筑波大学
知的コミュニティ基盤研究センター
Research Center for Knowledge Communities
University of Tsukuba

筑波大学知的コミュニティ基盤研究センターシンポジウム2006
ネットワーク時代の新しい情報学教育の潮流

Proceedings of 2006 Annual Symposium of RCKC

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New Directions for Information Science Education in the Networked Information Society

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March 9, 2006
Tsukuba, Ibaraki, Japan

筑波大学知的コミュニティ基盤研究センター
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序　言

ネットワーク時代の新しい情報学教育の潮流

ネットワーク時代における新しい情報学教育の潮流を探るため，海外の情報学，図書館情報学分野の大学院から教員を招き，それぞれの地域での情報学教育の動向に関する報告をお願いし，多様な視点からの意見交換と情報共有の場を作るために，国際シンポジウムを開催いたします.

このシンポジウムでは，アメリカの情報学分野の大学院による新しい連携組織である i-Conference Schools の主要なメンバー校であるピッツバーグ大学，ミシガン大学，カナダ・ブリティッシュコロンビア大学の情報学，図書館情報学分野の大学院のリーダーを招き，北米における状況の報告をお願いしております．また，台湾，韓国，シンガポール，タイ，オーストラリアからも図書館情報学関係の学部・大学院から教員を招き，この地域での状況の報告と意見交換のためのパネル討論などを計画しています．このように北米とアジア太平洋地域を結び，情報学教育分野の新しい潮流と将来に向けた方向について，参加者とともに意見交換と情報共有を進めたいと思います．なお，本シンポジウムは 2005 年度筑波大学国際連携プロジェクトの支援を受けて開催しています.

（知的コミュニティ基盤研究センター：センター長田畑孝一，教授杉本重雄）

筑波大学知的コミュニティ基盤研究センター シンポジウム 2006

～ ネットワーク時代の新しい情報学教育の潮流 ～

2006 年 3 月 9 日 10:00-17:30
筑波大学春日キャンパス情報メディアユニオン 2F ホール

プログラム

10:00 開会
午前の部：**北米における情報学教育** 講演 ・Ronald L. Larsen（ピッツバーグ大学情報学研究科, アメリカ） ・Gary M. Olson（ミシガン大学情報学研究科, アメリカ） ・Edie Rasmussen（ブリティッシュコロンビア大学, 図書館・アーカイブ・情報学研究科, カナダ）
12:00 昼休み
13:15 午後の部 1：**アジア太平洋地域および日本における情報学教育** パネル：**アジア太平洋地域における図書館情報学教育** パネリスト ・Hsueh-hua Chen（国立台湾大学図書資訊学系, 台湾） ・Sung-hyuk Kim（淑明女子大学文献情報学科, 韓国） ・Schubert Foo（ナンヤン工科大学コミュニケーション・情報学研究科, シンガポール） ・Graeme Johanson（モナシュ大学情報技術学部, オーストラリア） ・Kulthida Tuamsuk（コンケン大学, タイ） ・司会：杉本重雄（筑波大学図書館情報メディア研究科・知的コミュニティ基盤研究センター）
15:15 休憩
15:45 午後の部 2：**アジア太平洋地域および日本における情報学教育** パネル（つづき）：**アジア太平洋地域における図書館情報学教育** 講演 ・根本彰（東京大学教育学研究科）
17:00 Closing

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第１章　　シンポジウム講演資料

Symposium Proceedings

Foreword

New Directions for Information Science Education in the Networked Information Society

Our information environments have changed drastically during this decade since the explosion of the Web in mid-1990's. Library and information science schools have been affected by this drastic change and are seeking new directions for education for the future. The annual symposium of the Research Center for Knowledge Communities (RCKC), University of Tsukuba, focuses on the new directions of information science education at LIS schools in the North America and the Asia-Pacific Region.

The symposium has invited a number of distinguished speakers from library and information science schools in North America and Asia-Pacific countries. The speakers will bring up-to-date information about trends in education at the library and information science schools in their countries or regions.

This symposium is planned to provide a forum for participants from information science schools in different environments to bring their experiences and to share information and ideas about information science education for the networked information society of today and the future.

(Koichi Tabata, Director of RCKC and Prof. Shigeo Sugimoto)

Annual Symposium of the Research Center for Knowledge Communities

New Directions for Information Science Education in the Networked Information Society

March 9, 2006, University of Tsukuba, Japan
http://www.kc.tsukuba.ac.jp/symposium2006/

Program

10:00	Opening
	Morning Session : Information Science Education in North America Talks ・**Ronald L. Larsen** (School of Information Sciences, University of Pittsburgh, USA) ・**Gary M. Olson** (School of Information, University of Michigan, USA) ・**Edie Rasmussen** (School of Library, Archival and Information Studies, Univ. of British Columbia, Canada)
12:00	Lunch
13:15	**Afternoon Session 1 : Information Science Education in Asia-Pacific and Japan** Panel: Library and Information Science Education in Asia-Pacific Panelists ・**Hsueh-hua Chen** (Department of Library and Information Science, National Taiwan University, Taiwan) ・**Sung-hyuk Kim** (Department of Library and Information Science, Sookmyung Women's University, Korea) ・**Schubert Foo** (School of Communication and Information, Nanyang Technological University, Singapore) ・**Graeme Johanson** (Faculty of Information Technology, Monash University, Australia) ・**Kulthida Tuamsuk** (Khon Kaen University, Thailand) ・**Shigeo Sugimoto** (Graduate School of Library, Information and Media Studies, Univ. of Tsukuba, Japan), Moderator
15:15	Break
15:45	**Afternoon Session 2 : Information Science Education in Asia-Pacific and Japan** Panel: Library and Information Science Education in Asia-Pacific (continued) Talk ・**Akira Nemoto** (Graduate School of Education, University of Tokyo, Japan)
17:00	Closing

New Directions for Information Science Education in the Networked Information Society
Annual Symposium of the Research Center for Knowledge Communities
March 9, 2006, University of Tsukuba, Japan

Centripetal or Centrifugal Forces at Play?
– Emerging Directions in Information Research and Education –

Ronald L. Larsen
Dean and Professor
School of Information Sciences, University of Pittsburgh, USA

The rapid evolution and ubiquitous deployment of information technology telegraphs a future of new horizons in research leading to capabilities unimaginable today. It is my intention to share with you some directions this research may take, informed by the insights of participants in a workshop sponsored by the US National Science Foundation.

Beyond the research directions, though, I will also consider potential implications of that research. Tensions arise from evolving visions for information-intensive services, and we in higher education, industry and government need to consider adaptations that may be required to achieve the desired outcomes suggested by these visions.

As we explore visionary futures and possibilities, there are forces that emerge that introduce tension, sometimes seeming to pull us apart. But recognizing these forces and responding appropriately can transform them, or our perceptions of them, into forces that bring us together. An exploration of the nature of these forces may help us understand how to cope with them.

Research is rarely done for the pure purpose of knowledge discovery; it is driven by needs and priorities. These priorities have a number of dimensions to them. Many of us like to think of research as an intellectual process to advance knowledge and understanding, but that is not all it is. It frequently aspires also to advance societal and cultural prosperity, preserve lessons of the past, explore potential futures, and provide economic security. And it also seeks to ensure safety and national security, and understand the implications new research discoveries have on existing practices, processes, systems and infrastructure and their impact on society.

Underlying all of these objectives is information. We are rapidly becoming an information-intensive global society. While the discovery of knowledge and understanding is fundamental to advancing the frontiers of science and engineering, we also depend on industry to transform new knowledge into services, and government to set effective policy regarding economic and cultural prosperity. Technology directly impacts our safety and security. It enables us to detect threats and understand opportunities – it enables us to organize, extract and interpret the information that is vital to our survival.

Two years ago, Professor Howard Wactlar (Carnegie Mellon University) and I organized a workshop for the US National Science Foundation to explore future needs and to propose directions for research in digital libraries[1]. Digital libraries already provide a foundation for information and information services that is transforming research, scholarship, and education. The workshop was centered on a deceivingly simple model, but one that was entirely sufficient to understand current needs and to explore visionary futures. The model consists of three primary components: users, information, and interaction.

Users interact with information through repositories; repositories are carefully architected entities in which information is organized, stored, and indexed. Users interact with repositories in several ways. They interpret their information needs in terms relevant to the repository and its contents. They query the repository and retrieve relevant information, manipulate that information in order to extract results that are meaningful for them and abstract or aggregate the information into forms responsive to the initial need. They may return a value-added interpretation of the information to the repository.

[1] Larsen, R., and Wactlar, H., "Knowledge Lost in Information," Report of the NSF Workshop on Research Directions for Digital Libraries, June 15-17, 2003, Chatham, MA, NSF Award No. IIS-0331314, http://www.sis.pitt.edu/~dlwkshop/report.pdf

But this is too abstract a characterization of users' interactions with repositories. We need to penetrate these activities deeper in order to understand future needs, challenges, and opportunities. I suggest four fruitful directions that directly serve users:

- Management of individuals' personal libraries,
- Collaboration among information user communities,
- Semantic interpretation of user intentions, otherwise known as "Do What I Mean" (DWIM), and
- Cognitive completion through anticipation of needs based on user context (what's been seen; what's been done,) and correction of simple but non-trivial errors.

Regarding the information, itself, several basic functions will be considered:

- Capture of new information (from remote sensors, for example),
- Discovery of relevant information and information sources,
- Analysis of information,
- Transformational capabilities to make information more useful and more usable for people.

Capture involves the real time reception and ingest of potentially large volumes of data. *Discovery* addresses the ability to extract information automatically, or "read" the information in its emerging context. *Analysis* is the interpretation of new information in the context of prior information. *Transformation* applies to customization of distinct tasks for particular users, and, again, context is vital. One user may prefer to examine text to understand data. Another user may need to see it rendered pictorially, while a third may derive greater value from a spreadsheet, graphic, or chart. Imagine a system that could automatically ingest a vast body of raw material and not only organize, cluster, or rank order it, but also detect the biases that may be present, whether they derive from instrument calibration or the intellectual interpretation of a human. Imagine the ability to automatically detect what may have been the intention behind an author's particular writing. Imagine, further, the ability to identify that which is novel, unique, or simply different among subsets of information and, particularly, newly received information.

Question-answering systems have been the subject of research for at least 30 years, yet effective question answering remains a major challenge. Current question answering systems can handle factual information, but they have yet to deal effectively with more abstract, conceptual information. Within and beyond question answering, we need to understand how individuals use information in terms of patterns and levels of abstraction. And then we need to be able to manipulate those patterns and abstractions, always within the user's context.

One of the reasons Bangalore has become so important over the past decade derives directly from the unrelenting pace of technology that is resulting in "digital domination". Each of us now carries and depends routinely upon a multitude of devices that owe their existence to digital technology. Computers control our automobiles; we fly in fly-by-wire airplanes; and embedded computers even operate our refrigerators and toasters. Computing is now ubiquitous and sensory networks are widespread. Digital devices are literally distributed everywhere throughout our society. Despite our dependence on computing, we continue to complain about information overload. And this frustration is likely to continue because the pace of technology advancement will continue to exceed society's ability to absorb it. We cannot expect quick, simple answers to reduce this sensation of information overload.

While technology advances briskly, society evolves more slowly. We have yet to develop a threat-resistant information infrastructure despite a lengthy and increasing record of attacks on that very infrastructure. We feel threatened as individual humans by the ubiquitous surveillance systems designed to protect us. And we hear increasingly about new concerns such as "information pollution" that are poorly defined and even less well understood. There is an irony here. It appears that recurrent failures of technological quick-fix solutions to address technologically-induced problems fuel accelerated searches for such solutions.

Intellectual property is on the agenda for discussion at this conference. It will be interesting to see what progress is reported, as the participants in the NSF workshop expressed little encouragement in the vexing search for global solutions to the intellectual property issues with which we are wrestling today. The occurrence of this conference in Bangalore stands as evidence of the intense competition for global information products and services.

But let us get back to this vision of context-dependent services focused on humans. Consider a supporting framework based on three dimensions: information, technology, and society.

In higher education, we tend to isolate our disciplines along these axes. Issues of information technology are typically taken up under the auspices of computer science and engineering, electrical engineering, or telecommunications. Topics regarding the management, organization, utilization, and preservation of information are more likely to be addressed in library science. And when it comes to societal impact, the liberal arts, business, and law typically step forward. As long as the issues are separable, disciplinary isolation may be sufficient. But over the past couple of decades, we have seen greater independence among technology, information, and society that suggests a need for greater interdisciplinary research leading to new ways of thinking about these issues.

Interdisciplinary interaction is emerging to address these new challenges. Collaboration among scholars and practitioners in library science, computer science, and engineering has evolved the discipline of information science. Information science can be visualized as residing on the plane defined by the *information* and *technology* axes; it seeks effective, human-centric solutions for information-intensive domains. The three axes also define two other planes: namely those defined by the information and society axes and by the society and technology axes. These planes provide further opportunities for interdisciplinary collaboration addressing issues such as the management and accountability of public records, information ethics, and the role of technology in society.

But I suggest that new interdisciplinary research challenges reside beyond the planes defined by pairs of axes, in the space defined by all three. The systems of today are not only technologically complex, but are also information intensive and deeply embedded in our societies' infrastructures. They cannot be developed effectively in a mono-disciplinary vacuum. We need to understand how all of the pieces fit together and mutually interact, in order to design systems that are not only technological successful but are also appropriately sensitive to the societal constructs in which they operate.

Take information assurance, an area of increasing importance around the globe, as an example. Viewed as a technological problem, solutions such as cryptography, steganography, key management, and intrusion detection come to mind. Viewed as an information issue, other terms come to mind: identification, authentication, provenance, and access control, to name a few. Viewed from a societal perspective, yet another set of terms emerges: confidentiality, privacy, integrity, and authority. Can one effectively address information assurance without embracing all of these concerns in a total solution? I suggest that one cannot. But when one does, conflicts arise from norms held by constituents in differing disciplines.

Natural tensions arise in a number of areas. Consider *values*, for example, where to some, strength is derived from information access, while for others power is founded on information control. *Goals* are also subject to conflict. For some, safety and security accrue through limits to access and protective locks on content. (Consider, for example, the "need to know" criterion for access to classified information, or the current fascination with digital rights management.) On the other hand, justice and accountability are founded on principles of dialogue and debate, for which access to information is critical. *Models* provide another area of tension. Information access provides richly rewarded business opportunities, but public access to information is also a societal responsibility. Democracy, itself, is founded on principles of information access. Tension over models is further exacerbated by *economics*. Information is expensive to produce, but it is very inexpensive to replicate, deliver, and distribute. And finally, there are issues of *ethics*. What does it mean from an ethical standpoint to manage information in the world today? There are those, given the experiences of the recent past, who would argue that ethics is trumped by the realities of a brutal world. A compelling alternative view is that ethics is motivated by the realities of that same world.

The increasing need for interdisciplinary research and collaboration spanning information, technology, and society, and the recognition of deeply rooted tensions emerging from such interactions among the disciplines has fostered a new dialogue among leading institutions of higher education in North America. Some of these schools (currently eighteen in the US and Canada) have organized themselves into a consortium of information schools, or I-Schools, to address these issues directly.

There is similar interest in Asia, to which this conference bears witness. Collectively, we are striving to illuminate and provide greater clarity to the role of an I-School in the 21st century. We believe that I-School's have a crucial role in the education of professionals to lead society through the difficult and

complex transition to a global information society. I-Schools' mission aligns with higher education's historic role of conducting the fundamental research necessary to derive underlying principles and theories leading to accurate understanding, effective policy, and efficient practice.

I-Schools attempt to focus on issues that bring critical questions into better focus, such as the tension between intellectual property protection and fair use. They seek a better understanding of the implications of alternative system design strategies such as open extensible systems versus proprietary closed designs, both of which have proven to be viable but with different costs and different effects. They explore issues of information security versus accessibility and the resulting implications on public policy. They study the forces that lead to a preference for the expedient rather than the ethical. They consider issues of information secrecy, and requirements for appropriate accountability through records management.

As I-Schools position themselves for the 21st century, a careful balance is needed to uphold the long-standing and durable traditions of higher education while responding to the rapidly evolving challenges confronting society. I-Schools are not ivory towers. Those of us who are their faculty cannot live in a cloistered domain of academic isolation. We live in and are part of the world. Nor can we address the breadth of vital issues without the help of others. We must leverage each individual's and each school's strengths; the problem space is so large that no school has the possibility of making more than a very small contribution. We are learning to leverage our local strengths, and to network our global resources to build larger capabilities. We are learning to apply principles of globalization to the education of our students. We are experimenting with out-sourcing to leverage the strengths of our peers and with in-sourcing to capitalize on local strength. Ultimately, we strive to build networks of excellence that span state and national boundaries to build a global educational capacity.

Strategic partnerships are vital; they must include not only institutions of higher education but also government and industry. International partnerships offer exciting opportunities to extend the I-School vision globally and to develop educational applications of out-sourcing, in-sourcing and collaboration around the world.

The I-School mission is to educate information professionals who will create systems that integrate people, information, and technology to create effective solutions for a global, information-intensive society. It is a mission that is beyond the scope of any one institution, but one that is achievable through the collaborative efforts of partners around the world. It is necessary, it is timely, and it is happening.

The School of Information at the University of Michigan*

John King[1] and George Furnas[2]
Speaker: Gary Olson[3]

[1]*Dean and Professor*
[2]*Associate Dean and Professor*
[3]*Associate Dean and Professor*
School of Information, University of Michigan, USA

* This document was written in the Fall of 2003 on behalf of the School of Information by John King and George Furnas. It appeared as the introduction to a strategic assessment report written by the faculty and staff of the school.

The University of Michigan's School of Information (SI) is a bold attempt to come to fundamental terms with the Information Age. The School's mission can be summed up succinctly: "Bringing information, technology and people together in more valuable ways." The School is committed to making information and information technology increasingly valuable to human welfare. This challenge requires addressing intellectual problems that are novel and difficult, and changing institutions in academia and in society at large. The principal strategic objective of the School is to confront these problems decisively and be leaders in responding to them.

The School began this campaign when Daniel Atkins assumed the role of Dean in 1992 and began assembling the resources required. In a short time the School secured significant financial backing from University of Michigan President James Duderstadt and from the W. K. Kellogg Foundation. Dean Atkins built a stellar group of faculty drawn from the University of Michigan and beyond. He led the effort to consolidate the vision that created a new school from various historic roots. The new school was different from many academic programs in its breadth of mission and intellectual scope. Most important, the School embraced an integrated view of the issues of information. Information *connects* across space and time in sophisticated and contingent ways. Accordingly, the School was conceived as a non-departmentalized enterprise focused on an integrated learning model with multidisciplinary foundations. The result has been a rich portfolio of research and instructional capacities that breaks new ground, spanning disciplines.

SI's vision is that of a heterogeneous and multi-disciplinary faculty tied together by shared interests and a common commitment to professional education and research related to information. The integrated vision provides the master narrative of the School, but it is embodied through practical specializations in Library and Information Services (LIS), Human-Computer Interaction (HCI), Archives and Records Management (ARM), and Information Economics, Management and Policy (IEMP). These serve as formal professional specializations within the integrated Masters of Science in Information (MSI) degree program, and they help organize activity within the School and establish identifiable linkages to professional communities outside the School. They have become strong mobilizing forces without eroding or threatening an integrated vision. An important strategic challenge remains the maintenance of appropriate balance between integration and the practical utility of specialization. This is particularly true with respect to the School's Ph.D. program and in the building of the faculty.

The School is not alone in its belief that information is important, a critical area of research and training. In the years since SI's development began, several dozen such schools have emerged from a variety of disciplinary beginnings. The name "School of Information" is no longer strange and puzzling; it is now seen as representative of an intriguing and powerful notion that is gaining salience in all walks of life. An institutional transformation is under way in higher education focused on the study and design of information and information technologies. Key discriminating factors among these new programs are the degree to which they successfully pursue an interdisciplinary view of the problems, and their commitment to the goal of improving human welfare as

a result of their efforts. SI's goal of leadership rests primarily in these discriminating factors.

In the sections that follow, we attempt to provide a sense of the spirit of the School as captured by key intellectual signifiers. These are used to frame the essential tension embodied in the SI enterprise, as illustrated by two creation myths about the School's origins. From these creation myths a story emerges about the struggle to balance the practical need for professional education with the intellectual challenge of the integrated vision and the ethic of human service. This struggle gave rise to the school's professional degree curriculum for the Masters of Science in Information, or MSI, and from this struggle a number of important lessons were learned. These lessons shape the strategic challenges facing the School.

Intellectual Signifiers and the Spirit of the School

It is difficult to capture the spirit of the School of Information by examining faculty bios, curricula, student profiles, and descriptions of research projects (e.g., as available on the School's website[1]). Each of these makes a contribution to the whole, but the spirit of the School is found in the ongoing intellectual interaction among its members. Over the course of ten years, a set of intellectual signifiers have emerged that capture different aspects of the spirit. They can be found in white papers, minutes of meetings, descriptive literature, and handouts from classes. Four are particularly important:

Borromean Rings.

Borromean rings (Figure 1) are a set of three rings, interlocking such that the removal of any ring causes all three to separate. The three rings represent the School's primary foci of people, technology, and information. The interlocking nature of the rings signifies the fact that value can only be created when the entire set is present and integrated. SI embodies the dual goals of understanding and improving the phenomena represented by the interlocked rings.

Pasteur's Quadrant. **(Figure 2)**

This idea is taken from Donald Stokes' 1997 book of that name[2]. Stokes replaces the traditional distinction between basic and applied research with a dynamic model that characterizes the challenge of human understanding as the embodiment of both. His ideal is Louis Pasteur, the 19th century polymath whose work is characterized as use-inspired basic research. The idea embodies the SI faculty's view of research in the information realm.

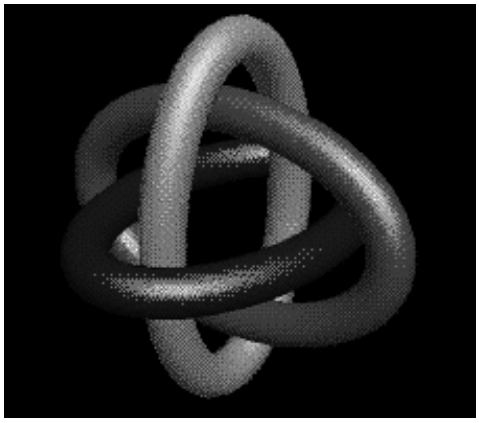

Figure 1. Borromean Rings

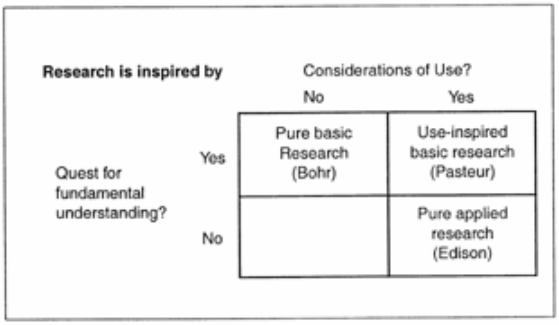

Figure 2. Adapted from *Pasteur's Quadrant* (Stokes, 1997)

Core and Cloud.

This concept, suggested in Figure 3, refers to the interaction of some kind of core with a larger, relevant, but less tightly coupled cloud surrounding it. The idea has gained currency in discussions of the future of the university.[3] SI's implementation has two different but related meanings. One refers to core ideas related to information that are surrounded by a larger cloud of relevant ideas. The other refers to a core of individuals engaged in the quest for understanding and improvement, surrounded by larger community of individuals who interact with, benefit from, and contribute to the core.

[1] www.si.umich.edu

[2] Stokes, Donald. *Pasteur's Quadrant: Basic Science and Technological Innovation*. Washington, DC. Brookings Institution Press, 1997.

[3] "The core and the cloud – a cardinal in cyberspace," in *The Economist,* (1997). http://sputnik.dpi.inpe.br/economist/uni4.htm

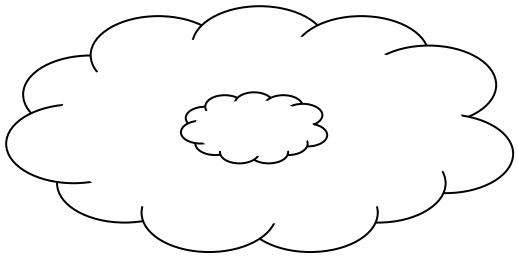

Figure 3. Core and Cloud

Connect!

This is drawn from E.M. Forster's dictum about the duty of the writer to engage the passion of life, and has been appropriated for a variety of purposes in which an existential call to action is appropriate.[4] Within SI the call to action focuses specifically on the need to connect the core and the cloud with respect to both ideas and people.

These signifiers taken together suggest a powerful underlying tension that characterizes the School of Information. The Borromean Rings embody the tension between the separate rings and the unity of the set. Pasteur's quadrant lies at the tense intersection of fundamental and use-based ambitions for knowledge generation. The core and cloud model carries the tension inherent in distinguishing the core from the cloud (and both from the rest of the world). The admonition to connect arises from the difficulty of establishing ties between the multiple communities represented in the core, the cloud, and the larger environment. This pattern of tension can be seen most vividly by examining the School of Information's evolution over the past decade.

The Essential Tension

The School of Information embodies compelling new ideas about information in the context of a long institutional legacy. It is impossible to separate these aspects of the School, but the relationship between them has often been tense. This tension can be captured by what we call "creation myths" regarding the School's emergence. This metaphor does not suggest that either of these characterizations of the School's creation is fictional; in fact, the tension arises because both are fundamentally accurate, yet they are at odds in important ways.

The first creation myth is that the School of Information was an entirely new academic program designed to pull together multiple perspectives on the topic and synthesize them into a new construction. This endeavor could have been carried out in several different ways, but the way chosen at the University of Michigan was to build the School on the foundation of a pre-existing academic program, the School of Information and Library Studies (SILS). SILS was both available for the purpose and already included important components of the new venture. The result was a *replacement* of SILS by SI, carrying forward selected aspects of SILS but representing a fundamentally different enterprise.

The second creation myth is that the School of Information represents an outgrowth of the 70 year old academic program called the School of Information and Library Studies. This program had focused on key aspects of the information realm, but various factors made it desirable to expand the School's portfolio significantly. The opportunity to do this came when a group of faculty with skills in the new areas agreed to join the School and add their strengths to the effort. The result was a *natural evolution* from SILS to SI, adding important new dimensions to the SILS tradition that warranted the contraction of the School's name to simply the School of Information.

Few in the SI community subscribe completely to either of these characterizations, but nevertheless, they denote significant tension regarding the School's origin and destination. The tension took two forms. One was the inevitable political turmoil that accompanies radical change in the structure and direction of academic programs. The other was the challenge of synthesizing multiple disciplinary perspectives into a coherent intellectual endeavor. These tensions might have destroyed the venture, but in fact, the desire to grapple effectively with the latter helped overcome the former. SI evolved from a bold and somewhat fractious endeavor into a bold and cooperative endeavor through the creation of the school's new professional education program.

The SI community was united by several shared beliefs. One was belief in an increasing need for *information professionals*, skilled practitioners who understand the complexities of the information realm who can help individuals and organizations deal with

[4] In fact, the quote is "Only Connect," but it is commonly changed in practice to "Just Connect." The original is in Forster's 1910 novel, *Howards End*: "Only connect! That was the whole of her sermon. Only connect the prose and the passion, and both will be exalted, and human love will be seen at its highest."

those complexities in reaching their objectives. This was not surprising, given that this professional bias was embodied in the SILS enterprise and in the fields from which new faculty came: management, public policy, engineering, computer science, and so on. Another belief was that the information realm could not be understood and improved only through the creation of pillars of academic excellence in sub-specialties related to information. There was a critical need to find the deep connections between the fundamental ideas embodied in each of the sub-specialties. This proved to be an extraordinary intellectual challenge. It often seemed that the traces of the deep connections would dissolve into a dark abyss without the necessary scaffolding to discover or create the deep connections. The resulting endeavor, which might be described as *scaffolding the abyss,* emerged as a fundamental and ongoing mission of the School.[5] Finally, both the creation of information professionals and the effort to scaffold the abyss had to be motivated by the desire to improve human welfare. This led to the embodiment of the concept of *service learning* in both instruction and research that proved to be a strong motivator for excellent faculty and students to join the School.

The interaction of these beliefs was as important as the beliefs themselves in the emergence of the SI of today. SILS was a going concern with a highly regarded professional Masters of Information and Library Studies (MILS). This program formed a starting point for the vision of the information professional, but that vision went considerably beyond the MILS curriculum. The goal was to create a bold new curriculum that embodied both the quest for the deeper connections between aspects of the information realm, and the commitment to service learning. The early efforts at scaffolding the abyss were applied to the evolving curriculum for the 48 unit Masters of Science in Information, forcing the faculty to think through many of the difficult challenges the scaffolding effort itself entailed. As the new curriculum was implemented on a student body that was substantially unchanged from the 36 unit MILS program, the difficulty of conveying the complex ideas the curriculum contained became clear. This forced a re-thinking of major aspects of the curriculum, and often, major aspects of the scaffolding effort. In the mean time, the implementation of the service learning concept in the form of the school's Practical Engagement Program, forced students to test their curricular experiences against real-world problems, which brought yet more information to the curriculum-scaffolding nexus.

On top of this already daunting challenge was the inevitable institutional dynamic of trying to change a going concern in real time without stopping. To use the example of the electrician who handles live electrical circuits, the SI faculty had to "work it hot" while trying to persuade prospective students to join the endeavor, to teach them once they were in the program, to manage their practical engagement and directed field experience efforts, and to help them find meaningful jobs upon graduation with an MSI degree that no employers had heard of before. When all that was accomplished, the students had to demonstrate high levels of performance and accomplishment to justify the investment SI had made in creating the new program, and to provide an example to prospective students that the MSI was a smart degree program to pursue. The elapsed time to accomplish this was about four years, from implementation in 1997 to the first clear signs of success in 2000. That was a time of tension for the SI community, and for the stakeholders in the SI venture at the university level and beyond. As the evidence of the effort's success mounted, it became clear that long-term challenges were just beginning. Those challenges are grounded in the learning experienced during the development, implementation, and follow-through in the MSI program that embodies the notion of the information professional, informed through the scaffolding effort, and imbued with the ethos that comes from service learning.

What We Learned

The learning that came out of the emergence of SI is as complicated to express as the experience itself was to endure. Nevertheless, the learning can be summarized in a few key observations.

Lesson One: It can be done.

The first thing we learned was that it can be done: it is possible to create a bold new program informed by the intellectual effort of scaffolding and embodying the

[5] The authors of this report created the phrase "scaffolding the abyss" in an effort to evoke some sense of the challenge. On review of the report, several thoughtful colleagues raised concerns about the use of this phrase, providing persuasive arguments against it. (e.g., an abyss is too empty, a scaffold is too temporary, nouns are not verbs) In the end, they agreed that it could be used, but they still had concerns. This controversy illustrates quite nicely the dilemma of the endeavor itself. All SI faculty understand the endeavor, but none can describe it succinctly in a manner that their colleagues will accept. Territory that can only be addressed through allusion and that has no real name is probably a good definition for a frontier.

ethos that comes from service learning. Moreover, it is possible to do this while "working it hot," transforming an existing instructional program in profound ways while maintaining remarkable professional continuity. The SI faculty were unwilling to discard or bypass key professional elements of the old SILS model, in part because they represented important career trajectories for students, and in part because the faculty believed that SI could provide valuable intellectual leadership to those professions.

There was considerable discussion in the creation of the MSI over whether the degree should be offered as an undifferentiated and unified pedagogy, or an umbrella with a strong core that branched into specializations. In order to increase the attraction of the strange new MSI degree to students familiar with more traditional degree offerings, it was decided to offer one degree with specializations in sub-areas such as library and information services and human-computer interaction. The deep ambitions of the scaffolding effort were incorporated in a set of "foundation" courses required of all students, typically taken in the first year of the program. The specialization classes would build upon the foundations.

This was a calculated risk; it was not clear whether professionally-oriented students would embrace the complexities inherent in the emergent scaffolding project. In fact, many students are frustrated by the foundations courses initially, preferring to move immediately into courses more germane to their chosen specializations. However, by the time the students graduate and move into professional jobs, that view is completely reversed and the foundations are held to be the most important part of the program. The foundations courses have the effect of destabilizing student professional sensibilities in constructive ways, breaking down old models and introducing a new flexibility of thought. There is much migration by students among the specializations while they are in the program, as well as boundary crossing after graduation. Students following the Library and Information Services specialization take positions in areas never previously seen to be part of the library world, while students following the Human-Computer Interaction specialization take positions in libraries. The so-called "Tailored" specialization, in which students construct their own program, has been one of the fastest-growing options in the past few years. The MSI students appear to grasp the underlying notion of the scaffolding effort, even if they are not directly participating in it.

Lesson Two: The accompanying need for institutional change.

The second thing learned was that changing the pedagogical thrust of education in the information professions requires simultaneous change in the larger institutional realm of the professions. This lesson was learned quickly upon the launch of the MSI program in 1996. The SILS professional Masters in Library and Information Studies (MILS) had long been ranked at the top of accredited librarianship programs. The American Library Association's Committee on Accreditation had scheduled the re-accreditation review for the MILS for 1997. The relatively simple solution of seeking accreditation only for the library specialization within the MSI degree was antithetical to the whole idea behind the new degree. The School worked with ALA on an innovative scheme to accredit the entire MSI degree, thereby broadening the scope of what might constitute professional training in librarianship and enabling students with much broader training to take positions that required a graduate degree from an ALA-accredited program. Five-year accreditation for the entire MSI program was granted by ALA in 1998. This was the first time ALA had done such a thing, and the action sparked considerable controversy among traditionalists. In the end, however, the innovation prevailed: in 2002-2003 the ALA re-accredited the MSI for a full seven years, specifically noting SI's leadership in broadening the field of library education.

This story about librarianship is important because that field was the first among the information professions to achieve strong institutional status (around the turn of the 20th century), but this kind of institutional change has been replicated in various ways in other professional areas related to SI. Computer science and management information systems programs have been around since the 1960's. They have been stable within their respective institutional homes, typically engineering and management schools, but they also have long been rather isolated intellectually and confused with respect to their professional standing. These programs have been criticized for becoming increasingly inward-looking, narrowing their foci instead of embracing the rapid expansion of the intellectual and pedagogical aspects of the information realm. The 25 or so ARM programs in North America are embedded as sub-specializations in LIS programs or history departments. SI is the first school to offer graduate education in ARM that is on par with other specializations. The larger ARM community is watching this development with interest. The younger field of HCI, in contrast, has wandered from one possible institutional home to another, finding difficulty

in establishing legitimacy in programs such as engineering, computer science, management, or psychology. SI has taken important institutional leadership roles in all three of these areas. SI faculty serve on the boards and direction-finding committees of key professional society boards such as the Computing Research Association that represents Ph.D. granting computer science and engineering departments in North America, and the Association for Information Systems that includes most of the information systems faculty in management schools. The HCI community has watched the evolution of HCI in SI, and a number of strong HCI groups have begun to emerge in the information schools evolving along the lines of the SI model. This institutional leadership extends to the realm of national and international policy, where SI faculty are active in shaping the information agendas in the National Science Foundation and other US agencies, and in the development of information policy in Europe and Asia.

Lesson Three: Such an ambitious venture requires appropriate resources.

A third major lesson concerns the importance of adequate resources for such an ambitious venture. The University of Michigan and the W.K. Kellogg Foundation made very substantial financial investments in the SI venture between 1992 and present. This enabled the School to assemble key faculty and begin the difficult process at the curricular-scaffolding nexus before it was necessary to show large enrollment increases. In this way, the School was able to create the instructional vision first and then attract students to it, rather than the more common but less effective practice of trying to co-evolve a pedagogical vision and rapid student growth. It also enabled the creation of infrastructure in the areas of student services, instructional computing, and teaching innovations that would have been impossible otherwise. Financial resources helped bring together other key resources, such as a heterogeneous faculty who brought with them diverse views of how to achieve academic strength. These included a strong focus on research and doctoral education, and innovative ideas for balancing teaching, research and service in effective ways. The School's sponsored research funding grew dramatically, from virtually nothing to the point where SI, despite being the second smallest of 19 Schools at the University of Michigan, was ranked seventh in total research funding. Adequate resources have also been essential in enabling SI faculty to play influential roles in the areas of institutional leadership noted above. It is no surprise that resources are vital for the success of the SI endeavor. The subtle and important lesson has been in the importance of focusing resources on efforts to change the context of the School's vision within which the text of its instructional, research and service endeavors will have meaning.

Lesson Four: Intellectual integration and growth require direction setting and hard choices.

The fourth thing learned is that the scaffolding enterprise is fraught with persistent and vexing difficulties, but that progress can be made if care is taken to avoid some things and seek others. In particular, it became clear that the most serious threat to the scaffolding effort was a set of deeply embedded institutional biases within the academy itself. At the heart of the scaffolding effort is the need to relax parochial disciplinary views of the information realm and cross intellectual borders without guidance on how to do so. The biases of the academy run contrary to this, preferencing relatively narrow disciplinary foci and specialization within rather than across fields. These biases are evident in the administrative structures of the academy, but a far more pernicious problem is the degree to which they are instantiated in the academy's reward structures. Doctoral students and junior faculty are socialized to avoid intellectual challenges that depart from the norm, to treat interdisciplinary work as a threat to career success, and to be skeptical of scholarly ventures that do not appear to have a solid disciplinary home. These do not scare off ambitious scholars who see the opportunity to make a quick victory of some modest challenge, but the challenges in the scaffolding effort are not modest and victory cannot come quickly. Only a sustained effort taking years and perhaps decades will yield the desired results. The danger is that the scaffolding effort will default to the prevailing biases of the academy, and thereby wither away. To avoid this risk, it is necessary to construct a set of countervailing forces that work against these defaults.

On the positive side, it has been found that the scaffolding effort is greatly enhanced by the reflective practice inherent in teaching in the MSI program, conducting research in the spirit of Pasteur's Quadrant, and maintaining focus through the notion of the Borromean Rings. At a practical level, this has found its form in a pattern that can be described by combining these signifiers as follows: The core-and-cloud model provides a tactic whereby connections can be made in the spirit of Pasteur's Quadrant, aimed at further understanding information, technology and people in the model of the Borromean Rings. This pattern can be thought of in two ways. In one, the focus is on the ideas themselves: some ideas are core and others are cloud, but all connect in the effort to gain understanding of

and means to improve the integration of information, technology, and people at both the fundamental and practical level. In the other, the pattern applies to the practices by which ideas are pursued: some people are core and some people are cloud, but they must connect with one another if the School is to understand the relationship among information, technology, and people in the fundamental sense, and to improve practice at the intersections. This duality arises because, to a large extent, in the academy people are associated with a corresponding cluster of ideas. As a result of this association between people and their ideas the core and cloud problem becomes in part a social management problem. Noting this link explains how intellectual goals of the school convert to a tactical path – social management of a social core and cloud of personnel and institutions.

This articulation is not a blueprint for the scaffolding effort; it is itself reflective, arising from a process of double-loop learning over the past 18 months that we call Intellectual Integration and Direction Finding.[6] This process has brought together SI faculty and doctoral students in an attempt to synthesize what we have learned and to figure out how we have learned what we have learned.

The final, and perhaps most immediate learning arising from this endeavor is the realization that there are two powerful issues that will enable or constrain the SI venture over the next few years: size of the venture and co-location of the participants. Each of these requires some explication.

The Matter of Size

Organizational size is a dominant, if not the dominant, factor affecting organizational structure and behavior. This was established beginning in the 1950's in work by Peter Blau, Richard Schoenherr, John Child, Derek Pugh, and others. In general, increasing size is correlated with increased organizational formalism, job specialization, standardization, and decentralization. Increasing size often is associated with decreased organizational flexibility and ability to innovate as an organization. Size appears to overshadow strategic management decisions, use of technology, and other factors also believed to be important in shaping organizational structure and behavior. This view of the dominance of size has been reinforced over several decades of research.

SI's organizational vision is that of a heterogeneous and multi-disciplinary faculty tied together by shared interests and a common commitment to professional education and research related to information. This vision is at odds with any plan to grow the size of the student body or the faculty beyond some threshold. The faculty have decided that SI should not grow above the size feasible for a single academic department of heterogeneous, multi-disciplinary faculty members. By maintaining a single department, the School's faculty and leadership will be required to find common ground among heterogeneous views and traditions. Departmentalization is a particularly serious risk to the SI vision because it facilitates what Donald Campbell has called the "ethnocentrism of disciplines" that results in subgroups of faculty clustering around relatively homogenous interests that do not interact much with other subgroups. In addition, separate departments will necessitate a taller hierarchical structure with greater formal decentralization. The faculty estimate the upper bound for faculty in a single-department school like SI to be in the region of 40 to 45. Assuming customary student-faculty ratios for strong graduate programs in research universities, this translates into a total student FTE of below 500.

Size affects nearly every other factor of SI's strategic planning. Given the School's current size of about 28 FTE (depending on how one counts), an upper bound of 40 to 45 means that the School will grow by about half. This seems like significant growth until it is remembered that the absolute number of faculty at build out is still quite small. Adding 14-18 faculty does not allow very many options for branching into entirely new areas of endeavor, given that any major new initiative will probably require hiring between three and five faculty. We can imagine perhaps one or two new initiatives. Constrained size also affects the School's revenue picture with respect to tuition. The University of Michigan budget model attributes tuition paid by students in a school to that school. This is of particular importance in a school like SI where a majority of the students pay out-of-state tuition that is substantially higher than in-state tuition (e.g., $22,000/year vs. $7,000/year). Any upper bound on student FTE in the School's main instructional program, the MSI, has effects on both the total tuition revenue possible and on whatever economies of scale are associated with tuition revenue. Of course, size also affects important issues such as long-term facility planning.

[6] The notion of reflective practice is drawn from Donald Schon; the idea of double-loop learning is taken from Chris Argyris.

Constrained growth need not impair the School's ability to have a significant impact on the University of Michigan or on the field of information. SI subscribes to the notion that the School's impact need not be, and should not be, simply a matter of its size. A key organizing ideology of the School is that the greatest impact will come from our singular level of integration and the intellectual scaffolding the school will provide to other, more disconnected enterprises. We aspire to be the school that ties things together. This is SI as "core". The impact on others will be through "cloud" relationships: strategic partnerships with other academic enterprises, both within the University of Michigan and elsewhere, which do not necessitate substantial growth in the School's faculty or student levels. A good example of this thinking is the School's current efforts to create innovative undergraduate education opportunities by working in partnership with the University of Michigan's Literature, Science, and the Arts (LS&A) college, and with private four year colleges that are part of the Michigan Colleges Foundation (MCF). The School's extensive dual degree programs at the masters level, as well as its participation in the University of Michigan's Museum Studies graduate program and its evolving Science and Technology Studies program provide examples of this strategy. The faculty have discussed both joint masters and Ph.D. degrees as possibilities, as well. There are challenges regarding the budget model and appropriate allocation of work effort related to this strategy that need to be considered carefully, but for the moment the strategy is manageable.

By following a strategy of limited growth SI puts itself in a somewhat different category than a number of similar schools at other universities. A relatively common model has been to start with a solid but small graduate program, and add an aggressively growing undergraduate program. Given the popularity of such undergraduate programs, growth is usually rapid. Some of these schools have grown from a few hundred undergraduate majors to more than two thousand in a short period of time. The faculty in these schools find themselves beset by major workload and management problems related to the undergraduate programs, and little time to think through serious questions of intellectual and pedagogical direction. At the same time, however, the strategy of partnership gives SI the opportunity to participate in a wide variety of educational ventures without necessarily having to commit to large enrollments and all that entails.

The Matter of Co-Location

The challenge of integration depends critically on close interaction among the faculty, staff and students. The long-term development of the School depends on growth to build-out of the instructional programs, and continuing growth in the research programs. SI has grown dramatically since the days of SILS, but the space available to accommodate these functions has not grown nearly as quickly. In an effort to assist the School, the University's senior leadership provided additional facilities, but also ended up splitting the School down the middle. Half of the School is in West Hall on Central Campus (called SI West) and half is in the School of Information North (SI North) building on North Campus, four miles away. SI West has approximately 75% of the School's faculty, 50% of the School's administrative staff, 80% of the School's computing support staff, all of its MSI instructional operations, and the only rooms capable of hosting large School events. SI North has 25% of the School's faculty, 50% of the School's administrative staff, 20% of the School's computing support staff, and most of the School's sponsored research and Ph.D. activity. SI North has no classroom or instructional laboratory space (building code restrictions make such uses prohibitively expensive) and the largest classroom in SI West can accommodate only one half of the students in SI's largest classes. To meet instructional needs, SI must use borrowed space from other schools in about a dozen buildings on North and Central campuses. No other academic program at the University of Michigan is split in half in this manner. Yet, given that the fundamental strategy of the School is to create a tightly connected interdisciplinary core, no other program is be more strategically vulnerable to such a split.

This condition, if not remedied, can fundamentally cripple the School in ways that will do permanent damage and foreclose key opportunities the School now still has open. The university leadership is mindful of the School's plight, and progress has been made in starting a process that will, hopefully, lead to identification of a permanent solution. There might be more than one possible solution to this problem. The School has considerable research expertise in the area of collaboration technology, and is in a good position to discover experimentally whether technology-assisted "distance independent" operations are genuinely workable, and the faculty are willing to undertake such an experiment. However, there is no guarantee that the experiment will be successful, and there is considerable empirical research to suggest that it will not be. If the School undertakes such an experiment, it must do so

with a contingency plan that provides for co-located space if the experiment fails.

Working Within Constraints

The size and co-location issues can be thought of as constraints, one imposed upon SI and the other imposed by SI upon itself. They are currently critical, but they are contingent on other factors and that might be temporary. In the case of size, the constraint is self-imposed by the SI faculty in order to enable continued success with the vital scaffolding project while maintaining a coherent instructional venture that embodies the ethos of service learning. In time, the School might evolve mechanisms that ensure continued progress without the constraint on growth. The problem of co-location (or, lack hereof) is a result of the University's difficult facilities problems. This problem must be temporary or the SI venture is likely to fail, at least with respect to the scaffolding effort. It is likely that SI will continue as a going concern even if the co-location problem is not solved, but it is very doubtful that the faculty who will be key to the scaffolding challenge will remain in the School. The result of failure on the scaffolding effort will be a major opportunity loss for the School, for the university, and for the whole field of information. These constraints govern all that follows in this report.

The Key Challenges

The learning mentioned above allows the synthesis of key challenges into a set of four, over-arching themes. Each incorporates components that stand alone as issues in their own right, and that are discussed individually in Part II of this report. Detailed understanding of these components requires reading in Part II. The objective of this section is to identify the themes that tie the components together and that represent the most serious issues confronting the School at this time. Each is identified by its engagement with the intellectual signifiers discussed earlier.

Challenge 1: Managing and Extending Substantive Vectors of Action

Intellectual signifiers: Borromean Rings, Pasteur's Quadrant.

The landscape of information is vast, but the School of Information is small. There is no way that the School's faculty can cover all aspects of the realm. The spirit of Pasteur's Quadrant requires engagement with the practical, and practical matters require some degree of specialization. The specializations within the MSI program are robust, and the faculty have to some extent organized themselves and their research around those specializations. Given that the School has imposed upon itself a significant size constraint, growth of any kind will be limited. It should be assumed that the faculty will grow by somewhere between 14 and 18 members over the next six to ten years. Some faculty hires will be needed to strengthen existing areas of specialization and focus, and to work on the scaffolding that yields the links among them. A number of faculty positions will remain available after this is accomplished. The School must devise a process for managing and extending its substantive vectors of action that balances the practical needs to focus on specific issues with the broader need to engage fundamental problems arising from those specific issues that aid the scaffolding effort.

Challenge 2: Sourcing and Producing Intellectual Leadership

Intellectual signifiers: Borromean Rings, Pasteur's Quadrant, Core-and-Cloud.

The School of Information is like every other academic endeavor in that it must hire new faculty, including junior faculty. It is also, by choice, engaged in the effort to produce new intellectual leaders through its Ph.D. program who will take positions in other programs. An enterprise such as SI creates an important symmetry in the challenges of sourcing new talent and producing new talent. The issues arise out of the threat of academic defaults noted earlier. Traditionally, doctoral students are socialized from the start to be strong in some established disciplinary tradition. This makes it relatively easy to evaluate their strengths and contributions, and to place them in appropriate academic positions when they complete their studies. On the sourcing side, SI seeks the best junior faculty available from doctoral programs. Many if not most will come from established disciplinary traditions that have relevance to the SI vision. When they become junior faculty in SI, the senior faculty must guide them in the pursuit of their career aspirations. The unusual vision of SI, especially around the scaffolding effort, is at odds with the disciplinary training most doctoral students receive. The senior faculty face a serious conundrum, trying to balance the extent to which they encourage junior faculty to pursue their disciplinary strengths in ways that yield relatively straight-forward evidence of career progress and preserve marketability in more traditional programs, or to pursue cross-cutting work that is more difficult to use in establishing career identity and that might not be marketable outside SI or

similar schools. Ultimately, this translates into the problem of evaluating the academic performance of junior faculty around the tenure decision. SI must determine how best to nurture its junior faculty to achieve the School's broader vision without jeopardizing the careers of junior faculty.

The same general problem arises with respect to SI's doctoral students. These students are selected on the basis of their aptitude and willingness to pursue the broader SI vision, but there are as yet relatively few models of doctoral education that encompass that vision, and there are comparatively few academic positions that do so. Ideally, SI doctoral graduates will be able to go into a variety of traditional disciplines and bring complementary advantages because of their unusual training. There is no question that the students SI recruits are intellectually capable of doing this. It is less clear that the SI faculty have developed the right strategies for accomplishing this. There are a growing number of information schools similar to SI that are beginning to hire new faculty. SI doctoral graduates are already competing successfully for those positions. The objective of the SI doctoral program is not merely to have its graduates compete for initial appointments. It is to produce doctoral graduates who become leaders in their fields. The SI doctoral program is still evolving, and the mechanisms to produce graduates who do achieve such leadership are still being constructed.

Challenge 3: Serving and Transforming the Learning Community

Intellectual signifiers: Pasteur's Quadrant, Core-and-Cloud, Connect.

SI's primary engagement with a learning community is the MSI program. It accounts for the majority of the School's students, and demands the most attention of the faculty's instructional resources. The program has undergone some remarkable changes during its evolution. In addition to the substantive changes from the MILS degree to the MSI degree mentioned earlier, the student population pursuing the degree has changed significantly. Prior to 1996 most of the School's graduate students were Michigan residents and many were part-time students. Today, most of the School's graduate students are from outside Michigan and are full-time students. There are still important challenges and changes to be found in the MSI program, including improvement in selectivity and developing ways to ride out changes in the professional job markets that all professional schools must deal with. Still, the apparatus is in place to manage these.

A more interesting challenge is found at the undergraduate level and in the realm of what is usually called "continuing education." The SI faculty have a strong interest in undergraduate education, despite the decision to constrain growth in part by not starting an undergraduate degree program. SI has already developed a number of innovative programs at the undergraduate level, in partnership with other academic units that offer undergraduate majors. Ultimately, SI seeks to influence key aspects of undergraduate education without offering an undergraduate major. There are a number of exciting ideas for accomplishing this, but there are also difficult challenges in sorting out whether, when and how to pursue such ideas. Similarly, there are a large number of practicing information professionals from traditional fields such as librarianship that need and desire educational opportunities to expand their intellectual perspectives and upgrade their professional skills. SI has not offered such opportunities because it has been so preoccupied with the challenge of building a strong MSI program, developing courses in the undergraduate arena, and launching a new Ph.D. program. The challenge is whether, when and how to begin offering some kind of continuing professional education of the sort that only SI can offer.

Challenge 4: Mobilization, Voice and Audience

Intellectual signifiers: Core-and-Cloud, Connect.

The SI vision is not merely to create an important and exciting new perspective on information. SI must also work hard to mobilize the audience that needs to hear the SI vision, and to develop the right voice for articulating that vision. There are a large number of relevant audiences, represented by academic journals, conferences, scholarly and professional associations, academic programs, and funding agencies. In addition, there are audiences on the praxis side, including employers of SI graduates and users of SI research findings. Were SI an established academic venture with well-established audiences, the task of connecting to these audiences would be a simple matter. Instead, SI is an emergent enterprise working at the frontier of thought and action. One might say that its largest audience is those who are as yet unidentified. Establishing ways to mobilize such people is a major challenge.

SI has found voice in a variety of ways that deserve mention. One, of course, is the performance of the School's graduates. Another is through the leadership of the School's faculty in important direction-setting efforts in the larger community. SI faculty have played important roles as leaders in professional and scholarly

associations, government funding agencies, and others relevant to the information realm. SI has also found voice through important demonstration projects and processes such as the creation of the Internet Public Library, the initial development of the University of Michigan CourseTools and WorkTools infrastructure, support for the Journal Storage Project or J-STOR, and its projects to preserve functionality of software executables held in archives. It is a challenge to develop effective ways for balancing the School's voice across such channels.

Strategic Questions

The following strategic questions arise from the foregoing narrative. This list is meant to be illustrative; it is not intended to be exhaustive.

- What is the feasibility of SI's aspirations to lead at the broad conceptual integration level?
- Does the consequent strategic choice to stay small and tightly knit make sense?
- Do the difficulties of the school being geographically split constitute a serious threat?
- What does integration mean? What questions would it answer?
- Is it reasonable to seek an answer by examining the structure of the problem of bringing People, Information and Technology (PIT) together in more valuable ways?
- What is the detailed structure of the PIT nexus?
- How do we further understand the structure of that nexus?
- What are the cross cutting threads and dynamics?
- How do we bring major intellectual traditions to bear?
- Can we, for example, reconcile the valid insights of post-modernism with the valid contributions of logical positivism/empiricism/rationalism?
- What specific content is needed?
- What kind of special intellectual expertise will help with the integration?
- What pillars of excellence will best help us find the deep understanding, the cross cutting themes?
- Which groundings in practice will most ensure valuable Pasteur's quadrant positioning?
- How do we create effective socio-intellectual processes for our mission?
- What kinds of people need to come together to the problem and why?
- How do they each fit in? Who should each talk to and why?
- Does the core and cloud model seem reasonable in this context?
- What core/cloud structures will be most useful? (Suggestions for what is in the core? What is in the cloud?) Content? Social processes?
- How do we build a vital core? How do we build a healthy cloud?
- What structures and processes do we set up to work against centrifugal defaults? (To make the core of the cloud robust attractor, instead of an ephemeral overlap?)
- What new professional specializations will be needed?
- In solving the problem in the world, what institutions need to be changed and how can we help change them?
- How can we help the interdisciplinary tenure process? Can we find better interdisciplinary evaluation metrics?
- How do we foster new forums for non-standard idea exchange – new journals, conferences?

Appendices

Appendix A: SI Mission Statement (first developed in 1996)

Library and Information Services • Archives and Records Management
Human-Computer Interaction • Information Economics, Management and Policy

Mission Statement
of the University of Michigan School of Information

Unprecedented change in the use of information is reshaping our personal activities, our community and organizational practices, and our national and global institutions. In managing these transformations, our society too often focuses narrowly either on extending technology or on revising social policies. We need an integrated understanding of human needs and their relationships to information systems and social structures. We need unifying principles that illuminate the role of information in both computation and cognition, in both communication and community. We need information professionals who can apply these principles to synthesize human-centered and technological perspectives. The University of Michigan School of Information is pioneering the development and application of the principles and is educating professionals to lead in the information age.

A New School

The School of Information was rechartered by the Board of Regents in 1996. It is creating a new class of professionals qualified to address these complex challenges. The School inherits the rich traditions of service, leadership, research and access from the School of Information and Library Studies, and extends these values into the digital age. Students and faculty with a broad range of perspectives and interests are forging a new body of theory, principles, and practices from the best of past and present scholarship in library and information science, computer science, the humanities, and the social sciences.

Generating New Knowledge

The School of Information is dedicated to investigating the fundamental role of information in society. Its field of study is information: how it is created, identified, collected, structured, managed, preserved, accessed, processed, and presented; how it is used in different environments, with different technologies, and over time. Faculty and students conduct multi-disciplinary research to discover new knowledge about the interplay between information, technology, and people with the aim of unifying human-centered design approaches and sophisticated technologies.

Delivering Quality Professional Education

The School is devoted to delivering the highest quality professional education to students who seek careers as librarians, information service providers, human-computer interface specialists, information system developers, archivists, information economists, and information administrators in both traditional and new settings. Yet the pace of change in both social organizations and information technology is such that the School must also provide lifelong learning opportunities to established information professionals and prepare students to pioneer career paths that do not now exist. Richly intertwined programs of instruction, research, and community engagement expose our students to innovative ideas, novel approaches, and the potential of new technologies.

Educating New Scholars

The School's doctoral students form a new cohort of scholars prepared to conduct distinguished research and innovative teaching. They are ready to assume roles as university faculty, administrators, technical innovators, and research scientists who can define the principles of the field, lead organizations, and design the next generation of information systems and technologies.

Building Partnerships to Solve Fundamental Problems

Because the School stresses the interaction between technical possibilities and the distinctive contexts in which information is actually used, it values partnerships with other parts of the University and with external organizations. The research and instructional programs at the School have a strong component of practical engagement with private enterprises, not-for-profit institutions, libraries, schools, and communities to address the pressing social and technological problems of information management, access, and use. The School integrates this larger community tightly into its instruction — via an innovative practical engagement program — and into its research — via partnerships in developing concepts and technologies that enrich both the practice and theory of the information professions.

Realizing a Vision

Information professionals are playing an increasingly vital role in empowering individuals, communities, and organizations to capture the promise of the information age. The School of Information embraces a vision that harmonizes people, information systems, and organizations to improve the quality of life. Our mission is to discover the principles and concepts that will enable society to realize this vision, to design the technologies, systems, and practices that will substantiate the vision, and to educate new generations of professionals who will put that vision into practice.

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Applying the i-School Model: a Case Study in Archival Education

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While the i-school phenomenon as an innovative force in information science education has been well publicized, the i-school group is not the only educational identity which has coalesced around the framework of schools of library and/or information science and related fields. With significantly less fanfare, a core group of schools with archival studies programs has emerged within this environment over the last 20 years. Like the i-schools, this group claims a unique identity, a common set of goals and problems, and a range of interests that goes beyond traditional library and information science, and overlaps with fields not traditionally associated with library and information science.

In order to determine whether the i-school model has commonalities with other initiatives in LIS education, we need to determine the characteristics of the model. What distinguishes an i-school? There have been a number of criteria put forward, many of them pragmatic such as the administrative reporting structure or the number of research dollars received annually. However it is more useful to consider the i-schools from a conceptual rather than a fiscal perspective. For instance, Von Dran has been quoted as saying that "information schools are focused on how we go about creating, transmitting, collecting, organizing, preserving, and retrieving information" and that "The i-School concept grew from the recognition that the traditional disciplines of information science, computer science, and IT are increasingly overlapping in today's digital, information-age society" (Ascione, 2005).

Similar claims can be made in the field of archival studies. According to the Society of American Archivists (SAA), "Archivists are the professionals responsible for the identification, selection, protection, organization, and description of archival records and papers, and, eventually, for their accessibility to any user"---a definition with considerable commonality of focus with that given above. The SAA notes further that records and papers encompass "documentary evidence produced by organizations and individuals in all media (paper, digital, audio, and visual) and in any format." (Society of American Archivists, 2003). This is consistent with the i-school's emphasis on a digital society, and suggests a relationship to computer science and a reliance on information technology.

Archival education has undergone a revolution over the past thirty years. Formerly, programs in archival studies were usually found in history departments and taught by adjunct faculty (Yakel, 2004). In the late 1980's programs began to develop within MLIS degree programs in schools of library and information science. At one institution, the University of British Columbia, a separate Master of Archival Studies (MAS) degree was created to parallel the MLIS degree, but more commonly archival studies appeared as a specialized track within the MLIS. Archival associations began to demand a higher standard for professional education. The Society of American Archivists developed a set of *Guidelines for a Graduate Program in Archival Studies*, which recommends a minimum of 18 credits of core archival courses (SAA 2003). While many LIS programs offer a few courses in archival studies, often taught by adjuncts, as of 1999 only 11 programs offered six or more courses to reach this recommended level (Cox, 2001). In a study conducted in 2001, 16 LIS schools identified themselves as hosting archival tracks (Bastian and Yakel, 2005). What has emerged is a core group of LIS schools with two or more full-time faculty who have a background and/or degree in archival studies, preparing graduates at the master's level for careers as professional archivists. These schools include several of the i-schools, for example the University of Pittsburgh, University of Michigan, University of Texas at Austin, and University of Toronto.

While the primary location of archival education has moved from departments of history to library and

information schools, the field of archival studies has changed in other ways as well, driven by the impact of digital technologies. The electronic environment has created new challenges for archivists and archival educators. Critical issues such as digital preservation, authenticity of electronic records, archival metadata, and standards and techniques for electronic records management need to be resolved through research and development. Large scale, nationally and internationally funded research involving the archival community has begun to appear. Examples of major studies are the NHPRC-funded 'Pittsburgh Project' ("Variables in the Satisfaction of Archival Requirements for Electronic Records Management") at the University of Pittsburgh, and the SSHRC-funded InterPARES ("International Research on Permanent Authentic Records in Electronic Systems") Project at the University of British Columbia. This type of multidisciplinary research aimed at resolving technology-related problems is relatively new to the field

An advantage arising from the placement of archival studies programs within LIS schools is an increased emphasis on research in a multidisciplinary environment. The research culture in archival studies is further strengthened by the presence of PhD programs in these schools. The growing number of PhDs who obtain their degrees through study and research in archival studies has created a new faculty model for archival studies programs, and helped to fill positions within the increasing number of programs (though there is still a severe shortage of academically-trained faculty in archival studies). Many of these new faculty have a broader research perspective through their awareness of related areas such as digital metadata, user studies, and human-computer interaction, areas which have not traditionally been part of archival training. As Yakel (2004) notes, recent graduates tend to be more technologically aware than the earlier generations of archivists that they are working with. And, because of their education in schools offering MLIS programs, they are more cognizant of the contribution and overlap of related fields such as history, library science, information science, information technology, records management, and digital libraries

How well does the i-school model match current developments in archival studies programs? As noted, the i-schools and the a-schools share some of the same goals: a desire to differentiate themselves from the larger group, a potential for interdisciplinarity, a concern with the impact of technology on the field of study. One difference may be that archival studies, like library and information science, has largely maintained the link to the physical institution, while the i-school model suggests a broader perspective on function rather than form. Another is that the archival studies programs, while forming a cohesive and interactive group, have not been as concerned with identifying themselves as a unique entity in the broader community.

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New Directions for Information Science Education in the Networked Information Society
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The Development of LIS Education in Taiwan – A Case Study of National Taiwan University

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1. Introduction

The evolution of information network and information technology had changed our daily life and production pattern, and also caused a big influence on the LIS education. There are nine universities offering Library & Information Science in Taiwan's higher educational system[1], among them six for undergraduate program, seven for master degree program, one for Ph.D. program, and two for on job master program.

In this paper, we first introduce the LIS education of National Taiwan University, including the degree program from undergraduate to Ph.D., and the two curriculum program – knowledge management curriculum program and digital library curriculum program. Then we give a comprehensive point of view to see the overall LIS course development in Taiwan's six undergraduate programs. These analyses can give us a clear understanding of the changing and the developing of LIS education in Taiwan.

2. LIS Education of National Taiwan University

2.1 History

The Department and Graduate Institute of Library and Information Science of National Taiwan University (NTU-LIS) opened in the fall of 1961, with a class of 25 undergraduate students. The master's program was established in 1980, the doctoral program was subsequently added to the Graduate Institute in 1989, and the on job master's program was offered in 2003.

The original intention of the Department at beginning was to nurture the professionals to the librarianship. With the fast development of information technology, however, the user's information needs and the search strategies vary from day to day in the internet era. Therefore, the Department's teaching and research scope was expanded from library science to some related areas, such as information science, teaching technology, and knowledge management. In order to adapt these changes, the Development of Library Science was renamed as Library & Information Science in 1998 to continuously nurture the main forces for the librarianship and other different kinds of information service institutions. Moreover, for the purpose of increasing the continuous professional training channel and enhancing the abilities of higher library managerial personnel, the Department offered the on job Master program in 2003.

For over 40 years, the Department has educated individuals to work in libraries, information agencies, and other information professions. Academic excellence has been a hallmark of the Department since its founding.

2.2 Faculty

The NTU-LIS now has nine full-time and twelve part-time faculty. The faculty of the Department have made significant commitments and are dedicated to the following research and teaching areas: library and information science theory, audio-visual material production, cataloging and classification, reference services, user studies, network communications, and computer technology.

The faculty members of the Department have actively participated in research projects funded by the

[1] Nine universities in Taiwan offers LIS program: (1) Dept. Library & Information Science, National Taiwan University (B.A., M.A., Ph.D., on job M.A.); (2) Library Informatics program, Dept. Adult & Continuing Education (B.A.), and Graduate Institute of Library & Information Studies (M.A.), National Taiwan Normal University; (3) Graduate Institute of Library, Information & Archival Studies, National Chengchi University (M.A.); (4) Graduate Institute of Library & Information Science, National Chung Hsing University (M.A.); (5) Master Program of Digital Library, Degree Program of Electrical Engineering and Computer Science, National Chiao Tung University (On Job M.S.); (6) Dept. Library & Information Science, Fu Jen Catholic University (B.A., M.A.); (7) Dept. Information & Library Science, Tamkang University (B.A., M.A.); (8) Dept. Information & Communications, Shih Hsin University (B.A., M.A.); (9) Dept. Library & Information Science, Hsuan Chuang University (B.A.).

National Science Council, Ministry of Education, the National Bureau of Standard, and the Research Development and Evaluation Commission. The current research projects of the faculty particularly focus on information retrieval, digital library, bibliometrics control, and information-seeking behavior.

2.2 Degree Program

NTU-LIS is the only one in Taiwan currently offering continuous courses and degrees ranging from B.A. to Ph.D. The Department emphasizes both theory and practice in designing its courses that train the students to have a basic knowledge of library collection development, information organization, reader services, reader education in relation to traditional library services. At the same time, the Department also combines professional knowledge in related fields such as information science, psychology, sociology, mass communications, management, etc. to cultivate future information professionals. The required credits and rules related to the courses offered by NTU-LIS are as follows.

(1) Undergraduate program.
The primary objective of this program is to educate library and information science beginning professionals. To earn the B.A. degree, a student must obtain a minimum of 139 credits of course work, including 30 credits required by the University, 61 required (including 6 credits for the second foreign language) and 28 elective credits for the major subject specialty, and 20 elective credits from other departments.

(2) The M.A. degree program.
The master's program needs two to four years of study. Students must obtain 30 credits of course work with a passing grade of B in addition to 6 credits applied to thesis research and writing. Students also have to complete both a comprehensive examination in two specialized fields, and a master's thesis and oral examination.

(3) The on job M.A. degree program.
It needs two to six years of study. Students must obtain 24 credits of course work with a passing grade of B in addition to 6 credits applied to thesis research and writing. Students who do not have library & information science B.A. degree will have to complete three prerequisite courses.

(4) The Ph.D. program.
The program needs at least two years of study. Doctoral students who do not have library and information science degree will have to complete all M.A. programs' required courses (including their prerequisite courses, if any). To earn the Ph.D. degree, students must obtain 24 credits of course work with a passing grade of B in addition to 12 credits applied to dissertation research and writing, and publish at least two papers on major journals. A comprehensive examination, a dissertation proposal, and a thesis examination are also needed.

2.3 Knowledge Management Curriculum Program

Library & Information Science has been working on the acquisition, organization, storage, and dissemination of people's recorded knowledge for a long time. LIS professionals are specialized in managing information and knowledge. Consequently, we pay close attention to the development and education of knowledge management (KM). Since KM is a cross-disciplinary concept, people with mono education background are unable to maximize the function of KM. Because of this, NTU-LIS and other three departments — Department of Business Administration (NTU-BA), Department of Information Management (NTU-IM), and Department of Computer Science & Information Engineering (NTU-CSIE) — had worked together to propose a "Knowledge Management curriculum Program" with an aim to educate and train all-round knowledge management professionals.

The program was passed in the National Taiwan University's educational administration meeting in December 2000 and began to recruit students in September 2001. The curriculum is shown in Table 1.

In view of the interdisciplinary and versatile training for KM professionals, we designed the curriculum consisting of three domains: "Resource", "Management", and "System" and stipulated that students must take the core courses of each domain to establish essential concepts about knowledge management approached by different disciplines. It is our hope that other colleges and universities can draw up similar programs to educate skillful KM professionals, who will play the role of catalysts to improve Taiwan's competitiveness in the business world and other fields so to gain a "favorable terrain" (or winning edge) in the competitive era of knowledge economy.

2.4 Digital Library Curriculum Program

Since 1996, National Taiwan University began "NTU digital library and museum (DL/M) project," the digital library research projects – they included

Phase		Course	Mandatory or Selective	Credit
Fundamental		Introduction to Knowledge Management	M	2
Advanced	Resource Domain	Knowledge Organization	M	3
		Indexing and Abstracting	S	2
		Information Retrieval (from Library Science approach)	S	3
		Business Information Service (including Industry & Business Library)	S	3
	Management Domain	Organizational Behavior (including Organizational Learning)	M	3
		Human Resources Management	S	3
		Decision Support System	S	3
		Project Management	S	3
		Knowledge Economy	S	3
	System Domain	Knowledge Management Systems	M	3
		Advanced Knowledge Management Systems	S	3
		Artificial Intelligence	S	3
		Information Retrieval & Extraction (from Computer Science approach)	S	3
		Natural Language Processing	S	3
		Database Management	S	3
Practical		Special Topics in Knowledge Management	M	2

Table 1. The curriculum of NTU "Knowledge Management curriculum Program"

NSC/AS/NTU Digital Museum Initiative in 1998, NSC/AS National Archive Digitization Project in 2000, IDLP with US and China in 2001, NSC National Digital Archives Program (NDAP) from 2002 to 2006, CCA National Repository of Cultural Heritage from 2002 to 2007 – have provided million digitized cultural materials for education and public consumption. Furthermore, these research projects created a lot of technical and domain's "know-how" that needs to retain and educate to the followers.

In this context, Prof. Hsueh-hua Chen was sponsored by Ministry of Education Advisory Office to plan the "Digital Library curriculum Program" course framework. Now it is almost finished and will begin to recruit students in six universities in September 2006. The "digital library curriculum program" consists of three parts: fundamental courses (including applicational courses), advanced courses, and practical courses. The curriculum framework is shown in Fig. 1.

2.5 Achievements of Graduates

After graduating from the department, students can pursue further study of library & information science or of other domains, such communication, management, and information-related graduate schools. Students can also gain the qualification of officials to become professional librarians. Students who are interested in practical business can go to work as well.

Regardless of whether they are in the country or not, 30% of our graduates serve in libraries after graduation, the largest proportion among the alumni. Most of them work in university libraries. Those who work in the information, computer and electronics industries account for 10%, the second largest portion. Others may work in universities, the government, commercial organizations, the news media, financial and insurance corporations, schools, and so on. Indeed, this reveals that the range of the career choices of our graduates is wide and diverse.

3. The LIS Education in Taiwan

Library & Information Science studies the creation, sorting, managing, and transferring of information. The main abilities of the LIS professional personnel are to manage the whole life cycle of information – its origin, dissemination, acquisition, properties, classification, organization, storage, retrieval, interpretation and use – called ODAPCPSRIU (pronounced O-DAP-COS-RI-U)[2]. Therefore, we analyzed all the undergraduate LIS

[2] Charles Curran. "What do Librarians and Information Scientists do? They ODAPCOSRIU in the I&OEM." American Libraries (Jan. 2001): 56-58.

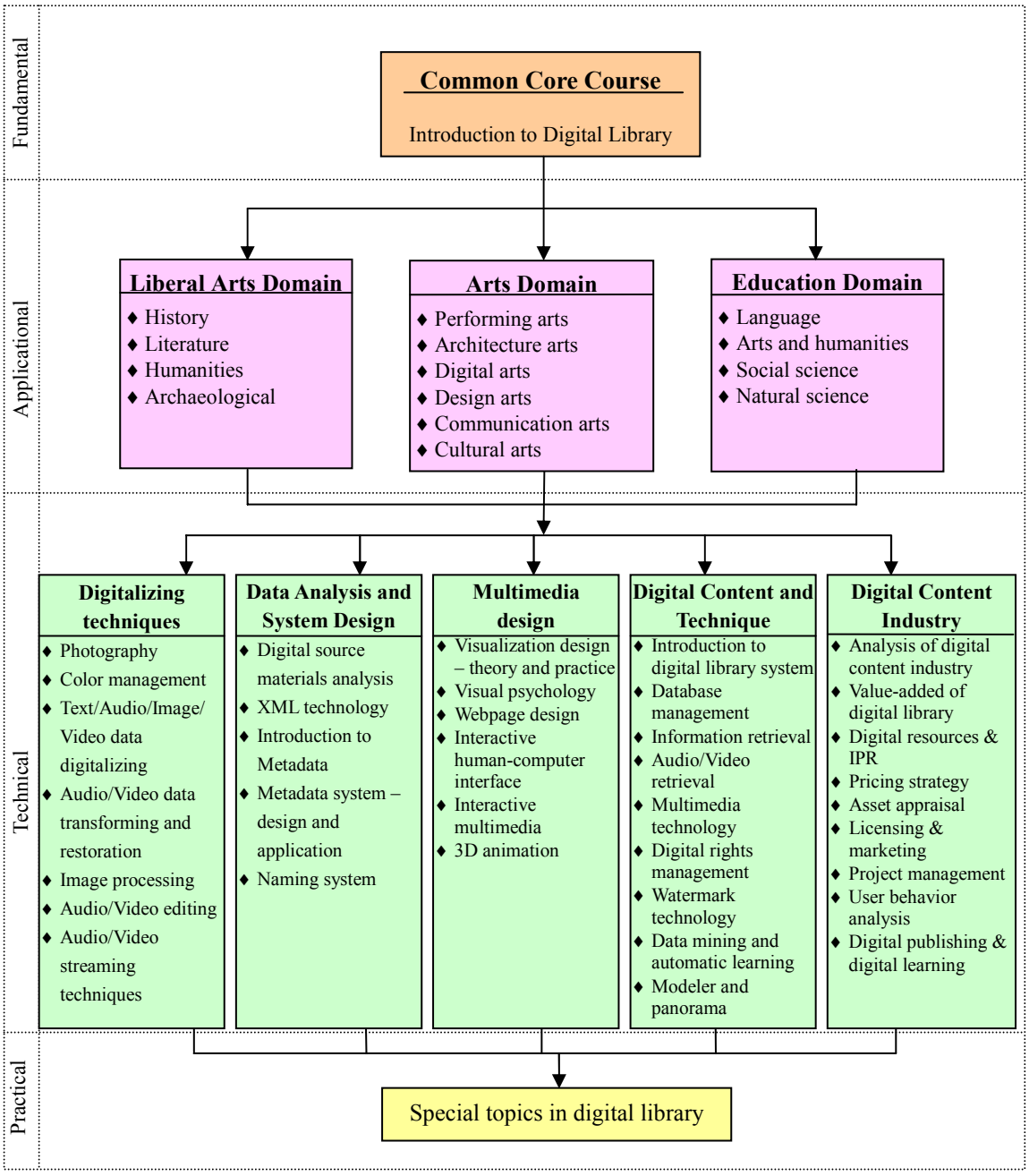

Figure 1. The curriculum framework of "Digital Library Curriculum Program"

professional courses of Taiwan's six university departments according to ODAPCPSRIU framework to review whether the training of our LIS education is sufficient for the needs. The course classification is presented in Table 2 and commented as follows:

1. From the "origin" part of information life cycle viewpoint, each department has opened mandatory courses about library science, information science, and computer science. Most departments have also opened Database systems and computer programming to enhance the students' information ability. We may note that most of the courses about the "origin" are just introductory, and lay stress on the information technology in comparison with library science.

2. In the "dissemination" part of information life cycle, all the departments have opened mandatory course about computer networks and communications. SHU, giving emphasis to

communication technology, has also opened "journalism", "communication and society" as the mandatory courses.

3. In the "acquisition" part, all the departments except SHU have opened "collection development" as mandatory course. However, the courses about the information "acquisition" in each department are too scanty to give further study for the students.

4. The number of the opened course about information "properties" is the most between all parts of information life cycle. They include the general reference resources, special resources in different academic topics, resource formats, users and libraries. Some departments also opened intellectual property rights and library laws related courses.

5. There are many courses provided for the "classification" and "organization" parts of information life cycle. In recent years, some departments have opened "subject analysis" and "information organization" instead of traditional "cataloging and classification" course. Moreover, since information technology has highly influenced the classification and organization methods, several departments have opened "data structures", "automatics indexing and abstracting", and some related courses to reflect these changes.

6. At the "storage" aspect, several departments has opened "introduction to media" as mandatory course and "archival management" as selective course.

7. In the "retrieval" part of information life cycle, most departments have opened "information retrieval" and "library automation" as mandatory course, and some departments have opened "information seeking behavior" as selective course to let the students have deeper understanding about users' information searching characteristics.

8. At the "interpretation" aspect, most departments have opened "reader services" or "reference services" as the mandatory courses. But SHU has not provided such course for the students.

9. In the final "Use" part of information life cycle, the departments have provided "library statistics", "information psychology", "system analysis" or "information seeking behavior" as mandatory or selective courses. In the last three parts of information life cycle –users' retrieval, interpretation and use – the departments seem to provide comparatively fewer choices to the students.

Table 2. Curriculum analysis of Taiwan LIS related undergraduate grogram—Using ODAPCPSRIU classification method

		LIS, NTU	LIS, NTNU	LIS, FJU	ILS, TKU	IC, SHU	LIS, HCU
Origin	(M)	♦ Introduction of Library Science ♦ Introduction to Computer Science ♦ Introduction to Information Science	♦ Introduction to Library Informatics ♦ Introduction to Computer Science ♦ Database Management System	♦ Introduction to Library and Information Science ♦ Introduction to Computer Science ♦ Database System ♦ Operation System	♦ Introduction to Library and Information Science ♦ Introduction to Computer Science ♦ Introduction to Technology Communication	♦ Introduction to esthetics ♦ Introduction to information ♦ Introduction to Information Systems ♦ Introduction to Database Systems	♦ Introduction to Library and Information Science ♦ Introduction to Computer Science ♦ Introduction to Database Management System
	(S)	♦ Planning and producing AV materials ♦ Computer Program Design ♦ Database Systems	♦ Publishing and Marketing	♦ Algorithms ♦ Library History	♦ Publishing and the Book Trade ♦ Electronic Publishing ♦ Photography ♦ Multi-media Technology and Application ♦ Digital Imaging and Animation	♦ Theory and practice of photography Chromatics ♦ System Analysis and Design ♦ Visual arts ♦ Digital image processing ♦ Digital video processing ♦ Computer Animation	♦ Library History ♦ Homepage Design ♦ Computer Programming ♦ Library Instruction ♦ Multimedia

		LIS, NTU	LIS, NTNU	LIS, FJU	ILS, TKU	IC, SHU	LIS, HCU
Dissemination	(M)	♦ Introduction to Communications ♦ Computer Networks and Communications	♦ Network Resources Application Techniques	♦ Introduction to Computer Networks	♦ Communication Technology and Library	♦ Communication and society ♦ Journalism ♦ communication ♦ Introduction to communication technology ♦ Computer Networks and Communications	♦ Computer Network and Communication
	(S)			♦ Building and Application of Scholarly communities		♦ Electronic Commerce ♦ Electronic publishing	♦ Network System Planning and Setting
Acquisition	(M)	♦ Collection Development	♦ Collection Development	♦ Collection Development	♦ Library Selection and Acquisitions	♦	♦ Collection Development
	(S)					♦ Collection Development	♦ Library Selection and Acquisitions
Properties	(M)	♦ Reference Resources ♦ Internet Resources ♦ Non-book Materials	♦ Reference Resources	♦ Reference Resources ♦ Network Resources	♦ Non-book Materials Management ♦ Literature of Humanities and Social Sciences ♦ Literature of Sciences and Technologies ♦ Network Resources and Applications	♦ Introduction to Intellectual Property Rights ♦ Introduction to Information Sources	♦ Chinese Reference Sources ♦ Western Reference Sources ♦ Literature of the Humanities ♦ Literature of the Social Sciences ♦ Public Libraries ♦ College and University Libraries
	(S)	♦ Introduction to Children's Books ♦ Law Materials ♦ Literature of the Social Sciences ♦ Reading and Library ♦ Literature of the Humanities ♦ Scientific and Technical Literature ♦ Business Information Services ♦ Library Information Law ♦ Public Libraries ♦ University Libraries ♦ Library Field Work	♦ Children and teenagers' books ♦ Resources of the Humanities ♦ Resources of the Social Science ♦ Resources of the Natural Science ♦ Resources of the Educational Science ♦ Resources of the Business information ♦ Introduction to Intellectual Property Rights ♦ Periodical Management	♦ Information Resources in Humanities ♦ Resources of the Social Science ♦ Business Information Service ♦ Health Sciences Information Service ♦ Public Libraries ♦ University Libraries	♦ Selection and Acquisition of Library Material ♦ Periodical Management ♦ College and University Libraries ♦ School Libraries ♦ Public Library ♦ Laws Library ♦ Children's Library ♦ Administration of Instructional Media Center ♦ Medical Libraries	♦ Reference resources	♦ Government Publication ♦ Serials Publishing and Management ♦ Literature of the Science ♦ Measurement and Evaluation of Library ♦ Children Literature ♦ Business Information Services ♦ Library and Information Law and Legislation
Classification	(M)	♦ Cataloging and Classification	♦ Subject Analysis	♦ Subject Analysis	♦ Cataloging and Classification	♦ Classification	♦ Chinese Classification and Cataloging ♦ Western Classification and Cataloging
	(S)	♦ Automatic Classification and Indexing		♦ Issues of Cataloging and Classification	♦ L.C. Classification	♦ Cataloging and Classification	

		LIS, NTU	LIS, NTNU	LIS, FJU	ILS, TKU	IC, SHU	LIS, HCU
Organization	(M)	♦ Information Organization ♦ The Study of Chinese Bibliography ♦ Cataloging and Classification ♦ Research Methods and Thesis Writing	♦ Book & Information Organization ♦ Indexing and Retrieval	♦ Information Organization ♦ Bibliography ♦ Object-oriented Programming	♦ Cataloging and Classification ♦ Indexing and Abstracting ♦ Chinese Bibliography	♦ Knowledge Organization	♦ Bibliography
	(S)	♦ Data Structures ♦ Automatic Indexing and Abstracting ♦ Automatic Classification and Indexing ♦ The Study of Western Bibliography	♦ Data Structures ♦ Bibliography ♦ Knowledge Management	♦ Data Structures ♦ Issues of Cataloging and Classification	♦ The Study of Chinese Bibliography	♦ Cataloging and Classification ♦ Indexing and Abstracting ♦ Special topic of information value-added and service ♦ Knowledge management	♦ Indexing and Abstracting
Storage	(M)		♦ Introduction to Media	♦ Introduction to Media		♦ Introduction to digital media	♦ Introduction to Media ♦ Information Storage and Retrieval
	(S)	♦ Archival Management	♦ Archival Management		♦ Archival Management ♦ Information Storage and Retrieval	♦ Archival management	♦ Archival Management
Retrieval	(M)	♦ Information Retrieval ♦ Library Automation	♦ Indexing and Retrieval	♦ Database Retrieval ♦ Library Information System	♦ Library Automation	♦ Introduction to information services ♦ Introduction to Information Retrieval ♦ Library Automation	♦ Information Storage and Retrieval ♦ Internet Resources Retrieval & Application ♦ Library Automation and Information System
	(S)	♦ Information Seeking Behavior	♦ Information needs and Seeking Behavior	♦ Information Seeking Behavior	♦ Information Storage and Retrieval ♦ Computer Application in Library	♦ Information Seeking Behavior	♦ Information Seeking Behavior
Interpretation	(M)	♦ Interpersonal Communication and Reader Services ♦ Reference Services ♦ Library Management	♦ Reference Services ♦ Library Management	♦ Reader Services ♦ Library Management	♦ Library Management		♦ Reader Services and Reference Services ♦ Selected Readings on Library Science ♦ Library Management
	(S)			♦ Library Media Services ♦ Cognitive Psychology	♦ Information Centers and Services		
Use	(M)	♦ Library Statistics	♦ Information Psychology		♦ Statistics		
	(S)	♦ Information Psychology ♦ Library Marketing ♦ Information Seeking Behavior	♦ Information needs and Seeking Behavior	♦ Systems Analysis ♦ Information Seeking Behavior ♦ Cognitive Psychology	♦ Information Psychology ♦ Library Operation Evaluation	♦ Information Seeking Behaviors	♦ Library Statistics ♦ System Analysis ♦ Library Marketing ♦ Information Seeking Behavior

Students who possess the professional knowledge and ability of Library & Information Science not merely suit to work in the substantial library but also contribute to more other working places, such as information developing center, media center, special library, knowledge management department, and other business units. We found that the Taiwan's LIS education have recognized these fast changes of outer world, tried to modify the mandatory and selective courses of the degree program, and combined the LIS with other academic domains to develop different kinds of curriculum programs to enlarge the LIS application. They include:

1. As mentioned above, NTU-LIS, NTU-BA, NTU-IM, and NTU-CSIE have proposed a "knowledge management curriculum program," and begun to recruit students in September 2001.

2. Because The Department of Library and Information Science of Shih Hsin University (SHU-LIS) is under the College of Journalism and Communications, it was renamed to Department of Information & Communications (SHU-IC) in 2001.

3. FJU-LIS has combined with the Department of Chinese (FJU-CH), the Department of History (FJU-HIS), and the Department of Philosophy (FJU-PHI) to open the "Chinese ancient books management curriculum program" in September 2002.

4. Degree Program of Electrical Engineering and Computer Science of National Chiao Tung University was opened on-job master program of "Digital Library" in September 2002.

5. Prof. Hsueh-hua Chen has invited ten professors of seven universities to meet together planning the "Digital Library curriculum Program" that is sponsored by Ministry of Education Advisory Office. In September 2006, this curriculum program will begin to recruit students in six universities.

4. Conclusion

As reviewing the undergraduate courses provided by the six universities, we found that the mandatory courses were similar, and the opened selective courses were limited to the teachers' professional specialty. In addition to the SHU that has transformed to information & communications, each department has no significant characteristics. The Taiwan's LIS education should rethink its goal, focus the target market, and plan more competitive programs for the students.

New Directions for Information Science Education in the Networked Information Society
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The New Directions for LIS Education in Korea at the Age of the Networked Knowledge Society

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1. Introduction

Fifty years have passed since the Department of Library Science was established for the first time in Korea by the US Education Missionary of Peabody at Yonsei University. During the last fifty years, the library science education has changed dramatically in terms of quantity and quality. Quantity indicates the number of the departments of Library and Information Science (LIS), the number of students, the number of librarians, and the number of Master and Ph.D programs, all of which have increased at an extremely rapid rate. Quality implies the adjustment of term 'Library Science' to 'Library and Information Science' and the change of the curriculum and education of LIS to adapt in this age of distributed intelligence. This paper will present an analysis of the current status of LIS education and suggest future directions for LIS education in Korea at the age of the networked knowledge society.

2. Analysis of the current status of LIS education

As of the year 2006, there are thirty two LIS departments in universities and seven LIS departments in junior colleges in Korea. Twenty four LIS departments have the master program while eleven LIS departments have the Ph. D program, and sixteen LIS departments have the master program for librarian education (for school libraries) in graduate schools of Education among 32 departments. It is significant to review in which colleges the LIS department has been included within a university. Originally, the LIS department was included in the college of humanities, then moved to the college of social science, and subsequently to the college of information science within the last 10 years in order to adapt to the era of digital environment. This shows that LIS education in Korea has been greatly affected by information and communication technology (ICT), and consequently it has raised issues on which area of study LIS belongs to. However, most professors in the LIS department in Korea do not have technology-oriented educational background but a humanity-oriented educational background.

Let us analyze the curriculum in terms of the LIS major study. The LIS curriculum has changed and developed continuously to reflect ICT and distributed intelligence. Since 1995, university education system in Korea has transformed from a department-oriented system to a division-oriented system (grouping related departments as a division). It indicates that if any student took 36 credit hours (12 courses) in the LIS department, he or she can receive a B.A. degree in LIS studies.

The LIS curriculum can be divided into the following groups: information organization, reference service, library administration and management, information science, bibliography, and archive. These groups reflect various fields of LIS such as library science, information science, bibliography, and archive. As ICT has come to enable technology in the age of networked knowledge society, the number of reference service and information science related courses has increased, but the number of courses in other areas decreased gradually. It demonstrates that information science related courses, such as programming language, Internet information processing, information network, information retrieval, data base management system, library automation, and digital library became more significant than other courses; this trend will continue in the future to keep up with the changing roles of librarians in the age of networked knowledge society. Archive related courses such as government document, archive management, preservation and maintenance, archive evaluation, and information media have also appeared since the Korean government made the law of pubic document management in 1999.

We have realized that the current LIS education in Korea is in crisis in terms of ICT and of the identity and

deficiency of professors who specialized in ICT. Moreover, our curriculums are still concentrating on library-oriented courses, and the library-related occupations are still one of the major job markets in Korea. Therefore, there is a great need for developing a new model of LIS education in Korea towards the direction of becoming competent in digital content processing technology which will maximize practical use of technology at this current age of distributed intelligence.

3. New directions for LIS education in Korea

The target materials to be studied in the LIS education are data, information, and knowledge. As the definition and difference between the terms are not clear, we often use these terms interchangeably. Theoretically, data can be obtained and measured from observations or experiments while information can be acquired through analysis of the data, and knowledge can be extracted through understanding of the information. As data, information and knowledge increase exponentially, it is impossible to handle and process these materials manually. Therefore, the new direction for LIS education in Korea is to focus on the automatic processing of data, information and knowledge. The automatic processing means that a machine or an agent can extract meanings of contents, classify them into semantically related topics, browse and display the retrieved results by semantic relationship on query. Hence, automatic processing is very closely related to semantic technologies such as semantic web, OWL and RDF, ontologies, web services, data integration, semantic modeling, knowledge capture, ontology engineering, semantic brokers, and so on. WWW is one type of digital libraries, and information on the Web is not for machines but rather for humans. This is the reason why Sir Tim Berners-Lee has proposed the Semantic Web, and W3C is developing various standards related to semantic processing on the Web, such as RDF, RDF(S), OWL , and SWRL.

In our time of distributed intelligence, it is essential to process the materials in automatic methods. The machines or agents should understand the semantics including syntax and structure of these materials. As the target materials are highly distributed and heterogeneous on Internet, Intranets or libraries and on other media, the integration of the materials still remains as a barrier to be overcome in the near future. We have to consider how to solve this barrier in the curriculum of the new LIS education system.

To solve semantic problems and to integrate distributed and heterogeneous digital contents, it is necessary to design information architecture to process by machine. It is a similar notion as in architecture as architects make preliminary drawings and design proposals to build bridges, houses, and other types of building. LIS curriculum should include semantic processing related courses such as technology of information structuring, information modeling, semantic web technology and ontology, as well as the information integration related courses such as information reasoning, metadata and XML technology, and knowledge representation and visualization.

When LIS students graduate from universities, they receive the Certification of Librarian by the law in Korea. The certification is necessary for job qualification in all the libraries in Korea. Consequently, the library-oriented courses, such as cataloging and classification, reference services, bibliography, library administration and management, are also significant in order to receive the certification. Furthermore, the preservation and archive related courses must be reflected in the LIS curriculum because these are the new emerging fields of study in this present era of networked knowledge society. It is important to consider how we can balance these emerging fields in the LIS curriculum.

Eventually in the future, data, information and knowledge will be converged into digital contents, and these digital contents will be used at any time, any place and by any device. Ubiquitous society, pervasive computing and ambient culture will be within our sights. Therefore, professors and students in the LIS department need to take charge of these fast changing information and environments, concentrating on how the LIS education and curriculum can follow and reflect these changes as the new directions for the LIS education.

4. Conclusion

As mentioned before, we are in the age of distributed intelligence or networked knowledge society. Most of data, information and knowledge are born digitally or through printed materials converted into digital form. These resources need to be transformed from human-readable digital resources to machine-understandable and machine-processable digital resources for automatic processing. Therefore, integration and interoperability between heterogeneous information need to go across systems, media, and communities of interest. Therefore, the LIS education and curriculum is obliged to reflect the demand for automatic processing of digital resources.

As physical boundaries between information media and various nations are no longer significant in the future, suitable international collaborations in the LIS

education will be a vital means for the new directions of LIS education. For this reason, I would like to propose an organization that incorporates LIS departments in the Asia-Pacific and that promotes collaboration, communication and various types of exchange in experiences, curriculum, students and professors.

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New Directions for Information Science Education in the Networked Information Society
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Developments in Information Science Education at the School of Communication of Information, Nanyang Technological University, Singapore

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This paper provides an update of information science education at Nanyang Technological University through its Master of Science programme in Information Studies (IS). The program, which started in 1993, has undergone four curriculum revisions to keep it abreast with the demands of IS which is facing constant changes as a result of rapid evolution of Internet and multimedia technologies, pervasive and exponential growth and use of digital information on the Web, and the demands to equip IS graduates with increasingly diverse interdisciplinary skills to function effectively in today's information landscape. The paper also outlines typical challenges faced and explores some ideas and trends that are likely to prevail in IS education in a networked information society of today and the future.

INTRODUCTION

Established in 1993, the Division of Information Studies (hereafter referred to as the "Division") has seen the substantive growth from a modest pioneer intake of 22 students in 1993 for its flagship part time Master of Science programme in Information Studies (MSc(IS)) to an annual intake of around 215 full time and part time students in her current offering of three Master of Science programmes in Information Studies, Knowledge Management (MSc(KM) - introduced in 2002), and Information Systems (MSIS - introduced in 2005).

The Division originated from the School of Applied Science that was established in 1998. The School was subsequently re-organized into two schools with the Division being part of the new School of Computer Engineering in 2000. The Division was subsequently incorporated into the School of Communication Studies in 2001 as part of a university restructuring exercise. The School subsequently changed its name to the School of Communication and Information in 2002.

The original programme in 1993 is part of a concerted effort to spearhead the Singapore economy into the information age and is therefore a part of the "manpower infrastructure" development programme to transform Singapore into an Intelligent Island. The programme complements the last 15-year emphasis on the technological infrastructure in Singapore by concentrating on the information content and its organisation, storage and retrieval, and the delivery and management of user-oriented information products, systems and services. The 1993 curriculum attempted to provide a generic degree enabling graduates to work in a wide range of information intensive environments but more specifically in a library environment, albeit a fast changing library environment. Specifically, it was the *de-facto* programme to prepare professional librarians for the transformation of the Singapore library system through the formation of a new statutory board, National Library Board of Singapore as outlined in the *Library 2000 Report* (1994). Since the inception of the programme, an estimated total of 750 MSc(IS) graduates have been trained.

The evolving information and knowledge-based economy, with an increasing emphasis on the important roles of information and knowledge, resulted in a situation of constant change that posed a significant challenge to educators to ensure that the curriculum and training is constantly reviewed, and kept abreast of developments and needs of the industry. In a span of a decade or so from 1993 to 2004, the information studies (IS) curriculum at Nanyang Technological University (NTU) has undergone four revisions, including a significant one in 2000.

This paper outlines the key developments and changes in the IS curriculum from its conception to date, identifies some challenges faced and solutions adopted by the Division, and finally, trends and possibilities for the future.

INFORMATIONS STUDIES CURRICULUM: 1994 - 2006

Key Curriculum Developments

Table 1 shows a summary of the evolution of the IS curriculum since its introduction in 1993. Appendices 1 to 5 outline the curriculum structure over the years. As can be seen, the curriculum has constantly evolved to meet the changing environment and needs of industry. Commencing from a more structured and highly prescribed 6 core and 2 elective subjects plus dissertation in the beginning, the first curriculum revision in 1998 introduced flexibility by changing this mix to 4 core and 4 elective subjects plus dissertation.

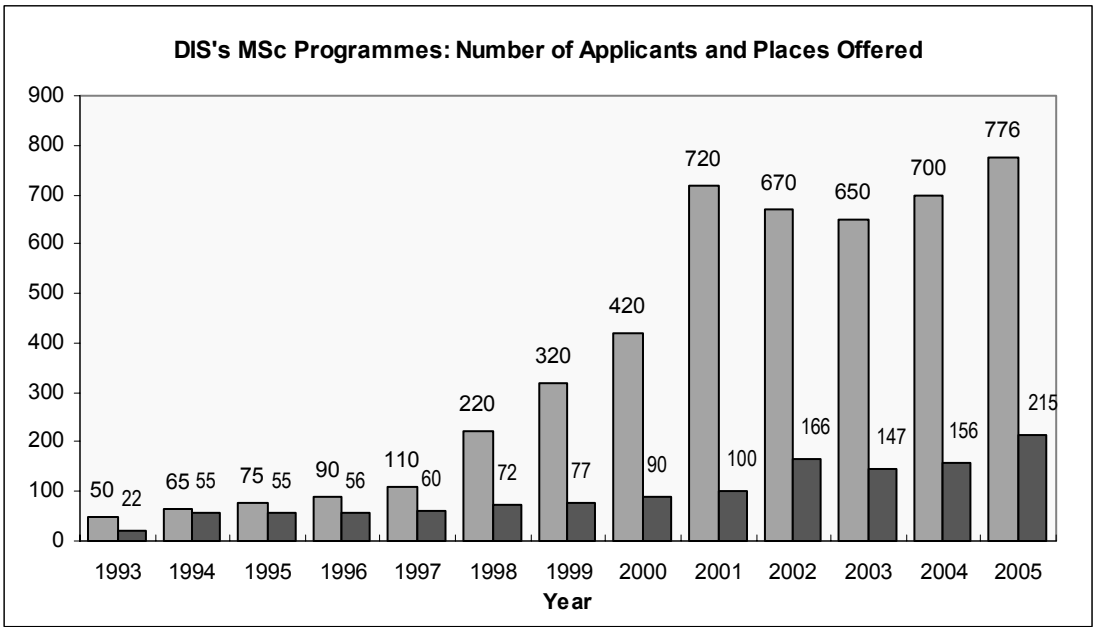
The 2000 revision was a major one that changed the existing two-tier structure into a three-tier structure of foundation, basic competency and specialized subjects, and the introduction of an additional subject as a new requirement. With an expanded range of revised and new subjects, areas of concentration with specialization were also introduced to help streamline students into areas of different vocation where they can opt to select. This is to ensure that students in these areas are given a collective mix of related subjects to enable them to function effectively upon graduation in their respective vocations. Technology and its application were also further integrated in all the subjects in the curriculum. It is noted that some of these areas of concentrations are stand-alone Masters programmes in other parts of the world. The small demand of placements in Singapore and the limited manpower resources in the Division necessitate this form of offering at that point in time, whilst attempting to serve the various information industries.

The subsequent 2002 revision attempted to better streamline the areas of concentrations to better focus and serve the needs of these industries that are now better identified and cultivated.

Table 1. Evolution of NTU MSc(IS) Curriculum since 1994

Year	Key Features	Remarks
1994	• Two tier structure with **6** core subjects and **2** elective subjects (chosen from a list of elective subjects) plus **Dissertation** • Total number of Academic Units (AUs) = **30** (equivalent to 30 credit hours)	➢ Original curriculum designed to primarily train library professionals for Singapore ➢ Majority of subjects are prescribed with limited choice of electives by students
1998	• Two tier structure with **4** core subjects and **4** elective subjects (chosen from a list of expanded elective subjects) plus **Dissertation** • Total number of AUs = **30** (unchanged)	➢ Revision of current subjects and introduction of IT subjects and orientation to cater to developments in Internet (search engines) and Web (hypertext) technologies. ➢ Reduced core subject requirements and expanded elective choices for students ➢ Electives allow specialization in three major areas of (1) Information products and systems development; (2) Information service management; and (3) Knowledge management in corporate organizations. ➢ More emphasis placed in the electronic environment for information seeking and use (products and services)
2000	• Three tier structure with **3** core subjects, **2** electives (Group A) and **4** electives (Group B) (chosen from a list of elective subjects) plus **Dissertation** • Total number of AUs = **33** (increased by 3 AUs from 1998)	➢ Significant revision to introduce a new 3 tier structure of foundation subjects, basic competency subjects and specialization subjects ➢ Introduction of new policy to allow electives (Group B) to be chosen from other Masters programmes at NTU. ➢ Additional subject to keep abreast with international 33 credit hours for IS curricula. ➢ Introduction of two major areas of concentration: ***Information Management and Systems*** (where students can specialize in Internet and multimedia

		based information systems, Information systems and product development, Document and records management, and Knowledge management), and ***Library and Information Services*** (where students can specialize in Public libraries, Academic libraries, School libraries and media resources, and Corporate information services). For each area and specialization, students are guided with a choice of prescribed electives (Groups A and B).
2002	• No change in curriculum structure or AUs – maintenance of a three tier structure with **3** core subjects, **2** electives (Group A) and **4** electives (Group B) (chosen from a list of elective subjects) plus **Dissertation,** and **33** AUs.	➢ Curriculum streamlined in terms of subject offerings. ➢ Revamped areas of concentration to provide better focus and training. A total of five areas of concentration are offered: **Archival informatics**, **Information management**, **Information systems, Library and information science** (LIS), and **School media resource management**. As before, for each area of concentration, students are guided with a choice of prescribed electives (Groups A and B). ➢ The Division introduced a new part time MSc programme in Knowledge Management (which was spawned from the 1998 knowledge management specialization). The MSc(KM) program is also one of the pioneer programmes in KM education in the world.
2004	• No change in curriculum structure but with introduction of Coursework and Dissertation option, and Coursework Only option. For the latter, students do another 2 electives (Group B) in lieu of Dissertation including a compulsory subject *Critical Inquiry in Information Studies*. • Total number of AUs remained at 33.	➢ Minor revamp in subject offerings. A new subject *Professional Seminar* is offered in place of *Information Users & Society.* A new subject *"Critical Inquiry in Information Studies"* is offered to cater to the coursework only option. ➢ No change to the five areas of concentration.
2005		➢ The Division introduced a new part time MSc programme in Information Systems (MSIS - which was spawned from the 1998 and 2002 information systems specialization). The program is jointly offered with the School of Computer Engineering, NTU.
2006	?	➢ The Division is working on the introduction of a new undergraduate programme in Information Studies in future ➢ The Division intends to offer the full time programme for both MSc(KM) and MSIS in the near future. ➢ Cross listing of subjects in the IS curriculum with other Masters curriculum (such as MSc(KM) and MSIS) to encourage students to broaden their scope of learning and take subjects of relevance to their needs across the university.



Note: MSc(IS) offered since 1993. It is available in both part time and full time basis.
MSc(KM) introduced in 2002 on a part time basis
MSIS introduced in 2005 on a part time basis.

Figure 1. DIS MSc Programmes: Number of Applicants and Places Offered

Student Intakes and Growth

The intake for the MSc(IS) started with modest rises in the formative years of the programme but gathered momentum with the substantial growth from 1998 to 2001 as shown in Figure 1. The highest number of applications peaked in 2001 with 720 applicants vying for the 100 places that were offered that year. It is likely that the 2000 curriculum revision and active marketing of it played an important contributory role in achieving this renewed interest in the programme. This intake number of 100 for IS students was increased by 10% in 2002 and thereafter and capped at the new level of around 110 subsequently, while the two new Masters programmes in Knowledge Management and Information Systems were introduced in 2002 and 2005 respectively. The Knowledge Managment programme has an annual intake that average 45 part time students, and the Information System programme started with a first intake of 46 part time students. In the last NTU academic year commencing in July 2005, there was a total of 776 applicants, with 215 places being offered (114 for Information Studies, 55 for Knowledge Management and 46 for Information Systems). There are plans to introduce full time programmes for Knowledge Management and Information Systems in the near future.

Some Challenges

Appended in this section are some challenges in IS education noted over the years. They are by no means exhaustive and some are probably similar and experienced by other institutions as well.

Typical information science education departments are small. This is also true of NTU. The Division started in 1993 with 1 Masters programme, 6 full time faculty, 2 support staff and 22 students. Now, it has 3 Masters programmes, an annual intake of 215 students, and about 350 active students at any one time. This is a result of the 3 Masters programmes that are offered on a two-year part time basis. This work is currently managed by 13 full time faculty, 2 adjunct faculty, around 10 part time lecturers on a semester basis, and 4 support staff, including a Graduate Programmes Manager. Even with these numbers, it has always been a challenge to carefully plan the subject offerings every semester and ensure that as many subjects are feasibility offered according to the curriculum structure.

The full time faculty workload is heavy, with each faculty typically teaching two subjects per semester. Besides teaching, there is substantial work associated with dissertation supervision and faculty's own

research. On top of that, faculty is often involved with institutional building activities (or administrative duties) and other Division and School initiatives. The appointment of adjunct faculty and part time lecturers were both strategic and necessary. Such staff provided much of the industrial experience to make the subjects more relevant and form part of the manpower resource management to support the programmes. They would have a minimum of a Masters degree and worked for several years in the relevant area prior to being appointed. They may also be involved with co-supervision of students' dissertations with full time faculty. Full time faculty acts as "buddies" to these staff when they first join the Division, and would co-teach with them for at least one semester before they manage the classes on their own.

Likewise, the introduction of the coursework-only option in the 2004 revision is strategic and aligns with some other existing IS programs. Students are now able to opt for this option and replace Dissertation (Project) with two other subjects. One of these subjects, namely, "Critical Inquiry in Information Studies", is compulsory and the other can be chosen from the list of electives. This subject can be thought of as a variation of the Dissertation (Project) but with more instructional and time structure, and done in a group. In this subject, students are given an overview of how to design and conduct a simple research study (project) for practical application on a selected topic in the areas of information services and systems. It covers study design, preparation of proposals, intellectual property and ethics. Students are introduced to the main types of research methods, with a more in-depth examination of a few useful methods, to address information service/system problems. The introduction of this option has provided more flexibility to students, better matches their academic ability and interests, and at the same time, helped reduce faculty dissertation supervision workload.

Learning with the aid of new technology has brought about another challenge. Many educational institutions are using education tools in the form of e-learning in course delivery. Kumar (2004) argued that online teaching and learning would become more effective through incorporating multimodality in content delivery which involves presentation of information in different modes of representation (e.g. visual, textual, audio). Multimodal presentations are known to stimulate and utilize the whole human brain (Thomas, Kellogg & Erickson, 2001) allowing more opportunities for erudition, creativity and the generation of ideas. We now see a trend from lecturer-centered to student-centered learning approaches (Stansfield, McLellan & Connolly, 2004). With the lecturer's role becoming that of a facilitator in the learning process, students actively participate and contribute to their own learning (Lee & Tan, 2004). As a result, students view things differently, more critically and creatively (Pan, 1999). The characteristics and attributes of online learning make it an ideal learning mode that can complement traditional learning modes. In this respect, the Division has been using NTU's Blackboard e-education environment since its introduction in 2000 to support delivery and management of courses. In a short span of time of 4 to 5 years since its introduction, NTU has witnessed quantum growth in the adoption of e-learning with over 90% of the courses heavily using it (Lee & Tan, 2004).

Known as *edveNTUre,* this customized environment is used by faculty to allow dynamic content to be delivered digitally through the University wired and wireless networks to all students anytime, anywhere on a variety of devices. It complements the traditional lectures through several e-learning tools including discussion forums for collaborative knowledge sharing, personalized learning, dynamic content delivery and other automated teaching tools, including a plug-in tool to detect plagiarism in students' work. As such, a multimodal approach, comprising face-to-face instruction and the use of e-learning tools for content delivery and collaboration, has been adopted for teaching courses in the IS curriculum. This has posed a challenge to less IT savvy faculty resulting in spectrum of differing adoption time and facilities offered by the new environment. Nonetheless, these systems are constantly being improved and made more user-friendly so that we can expect the learning time to be reduced, and the tool to be used more productively and effectively to enhance the educational experience and learning by students.

Differing class sizes continue to pose a challenge to faculty resource management and teaching assignments. Due to the structure of the curriculum that encompasses both core and elective subjects, class sizes can range from the whole cohort of 110 students for core subjects to as few as 10 students or lower for specialized elective subjects. In the academic year of 2005, the Division offered a total of 34 subjects across two different semesters. This number of subjects excludes those offered in the Knowledge Management and Information Systems programmes. While small classes are typically cancelled if they fall below a threshold value, some of these are still conducted on an exception basis since these are still needed to support the key courses in the various areas of concentrations. A solution that the Division is currently exploring to overcome this challenge is to form strategic alliances and partnerships with other IS educational institutions

to support the conduct of small classes through the use of online learning or short term faculty exchanges. The earlier is probably more practical for courses that are non-laboratory based.

TRENDS AND FUTURE POSSIBILITIES

Students and industries will continue to expect and demand more. Existing technologies will continue to evolve and improve and new technologies will emerge that have the potential to change the education landscape further. In such a climate of constant change, IS educators are in for an exciting future. We share some ideas in this section and envisage a number of possibilities.

An even more broad-based interdisciplinary programme will be demanded in future. Market forces will dictate flexibility to allow students (our customers) to tailor a curriculum of their choice to meet their needs, so that the traditional structured curriculum will subsequently have to co-exist with a student customized one. At a recent strategic retreat of the National Library Board of Singapore (in which the author is a Board Member), it became clear that there will be future demands for hybrid digital librarians who have skills that covers areas of library and information science, digital media and technologies, information systems and knowledge management. An opportunity presents itself to the Division to offer a new generic Master of Science programme in Information where students can customize their curriculum from the existing 3 Masters programmes that are currently now on offer.

A networked information society presents natural opportunities for virtual collaboration, and opens up many avenues of potential cooperation for educational institutions to leverage on individual strengths, and to make collective resources available for students across such collaborative possibilities. The Division is already working with a number of partner institutions in United States, New Zealand, Mauritius and Thailand to explore avenues of cooperation in online learning, joint degree programs and other forms of educational training and exchanges. As with the formation of consortia among the library communities, consortia among universities and IS schools will emerge and grow. A current example of such a collaborative network is Universitas 21. Established in 1997, Universitas 21 currently has 18 member universities from 10 countries. Its purpose is to "acilitate collaboration and cooperation between these universities and to create entrepreneurial opportunities for them on a scale that none of them would be able to achieve operating independently or through traditional bilateral alliances" (http://www.universitas21.com/). Among its many objectives, three are of particular relevance to the context of this paper. First is the facilitation of a framework within which the transfer of information, good practice and expertise contributes to programmes of institutional self-improvement. Second is the encouragement of individual member universities to internationalise the student experience and facilitation of collaborative efforts to support this aspiration. Third is in the form of collaboration in leading global e-learning operations.

Another area of development to monitor and engage in is the evolution of new e-learning initiatives. In NTU itself, new features are constantly being introduced to 'humanize' *edveNTUre* by making the e-learning more interesting, interactive and engaging for the students. Here, the goal is to add more human elements for effective "high tech – high touch" delivery of online contents (Lee, Tan & Goh, 2005). Some of the recent e-learning initiatives introduced by the NTU include the following (Majid, Foo & Chaudhry, 2005):

- **Distance Education:** NTU is seriously considering implementing distance education for certain academic programmes. It currently houses a highly interactive state-of-the-art distance learning facility known as the Smart Classroom with facilities for high-end video conferencing and a suite of collaborative tools. This facility has been successfully used in NTU to support the distance learning SMA (Singapore-MIT Alliance) programme in conjunction with the National University of Singapore (NUS) and the Massachusetts Institute of Technology (MIT) (refer to http://web.mit.edu/SMA/ for more information). The Division is currently exploring with the University of Mauritius and other universities in the Asia-Pacific region to offer selected courses in the Masters program via its distance education facilities. While distance learning is nothing new but an established and accepted mode of learning in many countries, it is still at the infancy stage in Singapore due to its small land area that have resulted in traditional face-to-face instruction in almost all institutions.

- **PresseNTUr:** This facility allows faculty to interlace a video presentation and synchronize it with a set of presentation slides. It enables faculty to quickly and easily create their teaching contents either by using a talking head or their own face through using a digital camera. The end result is an interactive digital media product. The utilization of the product is entirely in the control of students who can vary the pace and replay sections so as to

tailor to their own learning preferences and abilities. Another advantage of this system is the live delivery of presentations onto PDAs which students can view on the campus or anywhere through the Internet.

- **Breeze:** This Macromedia content creation tool allows converting PowerPoint slides into a low bandwidth format of the Macromedia Flash animation. It also allows voice narration to be synchronized with the PowerPoint slide delivery.

- **Reusable Learning Objects (RLOs):** The Centre for Educational Development in NTU in collaboration with the School of Communication and Information is in the process of implementing a taxonomy system aimed at building a better course management system. This system will enable staff to deposit learning objects in a repository organized to facilitate use and reuse for constructing lessons, presentations, and other documents. This system is expected to improve the use, reuse, and profuse of learning objects. Research is also being actively pursued by the Division's faculty in this research area of RLOs. It is currently developing a prototype reusable learning objects management system known as ReLOMS to address the problem of usability and reusability of learning objects in e-learning systems (Theng et. al., 2006).

CONCLUSIONS

An update of IS education at the School of Communication and Information is given in terms of curriculum revisions, challenges faced, trends and possibilities for the future. Improvements and innovations in technologies, industry needs and more sophisticated and demanding students' and employers' expectations will no doubt keep IS educators on their toes, propelling them to explore new ventures and create new opportunities and solutions to this gradually shrinking networked world. The key to continued success hinges on being proactive, and constantly adapting, collaborating and innovating.

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Discerning the Future of Information Science Education Through Community Networking Research

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Background and aim

The presentation begins with an overview of library and information studies education in Australia as reflected in accreditation processes for library schools by the Australian Library and Information Association – ALIA (http://www.alia.org.au/education). It then considers a range of community-oriented research projects based at one of Australia's university-based information science schools, that of Monash University, to discern emerging trends that may have relevance to the future of LIS education, and suggest what implications these may have for the ALIA and similar bodies of knowledge for LIS professional education, and the curricula that embody these.

The research projects cited have been conducted in conjunction with a range of partners by two research groups at Monash University:

- Centre for Community Networking Research - CCNR (www.ccnr.net), and
- Information and Telecommunication Needs Research Group - ITNR (www.sims.monash.edu.au/research/itnr).

'Communities' as conceptualised in the work of CCNR and ITNR include local and virtual communities, communities of knowledge and memory, and communities of practice. Research projects referenced in the paper fall into the following clusters:

- Collaborative technologies and e-research
- User-centred design and the knowledge commons
- Social network analysis and community-based organizations
- Community knowledge, civil society and e-democracy.

Research projects analysed

Cluster 1: Collaborative technologies and e-research. Two major, linked research and development projects based at Monash University are the focus of this theme. The ARROW project (Australian Research Repositories Online to the World) identifies and tests 'software or solutions to support best practice institutional digital repositories comprising e-prints, digital theses and electronic publishing' (http://arrow.edu.au). The closely related DART project (Dataset Acquisition Accessability & Annotation e-Research Technologies) deals with the integration of digital repository technology into the day-to-day practice of research communities – local or global - helping them create, capture, organize, use and share often vast quantities research data (http://www.dart.edu.au).

Cluster 2: User-centred design and the knowledge commons. Under consideration in this cluster of research projects are how the concepts of user-centred design and the knowledge commons affect future planning for libraries, museums and public broadcasters, and the communities they serve. For the library sector specific studies deal with challenges for public libraries presented by the aging the 'baby boomer' generation of public library users; and the repositioning of tertiary education libraries as more active elements in the public knowledge commons. Some of this work includes comparative study of Australia and Singapore.

Cluster 3: Social network analysis and community-based organizations. In concert with the international Community Informatics Research Network – CIRN (http://www.ciresearch.net), which Monash University helped to found, there is a strong focus on the uptake of information technology by local communities. This cluster of projects includes:

Neighbourhood Houses (local venues for informal education and personal support); rural community based organisations (comparison of Australia and Italy), and collaboration between small business, community-based organisations, local government, and universities for ICT capacity building in outer-suburban regions.

Cluster 4: Community knowledge, civil society and e-democracy. This cluster of research projects has considerable cross-over with the previous three in that they focus on the creation and sharing of knowledge and memory by communities as an essential foundation of personal and civic freedom. Much of this work, including two national consultations with Australian civil society, has been undertaken as input to the successive UN/ITU World Summits on the Information Society and to the development of Australian government policy on the information economy. Also included here are projects in e-culture: specifically the 'Trust and Technology' project dealing with Australian Indigenous Oral Knowledge in relation to archival institutions, and the development of VICNET, the civic Network of the state of Victoria. Other projects in this cluster relate to the development of Vietnam as a knowledge economy; domain-naming and power relations in Internet governance; and international e-commerce dispute resolution.

Resulting checklist for information science curricula

In comparing major issues that arise from such research with the current ALIA LIS body of knowledge, it is clear that many long-standing features of LIS education remain highly relevant. The major frontier appears to be in how far and in what ways libraries and other knowledge institutions, and the professionals who staff them, can more closely integrate with the entire continuum of knowledge creation, sharing and use by communities of all kinds; and how knowledge institutions can engage with communities in a continuing, sustainable cycle of user-centred service design and re-design.

Within this broad concern about the nature and extent of engagement by libraries and other knowledge institutions, some vital topics insistently present themselves. These suggest a checklist against which official LIS statements on body of knowledge and recommended curriculum content, such as that of ALIA, can be assessed. These include:

- The changing nature of the social contract as it impacts on, and is influenced by, information, ICTs and intellectual property
- The phenomena of complexity and interdependence as major issues in continuous user-centric service design
- The 'ever evolving, ever mutating' inter-relationship between action by stakeholders of knowledge institutions (notably including their professional staff) and the social structures which both support and constrain such action
- The engagement of knowledge institutions with the whole process of information and information creation, organisation and sharing, not just acquisition and distribution.
- The power inherent in the making and breaking of categories: metadata and the phenomenon of 'Ama-Google'
- The bases for sustainability in information enterprises
- The relationship between information and profit
- The relationship between information and learning
- The grail of 'seamlessness'
- Information practice, personal empowerment and social justice locally and globally.

New Directions for Information Science Education in the Networked Information Society
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Changing Trends in Educating the Library and Information Professionals in Thailand

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Professional education in library and information science in Thailand attracted a great deal of attention in the last decades and continues to do so even today. The aim of this paper is to present a historical perspectives on the changing trends regarding the education of library and information professional in Thailand. In addition, the paper will describe issues library and information schools in Thailand must address in order to prepare the library and information professionals to meet the continuous changes in the information world.

Historical Overview

Library and information science education in Thailand can be traced to 1951 when the first formal library training program, a Diploma in Library Science was introduced at Chulalongkorn University supported by the Fulbright Foundation. Later, a Bachelor degree of Arts in Library Science was offered in 1959 (Attakorn & Nandhivajrin, 1988). Between 1970s-1980s, due to the national policy on the expansion of public libraries at provincial and district levels, as well as the development of libraries in secondary and elementary schools to support teaching and learning, there was a great demand for library education in the country. The bachelor degree in library science had become an entry degree level of the library profession. Many universities, began to offer the bachelor degree program in library science, including Thammasat University (1964), Chiang Mai University (1967), Khon Kaen University (1970), Ramkhamhaeng University (1971), Prince of Songkhla University (1974), Slipakorn University (1982), Srinagarindwirot University (1983), and Mahasarakham University (1983) (Tantavirat, 1996).

In 1964, the first Master's degree program in Library Science was offered at Chulalongkorn University, followed by Srinagarindwirot University offered in 1967 and Mahasarakham University offered in 1982. In 1986, the first Master's degree program in Library and Information Science was offered at Thammasat University. The term "information" has been widely accepted and included in the names of the programs, both bachelor and master's programs in the professional field since then. The universities that offered the master's program in library and information science included Prince of Songkhla University (1991), Ramkhamhaeng University (1992), Khon Kaen University (1994), and Chiang Mai University (1995) (Surasieng & Tuamsuk, 2002).

The undergraduate programs emphasized on producing librarian practitioners for various types of libraries. Most libraries in Thailand usually had one professional librarian with undergraduate degree. Therefore the graduates were trained in both theoretical and practical works in all library functions. Courses covered such the familiar library traditional subjects as collection development, cataloging and classification, reference services, and library management. For the master's programs, the objective was to provide further education for professional librarians. The courses therefore were designed for those who already had library backgrounds. The course subjects mainly in line with library works but put some advancements or emphasized in more specific areas such as children library services, public library, science information resources and services, serial management, etc. The knowledge and skills in management and research were agreed the essential competencies for those who finished master's degree programs.

Current Trends

In the past five year has seen several changes in library and information education in Thailand. Although library educators claimed the development of information technology was a major impact on changes in library and information education, decreasing enrollment presented another factor. Fewer students perceive library and information science as an

economically attractive profession. Expected beginning salaries balanced against the requirements in subject, language, and technical skills have prompted many prospective candidates to enroll in other programs that promise them a greater return for their education investments, such as information technology, business administration, and service industry areas. The number of enrollments decreased from 50 to less than 40 per year at Khon Kaen University. Only a few students decided to undertake major in library and information science at Chulalongkorn University, Thammasat University and some other universities where the system allowed students to choose their majors in the second year of the undergraduate studies.

Weir (2000) said that, "one of the real difficulties facing library schools today is image. The term 'librarian' connotes an antiquated understanding of what we do and inadequately represents our capabilities." This is probably also true in the case of Thailand. The studies of needs for continuing education, as well as the expectations of employers on the library and information professionals reported some interesting issues that caused changes in curriculum as follows (Manmart & Sinbuathong, 2003; Inban, Tuamsuk & Sarawanawong, 1999):

- the increasing demands for continuing education in library and information science of those who employed in the private sectors, and most of them did not have library backgrounds;
- an increasing number of library and information degree holders who had jobs in the workplaces other than libraries;
- a decreasing number of students in library and information science programs preferred to work in the library;
- the degree name with the term "information" and/or "technology" in it would be more attractive for potential students, and provide better opportunities to get satisfactory jobs.
- the students need to be equipped with knowledge and skills of technology and its usefulness to society as a whole, and they should be able to keep their knowledge and understanding of integrating technology and other forms of information process to serve their clientele and to make decision or solve problems.

At present there are 14 public universities that offered the undergraduate program and 10 public universities that offered the master's program in library and information science. The names of the programs are varied including *library and information science*, *information studies*, *information science*, and *information management*. The concept became widely acceptable to most universities formulating curricula that related to all the information professions. Many courses in computer and information technology have been added and/or integrated into most curricula. Example of technology-oriented courses are information technology, information storage and retrieval, database management, digital libraries, information services, and information system development, etc. (Surasieng & Tuamsuk, 2002).

Due to the national policy on strengthening research products in the country through doctoral study, the Corporative Research Network (CRN) Project was introduced by the commission of Higher Education, Thailand. Khon Kaen University has been selected to be the core university of the CRN in library and information science. Under this CRN Project, the study of the needs for development of human resources in library and information science at the doctoral degree level was conducted in 2002 (Tuamsuk, 2002). Then, the first and only PhD program in information studies was opened at Khon Kaen University in 2003. This PhD program is a multidisciplinary-based program. Courses have designed so that the students with different backgrounds will be able to conduct their doctoral research in information studies that are applicable for their specialties and their future academia. Research study areas are ranging from information management, knowledge management, information system development, technology applications, and information in the contexts of social and economical changes, etc.

The Future Challenges

Information is becoming a critical factor for work and life in the twenty-first century. Everybody will need skills to retrieve and manage information to get along. Many will probably find the large quantity of information overwhelming and seek education or assistance in improving their information retrieval and management skills. We have opportunity to mold our future. Shall we take an active role in constructing it; or shall we let others chart the course for us?

When we look at the future of library and information science education the primary question before us is, how will library schools prepare themselves to meet those new challenges. In order to meet these changes it is necessary that library schools should look into their external and internal environments. Library educators of the future must have a good understanding of the coming situation of the 21st century and beyond. Their students need to be

equipped with knowledge and skills of technology and its usefulness to society as a whole (Abdullahi, 200?).

Weir (2000) suggested that traditional library skills still have a place but we must also seek out and encourage other characteristics and skills. These include:

1. Adaptability – Information professionals must be able to cope with constant change
2. Creativity – resolving many changes will require ingenuity and lateral thinking
3. Willingness to take risks – Not a characteristic normally associated with librarians
4. Self-starters – Much of the responsibility for self-improvement will fall to the individual
5. Project management skills and change management skills – Both essential in today's environment
6. Interpersonal and communication skills – Librarians are the 'human face' of technology for many people and, as we progress to be managers, we need good people skills to help both staff and clients adjust to the changes facing them
7. Sense of humor – Last but not least, this is as essential component of any jobs!

Abdullahi (200?) also suggested the issue concerning the humanistic skill. Information professionals of the future should be able to promote effective human relations through information to individuals, groups, organizations, and different people. As more and more society will be dominated by the use of technology, library students must have the education and skills of working with different people of diverse background and be sensitive to their needs.

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New Directions for Information Science Education in the Networked Information Society
Annual Symposium of the Research Center for Knowledge Communities
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Library and Information Science Education in Japan: Some Observations from the LIPER Project

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1. Introduction

The LIS education system in Japan is complicated. It is isolated from both the international LIS environment and the national college and university educational environment. It is difficult to understand not only for foreigners but also for most Japanese people except librarians and those concerned with libraries.

Japanese governments and companies adopted the bureaucratic model of nineteenth century European Continental countries in the process of modernization in the Meiji Era. That system has been maintained until now.[1)]

Librarians have tried to adapt the model by locating their professional roles within the bureaucratic system for 50 years but it is not always easy to mix bureaucracy and professionalism. There is self-contradiction in the Japanese LIS educational system.

Recently, however, the model has been changing into a more professional one, little by little. Some of the organizational principles of Japanese society are under reconstruction. We now need to reinvent the Japanese LIS educational model.

2. Historical development of Japanese LIS Education

2.1 Public Library Law (1950) and s*hisho* training programs

In Japan, there are two legal certificates of librarianship.[2)]

(1) *Shisho* 司書 (public librarian certificate)
(2) *Shisho-kyoyu* 司書教諭 (teacher certificate specific to school library management)

The Public Library Law (1950) was enacted during the post-war educational reformation period. The law defined s*hisho* as a librarian with a college education who had finished a training program for a 20 credit-points course (which means 300 hours training), which can be provided only by colleges and universities. The MEXT (Ministry of Education, Science, Sports, Culture and Technology) Ordinance set down the curriculum of the course. There are more than 10 such courses each year.

2.2 School Library Law (1953) and *shisho-kyoyu* training programs

The School Library Law (1953) was enacted in the year after Japan became independent again. Under the law, *shisho-kyoyu* is defined as a teacher who has completed the 10 credit-points (150hours) training program. The MEXT Ordinance set down the curriculum. Colleges and universities can provide the course for students who have finished or are taking the teacher certificate course.

2.3 Librarian Training Programs at colleges and universities

These two kinds of training courses were designed originally for in-service students. *Shisho* training courses were considered to be for students who were to be career librarians. As the School Library Law, in principle, imposed on every school a duty to have a s*hisho-kyoyu,* there was a need to quickly train many *shisho-kyous* to support more than 30,000 schools. Both courses were considered temporary during the transitional period.

The system has, however, continued for half a century. Over 250 colleges and universities provide *shisho* training courses. Over 100 colleges and universities (especially teacher training colleges) provide *shisho-kyoyu* training courses. The curricula of the training courses have not changed. We do not have formal librarian training curriculums for colleges and universities.

3. Current situation of LIS Education in Japan

3.1 Japanese bureaucracy

Japanese society has been a bureaucratic society where generalist bureaucrats are dominant within governments and companies. Professional librarians, if they exist, are liable to be located in marginal positions in governments, local communities, schools and universities.

In general, when students graduate, they search the job markets. I think legal education, economics education and even engineering education at the undergraduate level are not considered special or professional education in Japan but rather kinds of liberal education. LIS professional education has been difficult to locate at college and university education level. *Shisho* courses are considered inferior.

Recently, this pattern has been changed. Graduate professional education has been introduced (e.g. law schools, business schools). Continuing education at the graduate level has started in various occupational fields.

3.2 Information science programs

The computer industry has been considered as a national strategic one. It has been called the information industry. So computer science has been called information science in Japan.

In the last 10 years, liberal arts education, which was first introduced as a one or two-year curriculum for undergraduate students in the postwar period, has been nominally changed into information science education. This has meant the curriculum has tended to become more interdisciplinary.

At the University of Tokyo, there are several information science courses.

(1) Department of Information Science, Faculty of Science. (Undergraduate program of computer science)
(2) Graduate School of Information Science and Technology. (Graduate program for computer science and engineering)
(3) Graduate School of Interdisciplinary Information Studies. (Inter-faculty cooperative curriculum for journalists, computer designers, computer artists, etc.)

These are not typical programs but demonstrate something about the diversity of information science education in Japan.

3.3 LIS education at Japanese universities

There are five types of LIS education at colleges and universities.

(1) *Shisho* training—over 250 universities and colleges providing it;
(2) *Shisho-kyoyu* training—over 100;
(3) Undergraduate education (LIS major)—under 10;
(4) Graduate education (continuing)—under 5;
(5) Graduate education (research)—under 5.

Many programs are very small-scale. There are just four universities of more than 5 faculty members which provide (3) and (4)/(5) programs -- University of Tsukuba, Keio University, Surugadai University and Aichi-shukutoku University.

Another characteristic is isolation; isolation from other countries, from other academic disciplines and even from the library profession. Librarianship may have been isolated among academic disciplines in foreign countries, too, but it has have been backed up by the library profession.

There are no national educational standards for LIS education except *shisho* and *shisho-kyoyu* curriculums, which are independent and minimum standards for each curriculum. We don't have a national association for LIS education. There is a Library Science Education Division of the Japan Library Association (JLA) and the Japan Society of Library and Information Science (JSLIS). They have a membership system. There are many teachers at *shisho* and *shisho-kyoyu* courses who are not members of these bodies.

At Faculty/Graduate School of Education, University of Tokyo, we provide two LIS education programs; *shisho*-training course for undergraduates and a research program for graduate students. One associate professor and I teach the programs.

4. Three year study of the LIPER Project

4.1 Goals and methodologies

LIPER (Library and Information Professionals Education Reform) is a research project aimed at restructuring of LIS education in Japan. The name is taken from the KALIPER Project of ALA-ALISE, 1999-2000. We invited Professor Joan C. Durrance of SI of University of Michigan as a main guest and speaker at the 50th anniversary of JSLIS in 2003. She had been a chair of the advisory board of the KALIPER Project.[3)]

She emphasized, in her speech,. the importance of putting LIS educational programs within broad information environments and especially responding to

information users' needs [4] I agree with her in general, but I think what we need most is a 'Williamson Report (1923)' in Japan. It determined professional library education at graduate level in universities in the US from 1930s to 1950s. There is an 80 year time lag between US and Japan!

The LIPER project has continued under the sponsorship of the Japan Society for the Promotion of Science (JSPS). The funding source is the central government. With the cooperation of members of the JSLIS, there are about 20 participants.

The goal of the project is two fold, as follows:

(1) Assess the performance of education and training systems and curriculums.
(2) Clarify the scope of professional skills and knowledge required by those working at libraries and related organizations, considering the roles and functions of educational and training institutions, and developing guidelines for future education and training systems.

4.2 Research process and results

There are four working teams which survey, through interviews and questionnaires, and analyze the condition of job markets and job descriptions and employers' expectations of the curricula, and educational systems. We held three open symposia to listen to librarians and LIS educators. We invited LIS education specialists from China, Taiwan, Singapore, and Thailand to help us understand the actual state of LIS education and exchange opinions. This was very helpful to our understanding of our own situation in Japan (Fig. 1).

In February (2006) we published the final report of the LIPER Project.[5] It consists of five parts;

Part I Research summaries
Part II Proposals
Part III Research papers
Part IV Proceedings and abstracts of conferences
Part V Research materials

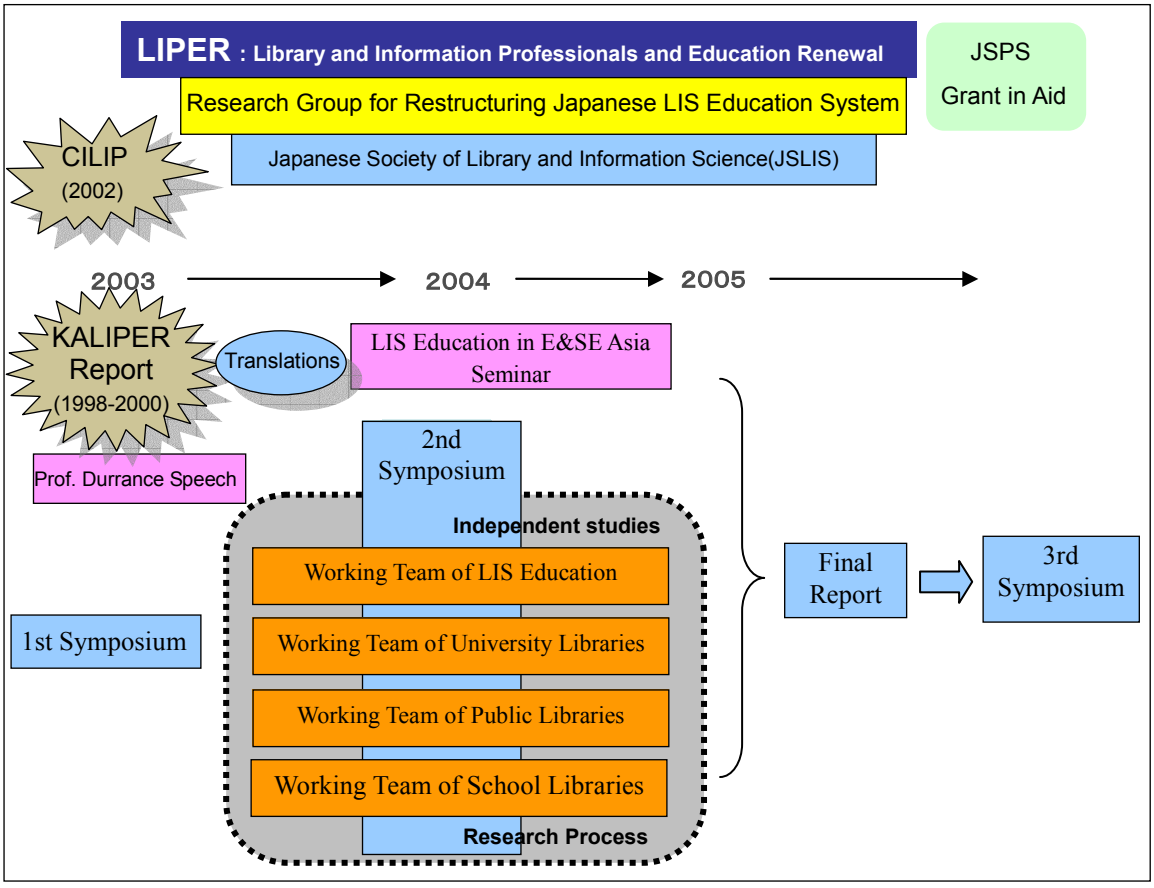

Figure 1. LIPER Research Process

The Interim report of the LIPER research results was presented last August at the IFLA World Library and Information Congress, Oslo.[6)]

In the final report, problems with the *shisho* curriculum are pointed out:

- Lack of course hours
- Shortage of digital and multimedia technology
- Lack of consideration for users' information behavior
- Duplication of course content
- Irrelevance to actual job sites
- Difference between the size of job market and the number of certificate holders
- Inadequacy for training academic, school, and/or special librarians

The last things are the more difficult to resolve.

4.3 Directions for restructuring of LIS education

We think that LIS education;

- has a common base for the different kinds of libraries
- should be at the higher educational level
- should have wider and deeper roots in university and college educational systems
- should be more competitive with each other and/or other disciplines and professions

We recognize the need for radical reconstruction of the LIS system butut the system is so deeply rooted in the current social organizational system that it is not easy to change. We need a strategy to differentiate what we can achieve with and without changing laws and ordinances and initiate what are easy and effective things to do first.

5. LIPER Proposals

5.1 Planning of graduate education and changing *shisho* curriculum

We prepared three proposals for the LIS education and library community. These are rather easy to put into action.

- Design of graduate education curriculum
- Shift the *shisho* curriculum to be the core basics of the curriculum
- Proposal of a LIS Achievement Examination

First, we propose a graduate education curriculum because there is a tendency to locate professional

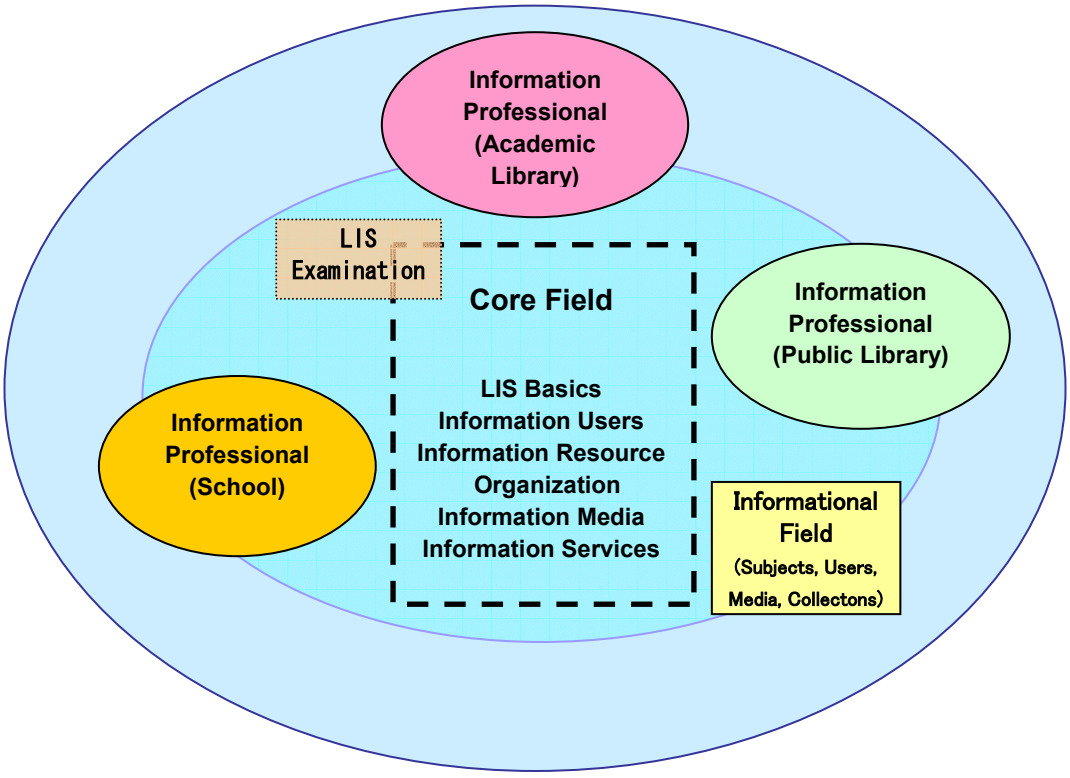

Figure 2. Curriculum structure at graduate level

education at graduate level in Japan, for example, teacher training and clinical psychologist training. Although it may be difficult to achieve graduate education of LIS immediately, it is important to establish the need for it.

The curriculum is structured (Fig. 2). There are three fields. One is a Core Field which consists of 8 subfields of courses for beginners of LIS. The second one is an Information Profession Field, which consists of three subfields for individual professionals. We prepared curriculum for information professionals at academic libraries, public libraries and schools, but not school libraries. At colleges and universities and local governments, the role of librarians is recognized but in schools it is not. So we use the term of information professional for schools. The third one is an Informational Field where colleges and universities can select groups of classes according to their principles. There are some examples illustrated in Table 1.

The Core Basics can be used as the curriculum for *shisho* training courses. In order to change the current *shisho* curriculum, the MEXT Ordinance must be changed. We would like to change it. As the Ordinance is based on the Public Library Law, it is not easy to change the *shisho* curriculum to one suitable for all kinds of libraries. Even without the changes to the Ordinance, however, we still want to recommend the changes for adoption by the colleges and universities.

5.2 Proposal of LIS Achievement Examination

The circumstances surrounding *shisho* courses at colleges and universities seem to be structurally stable. Students can comparatively easily get a legal certificate. For managers of colleges and universities, it is an inexpensive way to prevent declining enrolments. Of course, teachers of the courses also get more opportunities to keep their jobs. But for librarians on the scene, it is not easy to claim that the level of training is low and out of date because librarianship and LIS education are separated from each other.

To improve the standards, we consider introducing some competition. We propose carrying out LIS achievement examinations once a year. This is not a certification examination. Everyone can have a *shisho* certificate to show they have finished at least 20 units of courses. The proposed examination is a self-evaluative examination for *shisho* holders. The range of questions would be set in the Core Field of the graduate curriculum that I mentioned. Examinees would be informed of what and how to study for the examination. In Japan, this kind of examination is carried out in some academic fields, for example, in mathematics, law, economics and management.

For students, it is helpful to understand learning goals and it may be useful as an instrument of self-promotion in job hunting. For teachers, it helps to set their own teaching standards. For libraries, it is a tool to evaluate applicants. In general it will improve the quality of LIS education.

6. Expected effects and the future

These proposals are just proposals right now. We have to concentrate our action in the goals they suggest and to realize them.

I believe LIS education should be related to both libraries on the scene and other academic disciplines and professions. If library is considered to be a functional concept meaning processes of storage, organization and provision of information in the digital age, we don't have to distinguish between LIS and Information Science. So far, in Japan there has not been consensus about the necessity of these functions. This is a problem of culture and historical consciousness which will take a long time to change. I think the LIPER project will change the LIS education and have the effect of changing the national culture in the future.

•Core Field
–LIS Basics
–Information Users
–Information Resource Organization
–Information Media
–Information Services
–Information Systems
–Management
–Digital Information
•Information Professional Field
–Information Professional(Academic Library)
–Information Professional (Public Library)
–Information Professional(School)
•Informational Field(examples)
○Subjects
•Medical/health information
•Legal information
○Users
•People with visual impairment
•Children
○Media
•Movie films
•Old Chinese books
○Special collections
•Music collection
•Labor union collection

Table 1. Graduate curriculum

Acknowledgments

I would like to express my gratitude to those who gathered and discussed these issues as the members of the LIPER Project. The research results and proposals are our joint products.

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第２章　知的コミュニティ基盤研究センターの研究活動

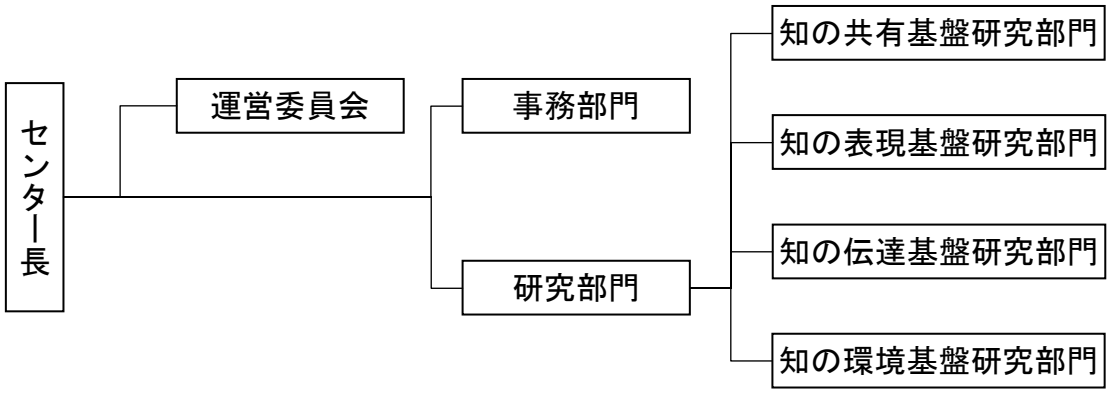
Research Activities in RCKC

組織の概要

目的

知的コミュニティ基盤研究センターの目的は，「高度情報ネットワーク社会における知的コミュニティ基盤の形成に係る研究を行い，学術研究の進展と研究成果の社会への還元を図ること」である．この目的のもとに，①センター教員，共同研究者による研究，②知的コミュニティ基盤研究に関する研究交流，産業界との交流，③コミュニティとの連携とコミュニティ支援，を推進する．このような研究とコミュニティ，産業界との連携を通じて，コミュニティにおける技術的・社会的知識・情報基盤の形成とコミュニティの多様な発展に貢献する．

機構



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知の共有基盤研究部門

Organization and Interoperability of Community Knowledge

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活動概要

「知の共有基盤」のミッションは，ネットワーク上で，知識と情報を探し，アクセスし，利用し，生産し，蓄積するために必要な共通の技術を提供する基盤環境を作り上げることである．現時点における本部門の基本的な役割は，ネットワーク上での情報の蓄積と流通のための基盤環境のための情報技術を研究開発することである．ここでいう基盤環境は必ずしも計算機技術のみによって作り上げられるものではなく，人間を要素として含む総合的な環境と考えている．別の言い方をすると，特定の環境を作り上げるのではなく，ネットワーク上で知識と情報を共有するためのミドルウェアを提供する環境を作り上げるものである．現在の計算機技術ではソフトウェアだけで十分な機能を持つミドルウェアを作り上げることは難しいため，このミドルウェアには人間によるサービスをも含めて考えている．こうした視点に基づき，本部門では，ディジタルライブラリやデータ工学分野における以下のような研究活動を進めている．本研究部門のミッションは以下の通りである．

研究トピックス紹介

1. メタデータスキーマの相互運用性

我々はネットワーク上で情報資源を蓄積・保存し，探し，選択し，そして利用する．こうした場面でメタデータは大きな役割を果たす．一方，メタデータの開発や維持のコストを下げるにはメタデータとメタデータスキーマの相互運用性を高める必要がある．メタデータスキーマの相互利用性や再利用性を高める役割を期待されるメタデータスキーマレジストリを中心として，メタデータの基本モデル，メタデータスキーマの再利用手法などの研究を，海外の組織とも協力して進めている．メタデータスキーマレジストリそのものに加えて，メタデータスキーマを基礎として，メタデータのための応用ソフトウェアを生成するツールの開発，スキーマ横断型のメタデータ検索技術，メタデータボキャブ

ラリの維持管理ソフトウェアツール等の研究を進めてきた. こうしたソフトウェアツールはスキーマレジストリと組み合わせて利用することを前提に考えており, こうしたツールの実現を通して, スキーマレジストリに関する評価を行うとともに, メタデータスキーマの蓄積を進めている.

2. ディジタルコンテンツのアーカイブ手法

ディジタルコンテンツのアーカイブはディジタルライブラリにおける重要な課題として認められている. ここでは, 長期保存のためのメタデータと Web アーカイビングの視点からの研究を進めている. Web 上で提供されるコンテンツのアーカイビングは, ディジタルライブラリ分野での重要な話題として認められている. Internet Archive に代表されるネットワーク上の網羅的収集と保存の取り組みがなされてきた. 我々は, 組織等の方針に基づいてWeb 上のコンテンツをアーカイブするための情報技術の研究や保存された情報資源を相互に預けることでアーカイブの高信頼化を図る技術の研究を進めた.

3. 利用者とそのコミュニティを指向したサブジェクトゲートウェイ

図書館情報学, 公共図書館などのコミュニティを指向したサブジェクトゲートウェイに関し, メタデータスキーマおよびコミュニティ指向の主題語彙等を中心として研究を進めている. 具体的には, 以下のような研究を進めた.

- 本研究センターが持つ図書館情報学関係の情報資源のメタデータに含まれる主題語のコアとなる主題語彙を開発し, それをもとにディレクトリを実現するシステムと, 利用者に合わせた表現方法でディレクトリを実現するシステムの開発を進めた.
- 岡山県立図書館との協調によるメタデータとメタデータボキャブラリに関する研究を進めた.
- 多言語によるメタデータの提供など, 異なる言語や表現形式を好む利用者のためのサブジェクトゲートウェイの構成方法, メタデータ記述方法などに関する研究を進めた.
- 日本国内の公共図書館を中心として, 図書館の Web サイトで提供されるディジタルコンテンツに関する情報を提供するためのメタデータに関して研究を進めた.

4. Web コンテンツの一貫性維持手法

Web コンテンツの一貫性を維持するために, Web コンテンツによく起きるリンク切れを, 自動的に検出し, 修復する技術の研究を進めている. 本年度はこれまでに開発してきた手法に基づいた本格的なプロトタイプシステムの構築を行い, そのシステムを利用した大規模な実験を進めてきた.

5. 知的コミュニティにおける情報管理・共有のための基盤技術

知的共同作業を行うコミュニティにおいて重要性の高い非定型情報の情報管理・共有を実現するために, 基盤ソフトウェア技術の研究開発を進めた. 具体的には, 各種活動イベントで記録したデータに対しメタデータを自動的に付与する技術や, コミュニティで集積した情報の関連を自動発見し, 整理する技術などの研究を進めてきた.

6. 半構造データの統合・変換手法

XML によって表された半構造データに対しデータの概念モデルの抽出と抽出されたモデルに基づくデータ変換, ならびに XML とリレーショナルデータモデルとの間での効率的なデータ変換の方式の研究を次の 2 つの観点から進めている.

- 大規模半構造データの変換問合せを効率よく構築するための研究を進めた. 本年度は, データの概念モデル抽出による分割統治アプローチに基づくプロトタイプシステムの作成を行った. 今後はこのシステムに基づく評価実験を進める予定である.
- XML とリレーショナルデータベース間の変換の効率化により, 既存情報システムの有効利用を行う研究を進めた. リレーショナルデータベースに対する XML ビューの構築についてこれまでの提案システムの改良を行い, その評価を行った.

7. 国内外の関連組織との協調

本部門では, 知的コミュニティ基盤研究センターの目的に従い, 大学の外にある図書館等との組織との直接的な協調に基づく研究開発を積極的に進めてきている. 国内においては, メタデータの蓄積と利用のための技術などに関して, 岡山県立図書館との協調的活動を進めている. また, メタデータスキーマレジストリの開発はこれまで Dublin Core Metadata Initiative 他の海外の組織と協調的に進めてきている. 今後もこれまでの研究活動をより活発に進めていくとともに, 外部の組織との協調的な活動をより活発に進めていきたいと考えている. また, 特にメタデータに関して, これまでの蓄積を生かし, メタデータに関する情報拠点となるよう研究活動を進めていきたいと考えている.

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知の表現基盤研究部門

Formation and Representation of Community Knowledge

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活動概要

本研究部門のミッションは以下の通りである．

１．コンテンツ表現技術の開発

知的コミュニティにおける知識伝達を考える時，その知識をどのように表現するかは重要な問題である．例えば，多元的な内容を含む知識はその理解が困難であるが，三次元 CAD に見られるように，その表現法を工夫する事により的確な知識伝達が可能となる．そこで，より多元的な知識を分かりやすく表現する技術・手法の開発を行うことを本部門の目的の一つとした．

２．コンテンツ作成環境の開発

これまでのコミュニティは単一の知識レベルを想定していた．しかしながら，教育に見られるような，異なる知識レベルの成員からなるコミュニティを考えた時，そこにおける知識流通においては，知識レベルの違いを緩衝できるようなシステムが必要となる．そこで，異なる知識レベルの人達のコミュニティ形成を支援する技術・手法の開発を行うことをもう一つの目的とした．

研究トピックス紹介

1-1 新規自己組織化マップ作成アルゴリズムの開発

Kohonen ネットワークに代表される自己組織化マップ（ＳＯＭ）は，多次元空間に配置される対象を二次元平面に空間をゆがめて射影する方法として知られている．得られたマップは対象群の構造を視覚的に表現することができ，様々な領域で利用されつつある．その作成は一種の競合学習であり，ランダムなベクトルを持つ正方格子上に配置されたニューロンの中からある対象の持つベクトルに最も近いものを選んで勝者ニューロンとし，その近傍を対象の持つベクトルに近づけるように変更を行う．Kohonen ネットワークは学習対象と成る近傍数を等価にするためにその上下と左右がつながるドーナツ空間であるが，示される

二次元平面のマップの解釈は直感的に難しい場合がある．我々は上下左右がつながらない，閉じた二次元平面に対して，学習対象数を一定にするアルゴリズムを開発し，その有用性を明らかにした．

1-2 タンパク質機能部位抽出法に関する検討

タンパク質の機能部位はその機能発現のメカニズムを考える上で重要であるが，三次元的な構造に基づくものであり，その扱いが困難である．機能部位の自動抽出法としては，これまで既知の機能部位とのマッチングや凹部分の検出による方法等が開発されているが，既知の機能部位が明らかになっている必要があることや，対象が酵素などの基質が関与するものでなくてはならない等の制約条件が強い．我々は同じ機能を発現するには同じアミノ酸残基群が三次元的に等価に配置される必要があるという仮説のもとに，複数の同じ機能を持つタンパク質から三次元的配置が同じであるアミノ酸残基群を抽出することにより機能部位を自動抽出する方法を提案し，その有効性を明らかにしてきた．その方法は，まず異なるタンパク質の同じアミノ酸残基の全ての対を作成してそれをノードとし，二つのノードを構成するアミノ酸残基間の距離が一定の範囲（しきい値）内であるときノード間にエッジを結ぶ．こうして得られたグラフから最大完全部分グラフを抽出すると，そのグラフのノードを構成するアミノ酸残基群が三次元的に等価な配置を持つことになる．我々は，抽出されたアミノ酸残基群が妥当なものであるのか否かを評価する方法として，しきい値を連続的に変化させて時に得られるアミノ酸残基群の集中度に注目した．種々のタンパク質を用いた検討の結果，妥当な結果を与えるには一定以上の集中度が必要である事を明らかにした．また，最大完全部分グラフの抽出は最適化問題であり，幾つかの高速化アルゴリズムが開発されており，我々はこれまでCarraghanのアルゴリズムを用いて来た．最近Ostergardが新たなアルゴリズムを提案したので，このアルゴリズムについての評価を行い，その特性を明らかにした．

1-3 印面による糸印の古銅印からの識別研究

糸印は古銅印であるが，その由来が生糸の貿易に使われたという説が明治期に出され以降，一つのグループを形成している．しかしながらその由来等を含めて不明な点が多い．糸印は印面と鈕からなる立体物であり，その特徴抽出により糸印の共通の特性を明らかにできれば，糸印研究に大きく貢献できる．ここでは糸印の印面に注目し，その濃淡データを一次元スペクトルと捉えてその周波数分析を行い，得られた周波数毎の強度を特徴量とした．糸印４２個と糸印ではない古銅印５４個について特徴量を抽出し，バックプロパゲーションを用いたニューラルネットワークによってリーブワンアウトによる予測精度の検討を行った．その結果，５９％と低い精度ではあるが，糸印と古銅印を識別できる事を示し，糸印のグループの存在を明らかにした．

1-4 大規模なネットワークの解析，シミュレーションおよび可視化

近年，社会現象，経済，生化学反応，物流，人間行動等，様々な分野において大規模なネットワークのシミュレーションおよび可視化が必要とされている．これは，ネットワークの挙動をシミュレートすることにより，複雑な現象の分析・解明・予測が可能となるからである．しかし，そのためには大規模な計算リソースが必要である．本研究で構築したネットワークシミュレータは，ソフトウェアによるシミュレーションの 10 万ー100 万倍の速度を持つ．なお，この速度は数千台の計算機で構成されるクラスタシステムによっても到達できない．

● ブログのネットワーク

インターネット上で様々なコミュニケーションツールが提供されているが，近年，ブログが広く使用されている．ブログにはトラックバックと呼ばれる参照先から参照元へリンクを張れる機能があり，これは従来の参照元から参照先へしかリンクを張れない HTML とは異なった形態のコミュニケーションを提供していると考えられる．ブログをノード，ブログ間のトラックバックをリンクとしてネットワークで表現した．ブログのネットワークについては，ノード当りのリンク数の分布が指数分布であり，ベキ分布を持つ HTML によるネットワークとは異なっている．ベキ分布の場合，ネットワークに追加されるノードはリンク数の多いノードに優先的に接続され，ネットワークが拡大することが知られている．分布の違いは，ブログが HTML とは異なった法則に従って広まっていることを意味する．さらに，ブログの記述内容に応じて 6 種類に分類できるが，これらをネットワークの構造を表す 2 つのパラメータ (平均経路長とクラスタリング係数) によって判別できることを示した．このことは，ブログの内容によって情報のやり取りの形態が異なり，その差がネットワーク構造に反映されていることを示唆している．

● 生体内反応ネットワーク

高速ネットワークシミュレータを基にシミュレーション対象を生体内化学反応に特化した専用計算システムを構築した．このシミュレータは実反応と同じ時間精度でシミュレーション可能である．

生物の 1 つの細胞内では約 100 億個 (種類数は数万)の生化学物質が反応を繰り返しており，この反応が生命現象そのものと言える．これらの反応の詳細を知ることができれば，生物の発生，老化，疾病についての知見が得られ，創薬等への応用が可能となる．しかし，生物実験によって知ることができるのは，それぞれの時点における各物質の量であり，本当に必要であるどのような反応が生じているかについては，網羅的に調べる実験手法は知られていない．さらに，このような大規模の対象のシミュレーションは，数百台で構成されるクラスタシステムによっても現実的な時間では完了しない．

本研究では，計算システムがデータベースを参照し，高速シミュレーションを行い，新たに得られる知識をデータベースへ還元するとともに，シミュレーション結果を解り易く表現するシステムを構築している．

2-1 中学校・高等学校の教科書における用語説明の比較検討

異なる知識レベルを相手にした時の，知識伝達の方法の違いを明らかにすることは，コンテンツ作成環境を考える上で重要な問題である．ここでは中学校と高等学校の教科書を取り上げ，生物領域の用語について検討を行った．まず，用語のタイプをモノとコトに分類し，さらにその説明の内容を２０種類に分類した．中学校の教科書２種類と高等学校の教科書２種類から，それぞれ１４９と７９４の説明を抽出し，分類を行った．その結果，モノについての説明が中学校の方に多い事，形状，性質，場所，方法による説明が中学校に多く，でき方，条件，値・量による説明が高校に多い事を明らかにした．

2-2 専門書と教科書のテキスト比較による用語概念の調査

専門書や学術論文に記載されている知識を表現するための生物学の知識基盤システムを引き続き構築し，組み込む専門用語数を増やし，新たな概念間の関係を構築した．概念ネットワークは二重の階層構造を持っており，新しく導入される概念は小さなグループを作り，その概念の一般化とともに他のグループとの接続が密接になり，知識全体へ組み込まれていくという概念ネットワークの進化機構の一部を既に明らかにしている．さらに，一定期間毎にそれぞれの時点で使用されている概念から階層構造を生成し，構造の時系列変化を解析したところ，概念が属する階層は時間の経過とともにより上位に移動することを明らかにした．このことは，研究分野の発展とともに出現する新しい概念は，概念構造の下位階層に組み込まれ，順次，より一般的な概念へと変化することが多いことを示している．

2-3 メディカルインフォームドコンセント支援システム

本研究の目的は，医学の専門外の人間が検索しやすく，かつ利用者の専門レベルに応じた情報を提供する医療情報提供システムの構築，および専門外の人間が理解しやすいような情報の提示方法についての研究である．特に心臓外科および救命救急を対象とする．医学の基本的な用語の収集のため，継続的に医学事典や専門書から専門用語を抽出している．これらの専門用語は，構築済の生化学，分子生物学，免疫学，生物学の専門用語集に順次統合している．また，図および表の電子化も行い，表題および図題に使われている専門用語を基に専門用語集と統合している．また，文章から得られる計量的な値を用いて難易度を推定する手法を考案した．この手法を用いて同一編集者による専門向けおよび一般向けの医学書 2 冊の相対的な難易度を正しく推定できた．

ユーザインタフェースは，ペンディスプレイを用いたシステム上に構築しており，専門用語間の関係をネットワークとして可視化するシステムと，情報を検索するシステムから主に構成される．このインタフェースを，利用者からのフィードバックに基

づいて改良している．また，情報提供システムを現場で評価するため，説明対象として経皮的冠動脈形成術（PTCA: Percutaneous Transluminal Coronary Angioplasty）を選択した．PTCA についての情報を収集・整理し，構築済みの知識基盤に統合した．

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知の伝達基盤研究部門

Communication and Collaboration in Community Knowledge

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活動概要

知の伝達基盤研究部門では，コミュニティにおいてつくりだされる知識（情報）の伝達に関して，人々の情報行動の探究などの知の主体に照準を合わせた研究と，知識（情報）伝達のための情報組織化技術や社会システムとしての伝達基盤（図書館・博物館・文書館・情報センター等）に関する，いわば知の集積に照準を合わせた研究とを行っている．後者は「知の集積」と言うことも可能だろう．ただし，この部門の研究が必ずしもこうした区分で構成されるわけではない．両者にまたがるテーマの研究も少なくない．基本的には知の伝達基盤研究部門に関わる研究は，どちらかに照準を合わせているとしても，おおむね人々の行為に密接に関わっており，そこには必ず「人間同士のコミュニケーションやコラボレーション」という視点が含まれている．

このような領域設定にあって，これまで伝達基盤部門では，次のような関心の研究が行われてきた．

第一に，大学研究者を中心とした学術情報の利用者に対する行動・意識調査があげられる．これは人間の情報行動を明らかにするという大きな目標を達成すべく行われているが，同時に大学図書館が直面している機関リポジトリ構築の問題やリンキング・システムの設計・導入などについて考えるときの一助となるものである．

第二に，コミュニティの情報伝達基盤に対する人々の選好意識等に関する研究がある．これは，情報伝達の社会システムのあり方を考えるものであり，図書館等に対するコミュニティ住民のサービスに対する選好意識や図書館の社会的価値の探索のための研究調査，および現状の図書館活動への住民によるアセスメント結果分析などが実施されている．

第三に，情報デリバリー基盤のシステムの構築に関する研究がある．これには，サブジェジェクト・ゲートウェイの構築に用いる知識集積の組織化の手法の研究や，異種のメタデータの結合と複数の情報資源に対する透過的なアクセス提供システム，あるいは，情報探索から入手へのパスを提供するリンキング・システムの設計などがある．

最後に，社会的情報基盤の経営指標に関わる研究である．これまでは，マーケティング論の分野での品質研究などを基盤に経営指標の探索を行ってきた．ただし，現在では成果指標に研究の中心が移行した．また基本的なパフォーマンス指標の研究の必要性も感じている．

研究トピックス紹介

1. 地域による子育て支援のための場づくりに関する実践:読書環境の整備と読書活動の展開

近年，地域での子育て支援の取組が注目されており，子育て支援の場に読書活動が積極的に取り入れられてきているが，こうした取組を地域で新しく始める際に手がかりとなる情報は非常に少ない状況にある．そこで，本研究では，親子が集まる読書活動の場として関東圏の 8 つの子ども文庫への訪問調査を行い，新しい場づくりのために参考となる情報を収集し，収集した情報を活かした実践を行った．

訪問調査では，コストを抑えて活動資源を充分に確保するための工夫や，読書活動を充実させ，親子が気軽に訪れることのできる地域コミュニケーションの場づくりの方法についての情報を収集するために，観察･インタビュー調査を行った．その結果，活動資源の確保については，無料の場所を利用する（場所の確保），知り合いや利用者（子どもの保護者）などの信頼のおける人に参加してもらう（活動者の確保），地域の助成金を利用する（予算の確保），手持ちの本の利用や図書館からの貸出を受ける（蔵書の確保），ポスターやチラシなどの広報を充実させる（利用者の確保）必要があることが示された．次に，活動における工夫点としては，靴を脱ぐ，手作りの飾りなどで装飾するといったくつろげる雰囲気作りをすることや，場の規模や利用者に対応した貸出・返却方法・活動内容（読み聞かせ，手作り遊び）などの活動システムづくりの重要性なども指摘された．

読書活動を取り入れた子育て支援の場づくりの実践では，茨城圏内で地域交流の場として子ども文庫をつくる活動に参加した．活動資源の確保については，空き店舗を文庫に改装する，近隣の子ども文庫や NPO の活動者の協力を得る，地域の助成金を利用する，本の寄贈や図書館からの貸出を受ける，ポスターやチラシを作成・配布することなどを行った．また，先の訪問調査の知見を参考に，場に畳を敷く，楽しい飾りつけをするなど，利用者がくつろげる雰囲気作りを行った．文庫開設日には地域の読書ボランティアによる読み聞かせなどが行われ，その後もイベント日には子ども文庫に多くの親子が集まっている．今後，イベント日以外にも多くの親子が集まる地域交流の場として活動を続けていくために，訪問調査から得た情報を利用し，さらに運営や読書活動を工夫していくことが期待される．

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2. 公共図書館における非定型学習：その成果と支援機能

公共図書館は，コミュニティにおける生涯学習施設として，資料の提供をはじめとするさまざまなサービスを提供している．これらは，コミュニティ住民がそれぞれの状況と関心に応じて主体的な学習（すなわち非定型学習）に寄与するものとして位置づけられている．

本研究では，公共図書館にとってこうしたサービスがどのように提供されているかの実態を把握しつつ，コミュニティ住民は図書館サービスとして何を望み，また実際のサービスをどのように評価しているかに焦点をあて，サービスの効果（効用）測定手法の開発を試みる．

今年度は，図書館サービスのうち，とくにプログラム・サービス（講座・講習会，あるいはイベントなど）に焦点をあて，どのような図書館プログラムが組まれているかを，日英の公共図書館界で把握し，また，その参加者がどのような目的・動機を持っているか，さらにはどのようにプログラム，あるいは図書館サービス一般を評価したかをとらえる．

そのために，茨城県の町立図書館のプログラム参加者への聞き取り調査，および質問紙調査により実施した．このケースでは，住民は図書館を生涯学習施設として位置づけ，広く活用していることが見てとれたが，図書館プログラムもその範囲での活動として位置づけられるものの，なお 2 次的な了解である点は否めない．

なお，非定型学習支援のためのツールとしての北関東の図書館・博物館データベースは公開され，その維持管理は引き続き行っている．

また，Sandra Parker が，客員研究員として取りまとめた，公共図書館の経営やサービスのあり方について日英の比較の副産物である．Public Libraries in Japan : A Glimpse of the Far East という論考が Update 誌（Vol. 4(1) 2005）に掲載された．

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3. 図書館における利用者の文献探索行動と機関リポジトリへの期待

電子ジャーナルの本格的な導入以降，大学図書館が果たすべき役割は確実に変化しつつある．そのような変化に対応すべく本学附属図書館が目指している試みに，検索と入手とを関連付ける動的リンキング・システムの導入と機関リポジトリの構築がある．本プロジェクトでは，附属図書館が行うこれらの試みが利用者である研究者たちにいかなる影響を及ぼす可能性があるか，さらには彼らにどのように受け入れられるかという観点から以下に報告する三種類の調査を行った．なお，いずれも本学の教員を対象とした調査であり，本学附属図書館との共同研究プロジェクトとして位置づけられるものである．

一つ目は，リンキング・システム導入に関連して，大学図書館利用者の探索行動経路を明らかにする調査である．本学中央図書館および医学図書館の来館者を対象とした質問紙調査と，電子図書館サービスの利用が比較的活発であると思われる研究科の教員を対象とした質問紙調査という形をとった．前者は 2005 年 9 月～10 月にかけて実施し，1536 名に配布して 923 名からの回答（有効回答率 60.1%）を，後者は 448 名に配布して 185 名からの回答(有効回答率 41.3%)を得た．結果として，(1)大学図書館利用者は文献情報データベースや電子ジャーナル・サイトより OPAC やサーチエンジンを情報探索経路として利用している，(2)電子図書館サービスを高頻度で利用する利用者は文献情報データベースや電子ジャーナル・サイトを経由して全文を入手する傾向にある，(3)研究分野に応じて様々なデータベースが利用されており，探索経路は多様である，という 3 点が確認された．

二つ目は，機関リポジトリ導入に関する調査で，本学の研究科教員全員（ただし，先の電子図書館サービスに関する質問紙調査の対象者は除く）に対して質問紙調査という形で実施した．2005 年 11 月に調査票(1322 通)を配布し，同年 12 月末日までに回収できたものを有効回答とした．回収数は 464 通（回収率 35.1%）である．調査項目は，電子ジャーナルをはじめとする電子資料をどのような形で入手しているか，研究者が手元に持っているデータにはどのようなものが多いか，機関リポジトリを実施したときに登録する意思があるかどうか，などである．

結果として，機関リポジトリに登録する意思は半数近くの回答者が持っており，積極的に反対するものはほとんどいないことが確認された．ただし，機関リポジトリがどのようなものかよくわからないという回答も少なからず見受けられ，機関リポジトリ実施の際には必要性や効果に関する PR が不可欠であることが示された．

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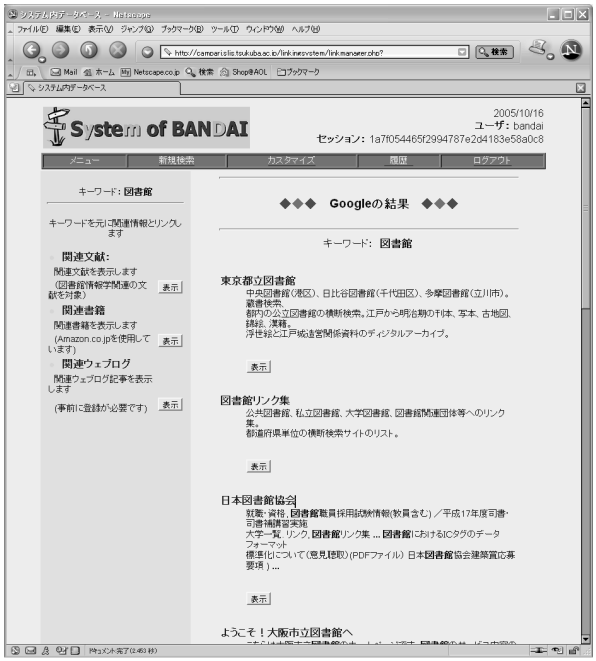
永田治樹（部門研究員），宇陀則彦（本学図書館情報メディア研究科），川井奏美（本学図書館情報専門学群），松林麻実子（部門研究員），竹入ふみ（本学図書館情報専門学群）．

4. リンキング･システムにおける利用者行動の分析と情報･知識探索パスの類型化

利用者は情報探索過程において，図書館やインターネット上にあるデータベースなどの多種類の情報資源を行き来して情報収集を行う．本研究では，インターネット上での情報アクセスを支援するため，多種類の情報資源内の関連情報に対して連続的にリンキングを行う手法を提案した．そしてこの手法を実装したシステムを構築し，利用者の情報探索行動のモデルと比較することで評価を行った．

情報探索における情報要求の変化について，Marcia BatesはEvolving SearchとBerrypickingからなる情報探索行動モデルを提案した．Evolving Searchとは情報探索の過程で得た情報に影響を受けて情報要求を変化させ，発展的な探索を行うことで，Berrypickingとは情報探索を行いながら少しずつ情報を拾い集めることを指す．上の図で

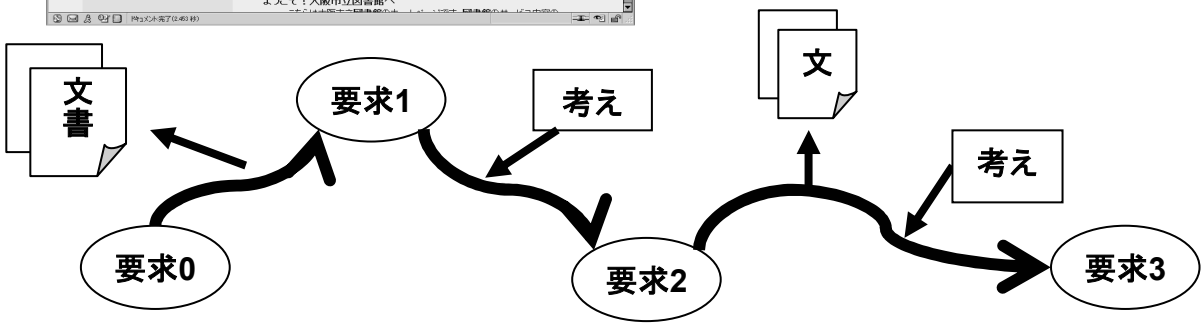


情報資源への統合アクセス

学術論文データベース, 書籍情報データベース(Amazon), Web 情報(Google), 研究者発信情報(RSS)など, 多種多様な情報資源へ統合的にアクセスできるようにした.

連続的リンクの提供

興味ある情報資源を選択するだけで, 現在表示されている情報から自動的にキーワードを切り出し, 次の関連情報を検索する. キーワードを手で入力し, 検索結果の評価を繰り返すという従来とは異なるアクセス機能を実現した.



は, 情報要求0の状態で探索を行い, ある文書を得たところ, 情報要求が要求1に変化したことを示している. そして, 情報要求1の状態で情報探索を行っている間に新たに考えが加わり, 要求2へと変化した.

本システムは Bates のモデルで解釈すると理解しやすい. 例えば, 利用者が「機関リポジトリ」に関する情報を探索しているとき,「オープンアクセス」という情報を見つけたとする. このとき, 利用者の情報要求は“機関リポジトリに関すること”から“オープンアクセスに関すること”に変化したと言える. 利用者は関連する情報資源へのリンクを辿ることによって, 少しずつ情報を拾い集め, 関連する情報を手に入れることができる.

【研究分担者】

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知の環境基盤研究部門

Media and Technological Bases for Community Knowledge

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活動概要

知の環境基盤研究部門は，現在のネットワーク情報社会を支える「環境基盤（ハードウェア)」を一層進化させるための研究開発をミッションとしている．一口にハードウェアと言ってもその対象は非常に広範囲であるが，当部門ではハードウェアの基幹コンポーネンツである「半導体デバイス」の研究を行っている．具体的には以下の３つの領域に属するデバイスを対象としている．

１．ユビキタス・ネットワーク技術に関するデバイス
- 携帯情報機器に搭載する低消費電力半導体メモリ（シリコン）
- 無線通信網を支える高出力マイクロ波デバイス（シリコンカーバイド SiC，あるいは SiC 上に作製された窒化ガリウム GaN on SiC，ダイヤモンド）
- 電源の超小型化を可能にするパワーエレクトロニクスデバイス（SiC，ダイヤモンド）

２．情報の大容量・高密度記録を可能にするデバイス
- 大容量の半導体メモリ（シリコン）
- 次世代光ディスク（青色 DVD）のさらに次の世代の光ディスクを可能にする高出力紫外発光デバイス（ダイヤモンド）

３．全く新しい情報処理を実現するデバイス
- 量子コンピューティング素子（シリコン，その他）

（）内は，そのデバイスを作るための半導体材料を示している．半導体から作られるデバイスの性能や信頼性は，半導体結晶あるいは異種結晶間の接触面（界面と呼ばれる）の品質によって決まる．そこで当部門では，結晶や界面の強力な評価方法として定評のある電子スピン共鳴（EPR）法を用いて，上に挙げられているシリコン Si，シリコンカーバイド SiC，ダイヤモンド C の３つの半導体材料・デバイスについて，様々な研究機関から寄せられる技術課題を解決するための研究活動を展開している．シリコンでは日本電気株式会社や慶応大学などと，シリコンカーバイドでは産業技術総合研究所（つくば市）や日本原子力開発機構（高崎市)，スェーデンの Linköping 大学，ハンガリーの Budapest 工科大学な

どと，ダイヤモンドでは産業技術総合研究所ダイヤモンド研究センターや物質・材料研究機構（つくば市）などと連携を行っている．

加えて，当部門では，半導体研究に必要な結晶欠陥の研究データをインターネット技術を使って収集，整理して情報発信を行うというコミュニティ活動も進めている．

以上のような研究活動について，ここでは，昨年度の同シンポジウムにおいても発表したトッピクスについて，その後どのように進展したのかを研究の背景・動機と合わせて紹介したい．その他のトッピクスや成果の詳細については私どものホームページ http://www.kc.tsukuba.ac.jp/div-media/indexJ.html に随時更新しているので，そちらを参照されたい．

研究トピックス

1. シリコンカーバイド

シリコンカーバイド（SiC）は，ワイドギャップ半導体と呼ばれる特殊な半導体の１つで，高出力のマイクロ波デバイス（無線通信用）や超低損失のパワーエレクトロニクスデバイス（様々な電源の基幹部品となる）として非常に有望な素材として90年後半から脚光を浴びている．SiCの重要な特長の１つは，現在主流のシリコンと同様に，単結晶ウェハが得られる点にある．このため，窒化ガリウム（GaN）といった他の有望なワイドギャップ半導体のベース基板としても魅力的な材料になっている．単結晶ウェハ作製技術は急速な進歩を遂げており，一昨年には”Powered by Crystal”と題してNature誌の表紙を飾ったことはまだ記憶に新しい（D. Nakamura *et al.*, Nature **430**, 1009 (2004)）．しかしながら，デバイスの量産・実用化のためには，低コストでデバイスを作製する技術やデバイスの劣化問題の解決などが必要である．それらの課題は結晶の品質（結晶中の欠陥）と密接に関係しているため，私達の評価技術が大きな役割を果たすことができる．取り組んでいる課題は，低コスト半絶縁性SiC単結晶ウェハ成長機構の解明，高効率n型（リン）ドーピング機構の解明，SiC-SiO_2界面欠陥の解明などである．ここでは昨年度も紹介した，半絶縁性SiC単結晶の評価研究について紹介したい．

半絶縁性SiC単結晶ウェハは，SiC上に作られるデバイスの性能を最大限に引き出すことができるため，低コストでこの基板を作れるようになれば産業的インパクトが非常に大きい．普通のSiC単結晶は半絶縁性を示さないが，ある特殊な結晶成長条件では何らかの結晶欠陥が結晶中に誘発され，これが半絶縁性の起源となることが分かっている．しかし具体的なメカニズムは判っておらず，この分野におけるホットトッピクスとなっているため，その解明を目指して研究がスタートした．研究は伊藤久義・森下憲雄・大島武氏（日本原子力開発機構，主に単結晶への電子線・イオン照射を担当），N. T. Son博士（スェーデンLinköping大学，私達と共に測定を担当），A. Gali博士（ハンガリーBudapest工科大学，理論計算を担当），M. Bockstedte博士（ドイツElrangen大学，理

論計算を担当）等と一緒に行っている．昨年度のシンポジウムではその途中経過を報告したが，その後これまでに判明した結果をまとめると，およそ４種類の結晶欠陥が半絶縁性の原因として重要であることを突き止めた．それぞれの欠陥についての詳細な報告はそこに記載されている文献あるいは学会発表でなされている．

- シリコン空孔：V_{Si}^{-}（T_{V2a}）

N. Mizuochi *et al.*, “Spin multiplicity and charge state of a silicon vacancy (T_{v2a}) in 4*H*-SiC determined by pulsed ENDOR”, Phys. Rev. B **72**, 235208 (2005)と，この中のN. Mizuochi *et al.*文献.

- 炭素空孔：V_C^{+}（*EI*5/*EI*6），V_C^{-}（*HEI*1）

T. Umeda *et al.*, “EPR and theoretical studies of negatively charged carbon vacancy in 4H-SiC”, Phys. Rev. B **71**, 193202 (2005)と，この中のT. Umeda *et al.*文献.

- シリコン-炭素複空孔：$V_{Si}V_C$（*P*6/*P*7）

N. T. Son *et al.*, “Divacancy in 4H-SiC”, Phys. Rev. Lett. **96**, 055501 (2006).

- 炭素アンチサイト-空孔ペア：$C_{Si}V_C$（*SI*5）

T. Umeda *et al.*, “Electron paramagnetic resonance of the SI5 center in 4H-SiC”; M. Bockstedte *et al.*, “Signature of the negative carbon vacancy-antisite complex”, International Conference on Silicon Carbide and Related Materials (ICSCRM2005), Sep. 17-23, 2005, Pittsburgh, USA.

2. ダイヤモンド

ダイヤモンド（炭素の結晶）は本来，電気を流さない絶縁体であるが，ドーピング（別の元素を微量添加する）を行うことで自由に電気を流すことのできる半導体へと変身する．ダイヤモンドの強力な短波長紫外発光を利用できれば，次世代光ディスクである青色DVDを遥かに上回る超高密度光ディスク記録が実現できる．また，ダイヤモンドには高出力マイクロ波デバイスとしての期待もある．このようなデバイスを作るための大きな技術課題がn型ドーピング（ダイヤモンドの場合はリン原子）をいかに実現するかである．リン原子のドーピングは，つくば市にある独立行政法人物質・材料研究機構（物材研）スーパーダイヤグループが1997年に世界で初めて成功し，現在でも彼らがデバイス化技術において世界をリードしている．

そこで物材研と連携して，ダイヤモンド結晶中に入ったリン原子の様子を原子レベルで観察する研究に着手した．昨年度のシンポジウムにおいては，電子スピン共鳴法により世界で初めて，このリン原子を観察することに成功したことを報告した．今年度はさらに詳しい実験を進めて，リン原子がダイヤモンド結晶の炭素原子を置き換えて結晶に入ると，２種類の環境の異なる状態ができることが分かった．現在，Budapest工科大学のGali博士にスーパーコンピューターを駆使した大規模第一原理計算シミュレーションを行ってもらっており，私達の実験結果と比較からダイヤモンド結晶中のリン原子の詳しい挙動を明らかにする予定である．ダイヤモンドのn型ドーピングに関する研究成果の参考文献として，

・M. Katagiri *et al.*, “Lightly phosphorus-doped homoepitaxial diamond films grown by chemical vapor deposition”, Appl. Phys. Lett. **85**, 6365 (2004).

・M. Katagiri *et al.*, “ESR characterisation of phosphorus donors in n-type diamond”, 16th European Conference on Diamond, Diamond-like Materials, Carbon Nanotubes, and Nitrides (DIAMOND2005), Sep. 11-16, 2005, Toulouse, France.

が挙げられる（M. Katagiri（片桐雅之）は大学院博士課程の大学院生）.

他方，ダイヤモンドのデバイス化にはp型ドーピング（ダイヤモンドの場合はホウ素を入れる）も不可欠であり，結晶欠陥を低減しつつp型ドーピングを行う技術の開発をつくば市にある産業技術総合研究所ダイヤモンド研究センターと共同で行っている．その結果，世界最高の品質をもったp型ダイヤモンド結晶が誕生している．下記の論文などを参照のこと.

・N. Mizuochi et al., “Hydrogen passivation effects on carbon dangling bond defects accompanying a nearby hydrogen atom in p-type CVD diamond”, Physica B (2006), in press.

3. インターネット技術を使った半導体研究者のためのコミュニティ活動

私達のみならず半導体結晶を研究している全ての研究者達が，インターネット技術を使って，研究成果をお互いにもっと効率的に利用できるような新しい知識情報基盤を整備しようという狙いで，半導体結晶欠陥に関するWebデータベース・システムを立ち上げて運用を開始した．現在，

http://www.kc.tsukuba.ac.jp/div-media/epr/

において公開中である．もちろん内容は専門家向けのもので一般受けするような類のものではないが，原則として，専門家，非専門家を問わず誰でも自由にアクセスして，半導体の結晶欠陥の専門的なデータを閲覧・検索したり，高度なシミュレーション機能を利用できるようになっている.

このデータベースの開発は昨年度からスタートしたが，その後多くの整備・改良を重ね，今年度に開かれた半導体結晶欠陥の国際会議ICDS-23（23rd International Conference on Defects in Semiconductors, July 24-29, 2005, Awaji-island, Japan）にて正式に公開を行った．このデータベースは，いわゆる数値やテキストを収録したデータベースとは違い，実際の電子スピン共鳴の実験で半導体結晶欠陥がどのように見えるのかという視点でデータが眺められるようになっている．もちろん，データを数値一覧表として見たり，数値検索をしたりすることも可能である．その設計ポリシーや機能の詳細については，下記の論文で報告される予定となっている（電子版はPhysica B誌においてすでに公開されている）.

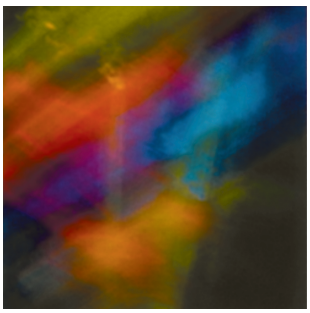
・T. Umeda and S. Hagiwara*et al.*, “A web-based database system for EPR centers in Semiconductors”, Physica B (2006) in press.

公開にあたっては，使用しているシミュレーションソフトウェアEPR-NMR©の開発グ

ループ（カナダSaskatchewan大学のJ. A. Weil教授）から学術用途という事で無料使用の許諾を得た．

現在のデータ登録件数は約320件である（昨年の同時期は約210件）．これらのデータは，過去の私達＋他の研究者の論文から選び出して，私達の手作業で登録したものである．今年度以降はデータの登録もさることながら，インターフェースの改良などに注力していきたいと考えている．このWebデータベース運営の最大の目標は，世界中の研究者が自分のデータを自らWebデータベースに登録して，さらにお互いにデータのメンテナンスを随時行い合うことで，データベースがあたかも半自立的に管理・拡張されていくような人を含めたコミュニティ・システムの確立にあるからである．そのためには多くの研究者が使い易いようなインターフェースの研究開発が大変に重要である．また，サイトの存在を知らせる宣伝活動や，個々の研究者に参加を促すようなダイレクトメール的な働きかけも重要であり，来年度に幾つかのアイデアを実施したいと考えている．とりあえず今年度は，国際会議での発表後，インターネットの主要な検索エンジンで直ちに見つかるようにGoogle，Yahoo，msnへの登録を行った．ちなみに，データベースへのアクセスをwebanalyzer®で見てみると，Visits数（およそユーザー数を表す）で1日平均で約130，30数か国からのアクセスがある．アクセスの半数はアメリカからで，細かな分析はしていないがGoogleなどからのCrawlerが多数来ているようである．

現在のデータベース（EPR データベース）は，電子スピン共鳴（EPR）法による半導体結晶評価に特化してデータが登録されている．しかし，半導体を調べる実験手段は他にも数多くあり，例えばPhotoluminesence（PL）法や Deep Level Transient Spectroscopy（DLTS）法，Cathode Luminesence（CL）法，電気測定法，電子顕微鏡，X 線回折，Positron Annihilation Spectroscopy（PAS）法，理論計算シミュレーションなどで，これら多くの実験法による結果がリンクしあって初めて半導体を理解することができる．したがって，半導体の研究者全てにとって有用な知識情報基盤とするためには，EPR データベースだけでは足りない面がある．そこで，「文献データベース」をもう１本の柱として立ち上げることを計画している．これは，半導体結晶欠陥全般について学術論文を収集して，普通の学術誌データベースでは調べるのが難しかった検索，例えば欠陥同士の関連や，実験手法同士の関連などを容易に調べることのできるようなサービスを提供しようというものである．関連付けは専門家が手作業で行う．EPR データベースと同じく，多くの専門家の参加を促して，関連付けのメンテナンスを Web 上で同時多発的にできるような仕組みを現在開発中である．このような活動が軌道に乗れば，半導体研究に関わる全ての人にとって役に立つ知識情報基盤が作り上げられると期待される．また，その運営自体が知的コミュニティ基盤に関する実践的な研究例になるのではと期待している．



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