we introduce knowledge management systems and their roles in the organization. Finally, we discuss how the rest of the book is organized.

WHAT IS KNOWLEDGE MANAGEMENT?

Knowledge management (KM) may simply be defined as *doing what is needed to get the most out of knowledge resources.* Although KM can be applied to individuals, it has recently attracted the attention of organizations. KM is viewed as an increasingly important discipline that promotes the creation, sharing, and leveraging of the corporation's knowledge. Peter Drucker (1994), whom many consider the father of KM, best defines the need for it:

> Knowledge has become the key resource, for a nation's military strength as well as for its economic strength . . . is fundamentally different from the traditional key resources of the economist—land, labor, and even capital . . . we need systematic work on the quality of knowledge and the productivity of knowledge . . . the performance capacity, if not the survival, of any organization in the knowledge society will come increasingly to depend on those two factors. (pp. 66–69)

Thus, it can be argued that the most vital resource of today's enterprise is the collective knowledge residing in the minds of an organization's employees, customers, and vendors. Learning how to manage organizational knowledge has many benefits, some of which are readily apparent, others not. These benefits may include leveraging core business competencies, accelerating innovation and time-to-market, empowering employees, innovating and delivering high-quality products, improving cycle times and decision-making, strengthening organizational commitment, and building sustainable competitive advantage (Davenport and Prusak 1998). In short, they make the organization better suited to compete successfully in a much more demanding environment. Organizations are increasingly valued for their intellectual capital. An example of this fact is the widening gap between corporate balance sheets and investors' estimation of corporate worth. It is said that knowledge-intensive companies around the world are valued at three to eight times their financial capital. Consider for example Microsoft Corporation, the highest-valued company in the world, with a market capitalization that was estimated at around $302 billion as of January 2014. Clearly, this figure represents more than Microsoft's net worth in buildings, computers,

and other physical assets. Microsoft's valuation also represents an estimation of its intellectual assets. This includes structural capital in the form of copyrights, customer databases, and business-process software. Added to that is human capital in the form of the knowledge that resides in the minds of all of Microsoft's software developers, researchers, academic collaborators, and business managers.

In general, KM focuses on organizing and making available important knowledge, wherever and whenever it is needed. The traditional emphasis in KM has been on knowledge that is recognized and already articulated in some form. This includes knowledge about processes, procedures, intellectual property, documented best practices, forecasts, lessons learned, and solutions to recurring problems. Increasingly, KM has also focused on managing important knowledge that may reside solely in the minds of organizations' experts.

Consider, for example, the knowledge of commercial pilots. Not only they are expected to ensure the safety of passengers, but also keep their flights on time under various weather conditions. They need to discover and establish the relevance of all available information related to problems of flight, diagnose problems, identify alternative action, and obtain the risk associated with each alternative within the available time. The number of flight hours and years of flying experience have been considered as indicators of a pilot's level of expertise. This level of knowledge has been obtained through many years of experience and successful decisions. With retirement looming, how can an airline organization elicit and catalog this knowledge so that new generations may benefit?

KM is also related to the concept of **intellectual capital**, which is considered by many as the most valuable enterprise resource. An organization's intellectual capital refers to the sum of all its knowledge resources, which exist in aspects within or outside the organization (Nahapiet and Ghoshal 1998). There are three types of intellectual capital: human capital, or the knowledge, skills, and capabilities possessed by individual employees; organizational capital, or the institutionalized knowledge and codified experience residing in databases, manuals, culture, systems, structures, and processes; and social capital, or the knowledge embedded in relationships and interactions among individuals (Subramaniam and Youndt 2005). Recent study shows that utilizing intellectual capital and knowledge management capabilities would lead to innovation and firms' performance improvement (Hsu and Sabherwal 2011).

Forces Driving Knowledge Management

Today, organizations rely on their decision makers to make "mission critical" decisions based on inputs from multiple domains. The ideal decisionmaker possesses a profound understanding of specific domains that influence the decision-making process, coupled with the experience that allows her to act quickly and decisively on the information. This profile of the ideal decisionmaker usually corresponds to someone who has lengthy experience and insights gained from years of observation. Although this profile does not mark a significant departure from the past, the following four underlying trends are increasing the stakes in the decision-making scenario:

1. Increasing Domain Complexity

The complexity of the underlying knowledge domains is increasing. As a direct consequence, the complexity of the knowledge required to complete a specific business process task has increased as well. Intricacy of internal and external processes, increased competition, and the rapid advancement of technology all contribute to increasing domain complexity. For example, new product development no longer requires only brainstorming sessions by the freethinking product designers of the organization, but instead it requires the partnership of interorganizational teams representing various functional subunits—from finance to marketing to engineering. Thus, we see an increased emphasis from professional recruiters around the world seeking new job applicants who not only possess excellent educational and professional qualifications, but who also have outstanding communication and team-collaboration skills. These skills will enable them to share their knowledge for the benefit of the organization.

2. Accelerating Market Volatility

The pace of change, or volatility, within each market domain has increased rapidly in the past decade. For example, market and environmental influences can result in overnight changes in an organization. Corporate announcements of a missed financial quarterly target could send a company's capitalization, and perhaps that of a whole industry, in a downward spiral. Stock prices on Wall Street have become increasingly volatile in the past few years resulting in the phenomenon of day trading, where many nonfinancial professionals make a living from taking advantage of the steep market fluctuations.

3. Intensified Speed of Responsiveness

The time required to take action based upon subtle changes within and across domains is decreasing. The rapid advance in technology continually changes the decision-making landscape, making it imperative that decisions be made and implemented quickly, lest the window of opportunity closes. For example, in the past, the sales process incorporated ample processing time, thus allowing the stakeholders a "comfort zone" in the decision-making process. Typically in response to a customer request, the sales representative would return to the office, discuss the opportunity with his manager, draft a proposal, and mail the proposal to the client, who would then accept or reject the offer. The time required by the process would essentially provide the stakeholders sufficient time to ponder the most adequate solution at each of the decision points. Contrast yesterday's sale process with today's, like for example the process required by many online bidding marketplaces thriving on the Web. Consider the dilemma faced by a hotel manager that participates in an Internet auctioning market of hotel rooms: "Should I book a $200 room for the bid offer of $80 and fill the room or risk not accepting the bid hoping to get a walk-in customer that will pay the $200?" Confronted with a decision to fill a room at a lower rate than what the hotel typically advertises poses an important decision that the hotel manager must make within minutes of a bid offer.

4. EMPLOYEE TURNOVER

Organizations continue to face employee turnover due to voluntary (i.e., decided by the employee, for example, due to opportunities for career advancement) as well as involuntary (i.e., for reasons beyond the employee's control, such as health-related problems and termination of employment by the employer). Employee turnover is especially important in tough economic conditions such as those faced in the 2008 to 2009 period, when several large companies laid off large numbers of employees. Such employee turnover inevitably leads to the organization losing some of the knowledge possessed by the departing individuals. Moreover, in some cases these individuals might have knowledge that would be valuable to competitors. According to Kenny (2007), "As staff leave, retraining is necessary. This strains company resources and hinders growth. Replacing a full-time, private-sector worker costs, at a bare minimum, 25 percent of his or her total annual compensation, estimates the Employment Policy Foundation. Productivity nosedives, ultimately cutting into profitability." In case of turnover, new employees must be hired and trained. In addition to the cost of training, there is considerable time required for a new employee to be effectively productive.

So, what does this mean? Faced with increased complexity, market volatility, accelerated responsiveness, and employee turnover, today's manager feels less adequate to make the difficult decisions faced each day. In the decision-making scenario described above, it is evident that knowledge can greatly assist the decisionmaker. In the past, this knowledge resided mostly in the decisionmaker. The complications seen above indicate that in modern organizations, the knowledge necessary to make good decisions cannot possibly all reside with the decision maker, hence the need to provide her with the requisite knowledge for making correct, timely decisions.

Perhaps nothing has made more evident the need for KM than the corporate **downsizing** trend at public and private organizations that marked the re-engineering era of the 1990s, a well-known feature of the economic landscape of the late twentieth century. The dominant driver of downsizing in most organizations is well understood: Rapidly reduce costs in order to survive against competitors. Clearly, a negative side effect of downsizing is the dissipation of the knowledge resources, resulting in devitalized organizations. Some of the symptoms of such organizations are: decreased morale, reduced commitment, inferior quality, lack of teamwork, lower productivity, and loss of innovative ability (Eisenberg 1997). The fact is, many individuals who were laid off as a result of downsizing had performed significant tasks and had acquired considerable and valuable skills over the years. Many companies are typically not prepared for downsizing, and few take any steps to prevent the escape of knowledge that usually follows. To minimize the impact of downsizing, organizations should first identify what skills and information resources will be needed to meet **mission-critical objectives**. Therefore, effective **methodologies**, including tools and techniques to capture vital knowledge, are essential for an organization to maintain its competitive edge.

KM is important for organizations that continually face downsizing or a high turnover percentage due to the nature of the industry. It is also important for all

organizations since today's decisionmaker faces the pressure to make better and faster decisions in an environment characterized by a high domain complexity and market volatility, even though she may in fact lack the experience typically expected from a decisionmaker, and even though the outcome of those decisions could have a considerable impact on the organization. In short, KM is important for everybody. Box 1.1 illustrates this fact.

KNOWLEDGE MANAGEMENT SYSTEMS

Rapid changes in the field of KM have to a great extent resulted from the dramatic progress we have witnessed in the field of information technology (IT). Information technology facilitates sharing as well as accelerated growth of knowledge. IT allows the movement of information at increasing speeds and efficiencies. For example, computers capture data from measurements of natural phenomena, and then quickly manipulate the data to better understand the phenomena it represents. Increased computer power at lower prices enables the measurement of increasingly complex processes, which we possibly could only imagine before. According to Bradley (1997):

> Today, knowledge is accumulating at an ever-increasing rate. It is estimated that knowledge is currently doubling every 18 months and, of course, the pace is increasing. . . . Technology facilitates the speed at which knowledge and ideas proliferate. (p. 54)

Thus, IT has provided the major impetus for enabling the implementation of KM applications. Moreover, as learning has accrued over time in the area of social and structural mechanisms, such as mentoring and retreats that enable effective knowledge sharing, it has become possible to develop KM applications that best leverage these improved mechanisms by deploying sophisticated technologies.

In this book, we therefore place significant focus on the applications that result from the use of the latest technologies used to support KM mechanisms. Knowledge management mechanisms are organizational or structural means used to promote KM. The use of leading-edge information technologies (e.g., Web-based conferencing) to support KM mechanisms in ways not earlier possible (e.g., interactive conversations along with instantaneous exchange of voluminous documents among individuals located at remote locations) enables dramatic improvement in KM. We call the applications resulting from such synergy between the latest technologies and social/structural mechanisms **knowledge management systems**, as described in Chapters 6 through 9 of this book. Knowledge management systems utilize a variety of KM mechanisms and technologies to support the knowledge management processes. Based on observations on the KM systems implementations under way at many organizations, a framework emerges for classification of KM systems as:

1. Knowledge Application Systems (discussed in Chapter 6)
2. Knowledge Capture Systems (discussed in Chapter 7)
3. Knowledge Sharing Systems (discussed in Chapter 8)
4. Knowledge Discovery Systems (discussed in Chapter 9)

Box 1.1

Is Knowledge Management for Everybody?

John Smith owns an independent auto repair shop in Stillwater, Oklahoma, which he established in 1985. Prior to opening his own shop, he had been repairing foreign cars as a mechanic for the local Toyota dealership. In these days of increasing complexity in automobiles, he had to learn about such new technologies as fuel injection, computer-controlled ignition, and multivalve and turbocharged engines. This has not been easy, but he managed to do it, and at the same time created a successful business, one with an outstanding reputation. As his business grew, he had to hire mechanics to help him with the workload. At first, training them was easy since cars were simple. That has radically changed in the last ten years. He now finds himself spending more time training and correcting the work of his mechanics instead of working on cars himself, which is what he truly enjoys. To further complicate matters, his mechanics are so well-trained that the local Toyota dealership is hiring them away from him for significant salary increases. Being a small business he cannot afford to compete with them, so he finds himself doing more and more training and correcting all the time. The turnover has now begun to affect the quality of the work he turns over to his customers, increasing complaints and damaging his hard-earned reputation. Basically, he has a knowledge problem. He has the knowledge and needs to capture it in a way that it is easy to disseminate to his mechanics. He must find a way to manage this knowledge in order to survive. How successful he is will dictate his future survival in this business.

Artificial intelligence and machine-learning technologies play an important role in the processes of knowledge discovery, capture, sharing, and application, enabling the development of KM systems. We provide a short introduction to these technologies in each of these chapters. Because KM systems provide access to explicit company knowledge, it is easy to learn from previous experiences. **Experience management** is another recent term also related to knowledge management. Basically, experience develops over time to coalesce into more general experience, which then combines into general knowledge. Experiences captured over time can be managed by the use of technology. We will discuss how intelligent technologies are used to manage experiences as well as create new knowledge.

ISSUES IN KNOWLEDGE MANAGEMENT

In practice, given the uncertainty in today's business environments and the reality of continuing layoffs, what could make employees feel compelled to participate in knowledge management initiatives? Although many attempts have been made to launch KM initiatives, including the design and implementation of KM systems, not all KM implementations have been successful. In fact many KM systems implementations, for example of lessons learned systems (discussed in Chapter 8), have fallen short of their promise. Many KM systems implemented at organizations have failed to enable knowledge workers to share their knowledge for the benefit of the organization. The case in point is that effective KM is not about making a choice between "software vs. wetware, classroom vs. hands-on, formal vs, informal, technical vs. social" (Stewart 2002). Effective KM uses all the options available to motivated employees in order to put knowledge to work. Effective KM depends on recognizing that all of these options basically need each other.