Information Professionals 2050: Educational Possibilities and Pathways

Edited by Gary Marchionini and Barbara B. Moran

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School of Information and Library Science

University of North Carolina at Chapel Hill

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This book is dedicated to the memory of Lee Dirks, ’90 graduate of the School of Information and Library Science at the University of North Carolina at Chapel Hill and Director for Portfolio Strategy at Microsoft who was killed tragically in an automobile accident in August, 2012. Lee was an energetic and enthusiastic champion and advocate of scholarly communication, data curation, digital futures and other information school topics that challenge all information professionals, both today and in the future.

Contents

Information Professionals 2050: Educating the Next Generation of Information Professionals

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Over the past decade in the United States an enormous amount of critical attention has been focused upon all aspects of higher education. Much of this attention has been spawned by utilitarian concerns about economic costs and subsequent career return on investment,[1] and by innovations in technology that lead to globalization and alternative modes of teaching and learning. Scientific and technical advances have become increasingly dependent on interdisciplinary teams that leverage diversity of thinking and work practices to solve complex problems and develop new fields of study that aggregate or subsume traditional boundaries. The structure and traditions of higher education resist development of interdisciplinary instructional degrees and programs.

Critics of education have been especially harsh in judging those schools designed to educate individuals to enter various types of professions. Professional education has always faced tension in balancing theory and practice and today's utilitarian concerns tend to emphasize translating theory to practice and embracing technology to improve productivity. These professional schools have been reproached for providing education that is outdated and inappropriate to meet the needs of the modern age. Professional schools of all types are now reconsidering long accepted pedagogical approaches and searching for ways to modernize both what is taught and how it is taught. Many large scale assessments of professional education in specific professions have attempted to provide new alternative approaches. For instance, the Carnegie Foundation for the Advancement of Teaching has recently funded a series of studies examining the educational preparation for many professions, including medicine, nursing, engineering, law and the clergy. (Cooke, 2010; Benner, 2009; Sheppard, 2008; Sullivan, 2007; Foster, 2005)

The changes that are occurring within the environment in which professional schools operate necessitate a reexamination of the old patterns of education. These traditional models have become outdated in the modern world where the nature of higher education, libraries, and information resources are affected by globalization, new technologies, multiculturalism, and both financial and environmental constraints. As part of this reexamination, it is time for the institutions which prepare information professionals to re-envision the education that will be needed for the next half-century. *Information Professionals 2050* is designed to bring together thought leaders in the diverse information field to create a blueprint for educating the next generation of information professionals.

The School of Information and Library Science at the University of North Carolina at Chapel Hill (SILS) has been a leader in training librarians for decades, and over the past twenty-five years we have developed

[1] The much-trumpeted report that student loan debt in the US now exceeds all US credit card debt has honed awareness that education is a consumer resource as much as it is a creator of resources (Chopra, 2012).

our MSIS and BSIS programs to broaden our programs to serve the information management needs of business, industry and government. As one of the leading information programs, we are taking the opportunity of our 80th anniversary celebration to sponsor this symposium as a way to help the field and all information schools begin to think about the changes that will be necessary to successfully produce that next generation of information leaders.

Today most information professionals are educated in what have become known as i-Schools. Some of these schools were created specifically to address information education, some were created by merging existing departments (e.g., computer science and media studies), some are aggregations of faculty and courses from the entire gamut of academic departments, but most adapted from roots in education for librarianship. Regardless of their origins, i-Schools around the globe are evolving rapidly. We use an evolutionary change model to illustrate this evolution and to identify the challenges that all i-Schools face regardless of genesis.

The first "library" school was established at Columbia in 1883 by Melvil Dewey; however, most of the early programs to prepare librarians were located not in institutions of higher education but in libraries. In the late 19th and early 20th century when librarianship was beginning to emerge as a profession, education for librarians, like that of lawyers and many other professionals, was commonly based on an apprenticeship model. Aspiring librarians were prepared for the profession either on the job by more experienced librarians or in specialized educational programs located in large public libraries. It was not until after the Carnegie Foundation commissioned Charles C. Williamson to study training for librarianship that library education was brought into the academy. The Williamson Report of 1923 (Williamson, 1971) made many recommendations to strengthen the education of librarians, but among the most important was that preparation for the profession should move from public libraries to universities. Subsequent to the Williamson report there have been numerous efforts (including comprehensive reviews such as the Wheeler Report [1946], the Conant Report [1980], the King Report [1986] and the KALIPER report [2000] (Wheeler, 1946; Conant, 1980; Griffiths, 1986; KALIPER Advisory Committee, 2000) to survey the state of education for information professionals and make recommendations for its reform. *Information Professionals 2050* is designed to provide the groundwork for another such reexamination.

In the decades since the schools originally designed to prepare librarians moved to the higher education sphere, these schools themselves have evolved to meet the needs for new types of information professions in careers that did not exist when the schools came into existence. Originally the education in these schools was narrowly focused on preparing individuals to work in one type of information agency, the library; however, for at least the last 40 years the focus has been much broader. Our schools have moved from a Ptolemaic information world with the library at the center to a dynamic, Copernican universe with information at its center and with libraries as one of the many planets revolving around this information core (Taylor, 1979). Now the i-Schools prepare a wide range of information professionals including information architect, data analyst, database administrator, web developer, ontologist, usability engineer, social media strategist, data curator, chief information officer,

and of course librarian, archivist, and museum curator. This range makes it more difficult to foresee the preparation needed for future information specialists because students come to our school to be prepared for so many diverse careers. Compounding the difficulty is the fact that it is impossible to predict the information environment where our graduates will be working even a decade from now. Although it is a daunting challenge, the i-Schools of today need to rethink the education being provided so they are able to better prepare the professionals of tomorrow. Some questions i-Schools grapple with include:

- How do they recruit the best and brightest students and sustain life-long learning relationships with those students?
- How diverse a faculty should they recruit to represent the spectrum of disciplines that are critical to modern LIS schools?
- How should i-Schools deal with the task of integrating knowledge and practice in a way that will prepare their graduates for the challenges of the rapidly changing information environment of the future?
- How can these schools leverage information technologies to be more effective and efficient?
- How do they build mutually beneficial partnerships with information industries and agencies? With different schools and departments?
- How do we assess our schools? Our faculty? Student outcomes?

The information professions are at an inflection point in time. The environment in which all information professionals operate has been revolutionized, primarily due to profound changes in technology. Technology has transformed almost all aspects of our world, and has certainly transformed the careers into which we send our graduates. These technological changes have altered traditional methods of information storage and retrieval that have endured for centuries. Scholarly communication has been transformed and user expectations heightened. Access to information is ubiquitous and information permeates all aspects of our lives. This is no evolutionary change but a disruptive one as we move from a world where information was contained within walls in finite containers such as books and filing cabinets to one where information is virtual and omnipresent. Information schools once prepared professionals to work in a specific type of institution; now they are preparing professionals for careers in a world where the institutions that employ them (if they actually do work within an institution) are of many types and serve many different purposes. Once information was typically dealt with on a local scale; now information professionals work with information that is international in scope, linking institutions and individuals across the globe in real time. These profound changes in the information world demand equally profound changes in the education of the professionals who will spend their careers working in this new world.

What are some of those changes that need to be considered and how might we organize our thinking about the directions that those changes will take? There are a number of ways to look at reshaping educational programs but it seems that, at bare minimum, we need to consider each of the major components in any type of educational program -- the students, the faculty, the curriculum and the modes of delivery -- and deliberate the changes that need to be considered in each of those four components. What are the necessary changes we need to make to ensure that our schools are ready to educate the information professionals who will be vital in tomorrow's world? For each of these components, a few illustrative questions follow to set the stage for discussion.

- Students: What are the characteristics of successful information professionals? Beyond obvious characteristics such as intelligence, creativity, and desire to serve others, should we recruit young people who have high tolerance for ambiguity? Analytical problem solving talent? Intuitive or empathetic interaction styles? Outgoing personalities?

- Faculty: What kinds of faculty should we recruit and promote? Generalists or specialists? Quants or quals? Exclusively from information programs or from many fields? What are the best balances between research and teaching? How do we evaluate research success and impact? How do we assess teaching effectiveness?

- Curriculum: Should we identify core ideas and techniques that must be included in every student's program or individualize curricula to learners? How can we balance information theories with information best practices? How comprehensive should a curriculum be? How do we evaluate student learning outcomes and career impact?

- Delivery: What is the right balance of individualized and group learning? What is the right balance of face to face and online learning? How can we balance coursework and in situ learning? Should information professionals be licensed?

Redesigning education for information professionals will demand an enormous effort on the part of all of us as we rethink the prior educational preparation of entering students and the role and type of faculty needed, curricular needs, and the type of pedagogy and delivery of these new programs.

Answering these and similar questions will require educational leaders to carefully assess what is essential to preserve from today's programs and what to delete, adapt, and add. Most of us would say that our responsibility to the information professions of tomorrow requires us to continue to offer learning experiences that foster creative and adaptive thinking, cooperative problem solving, compassion and mutual respect, and devotion to learning and knowledge stewardship. In fact, we believe that there is a set of core values that provide the warrant for today's i-Schools and will continue to warrant our programs far into the future. There are values we share with all educational programs such as excellence, creativity, curiosity, and passion for learning, but i-Schools draw their defining values from librarianship:

- Organization of information
- Universal access
- Collaboration
- Intellectual freedom
- Self-directed learning
- Stewardship

These values are what have distinguished our profession and have provided the basis for the service information professionals have performed for society. However, we must realize that some of these values may come into conflict with the for-profit nature of many of the organizations where our graduates will find positions. Are these values so critical to our professional identity that we will continue to insist that they remain a part of the professional preparation of every graduate?

It is these values that distinguish us from other disciplines and beginning with these values provides another basis upon which to investigate and build educational programs. Many information educators say that our schools consider the interactions of people, information, and technology. We suggest that central to this triad is the entire information life cycle and the ways that people and technology participate in this cycle. Our core values dictate the learning and teaching actions people apply to their information lives. Traditional librarianship focused most heavily on stewardship of extant information and today's information programs have broadened this mandate to the full information life cycle that includes generation, management, transmission, use/reuse, and preservation:

- Information professionals are partners in generating and collecting information; they are part of the research, data mining, or design team. Placing value on accurately-represented and well-organized information serves information production teams well.
- Information professionals elicit, ingest, organize, and evaluate information. They do so using distributed databases and by directing data streams. Because they value universal access, they create powerful and adaptable indexes, ontologies, and because they value stewardship, they worry about cost-effective but sustainable data structures.
- Information professionals share information openly and freely. Because they value universal access and self-directed learning, they advocate open access publishing and easy-to-use access systems.
- Information professionals are participants in using and reusing information to solve problems, make decisions, learn, and play. Educating the public to find and use information, assess its accuracy and provenance, and joining small or massive teams to aggregate, synthesize, annotate, or summarize are all roles that information professionals play. Because they value

collaboration and learning, they are willing to go beyond simply delivering information to helping people apply it.

- Information professionals have long served as stewards of knowledge and this is even more important today for the diverse forms and volumes of digital information. Valuing access and stewardship, they know they go hand in hand and that substantial context must be included if information is to be useful in the future.

These examples of how values and the work of information professionals interact are not exhaustive but meant to suggest a basis for creating educational programs that are rooted in core values. Clearly, at each stage in the information life cycle, there are policies, costs, and systems that are essential to good theory and practice. The values we bring to the problem determine what policies and systems we develop and apply and what costs and constraints we are willing to bear.

Information Professionals 2050 provides a venue for examining these questions and thinking about how to restructure professional education to meet the needs of tomorrow. We look forward to the discussions of the next two days and hope that our activities will result in at least the beginning of a re-envisioning of the education of the next generation of information professionals. It is unlikely we will come up with a definitive plan, but we anticipate we will leave with at least an outline of where we need to go and what the next steps should be. But it will not be an easy task. Because of the disruptive changes in the information environment our past cannot serve as an adequate guide to the future. Most of us are deeply involved in education for today's information professionals and bound to some extent by our past experiences, and thus it will be hard for us to envision a vastly different education for tomorrow's professionals. If we are to be successful, we will need to set aside the model of education for information professionals with which we are all familiar and focus on the demands of the future. What will be the needs of information users in 2050 and what kind of professionals will be needed to address those needs? What are the changes that must be made in all of the components of the learning process to educate these information professionals? And finally, how do we define and preserve the core values that are essential to the information profession? We expect the discussions over the next two days will begin to provide us with some of the answers to these questions.

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PART ONE

Education Trends

ED and INFO 2052: Oh, the Places You'll Go!

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NOTE from 2052: Since the purpose of this piece is to explain education and the information field today as if we were speculating from 40 years ago, we decided to immerse ourselves back in a 2012 state-of-mind by putting aside our current technologies, spaces, and approaches (particularly our knowledge processors, mediatrons, and virtual study rooms) and "write" a paper using a word processor. Please forgive the blandness and occasional syntax mistakes as we are still getting reacquainted with these charming but limited tools.

Introduction

Human daily life today—at work or home—would seem comfortably familiar to someone living in the United States 40 years ago, in 1972. In 2012, most adults still commute to work morning and evening, and work 5 days a week, 9 to 5. Most live in cities or suburbs[2] in nuclear families, and engage in a wide range of recreational activities, e.g., reading, playing or listening to music, watching TV or movies, playing video games, gardening, hunting, hobbies, sports, and travel. (Recreation, 2012)

Still, there are also some fundamental differences in human society and the experiences of individuals and groups. Many of the most visible changes relate to technology – computers, the Internet, cell and smart phones, and the World Wide Web. Facebook, Twitter, and other forms of social media are the norm. The world is more networked than ever. We truly live in an instantly and continually connected global village–interdependent on each other economically, socially, and culturally.

American K-20 education in 2012 is also strikingly similar to 1972, but with some notable progress. For example, in terms of literacy, the *CIA World Factbook* (2012) reports that 99% of the U.S. population can read and write. And, based on U.S. Census Department data, there is a marked increase in high school graduation: in 2009, more than 4 out of 5 (85 percent) of adults aged 25 and over reported having at least a high school diploma or its equivalent. This number was just 25% in 1940, 50% in 1967 and 75% 1986. (Ryan and Siebens 2012) However, schools today are organized and managed much as they were in 1972—based on a mass-production, factory model with students divided up into grade levels and classrooms of 25 to 40 students with one teacher, responding to bells or buzzers signaling when it is time to shuffle off to another activity. The content of education is a state-determined curriculum separated into subject areas articulated as grade level standards, expectations, or essential learnings. Student progress is assessed primarily through formal testing. In fact, statewide, standardized testing has increased multi-fold in recent years in response to federal initiatives such as No Child Left Behind. (Institute of Education Sciences National Center for Education Statistics, 2012)

[2] As of 2010, 82% of the U.S. population lives in cities or suburbs. Central Intelligence Agency (US), (2012).

For K-12, the 2012 student experience is much the same as in 1972: a fixed, 6 or 7 hour school day, 5 days a week, 180 days a year, in self-contained classrooms with one generalist teacher in elementary schools, or a series of subject area teacher specialists at the secondary level. Most students (and teachers) follow a fixed schedule with minor variations each day.

At the district level, the logistics of managing thousands of students each day often trump preferred pedagogical or sound learning science decisions. For example, according Carskadon and colleagues (Carskadon, 1999, cited in Banks and Atkinson, 2004) "…hormone and physiological changes that come with puberty affect teenagers' sleep schedules so that they find it difficult to go to sleep early or get up early. Puberty causes shifts in teenagers' sleep cycles to favor a late night schedule, and teenagers who stay up late at night and are difficult to wake in the morning may not be 'lazy' but may simply be following their natural cycle." In a follow-up study, Carskadon et al. found that the students' brains at 8:30 in the morning were essentially still asleep. (Carskadon, Wolfson, Acebo, Tzischinsky, & Seifer, 1998) These puberty-associated changes unfortunately often coincide with the transition to secondary schools that often have earlier starting times than elementary schools due to bus and after-school sports and activities schedules. Even when such research indicates that change is warranted, it has been difficult to overcome the inertia and mindset of the mass-production, factory model.

In terms of higher education, we see widespread recognition of the value of higher education with a greater percentage of young people attending and graduating than ever before. For example, the rate of college completion for the population 25 years and over grew from 11 percent in 1970 to 30 percent in 2009. (Ryan and Siebens, 2012) However, as with K-12, the structure and approach of education in college and universities in 2012 is still very much the same as in 1972—organized into degree programs often comprised of a series of lecture-based courses. On the undergraduate level, many of these classes occur in large lecture halls where students are essentially anonymous. A telling video created by Kansas State cultural anthropology professor Michael Wesch and 200 students highlights the frustrations of students today and the challenges they will face in their lifetimes. (Wesch, M. 2007, October 12)

But, the winds of change are strong—fueled by the advances in information technologies. Our daily lives are infused with digital tools and devices—personal computers, mobile and smart phones, game consoles, and social networks. These technologies boost our capacity to process, store, retrieve, and communicate information and have fundamentally changed the way we engage in work and recreation.

One would expect similar profound changes in education; however schools, particularly K-12, have lagged behind in terms of ubiquitous use or integration of technologies in learning and teaching. While the ratio of K-12 students to instructional computers with Internet access has dropped significantly in the U.S. (6.6 to 1 in 2000, 3.8 to 1 in 2005, and 3.1 to 1 in 2008 according to the National Center of Education Statistics, 2010), many students still do not have continuous or regular access to a computer or digital device for individual use in school. It is still the norm for K-12 students to share limited numbers of machines in classrooms or be scheduled every few days for a period of time in computer labs.

Availability and access to technology is much different in higher education. According to the 2011 EDUCAUSE annual study (ECAR) of 3,000 students at 1,179 colleges and universities, most students own multiple digital devices including a laptop (87 percent), a USB thumb drive (70 percent), an iPod (62 percent), a smartphone (55 percent), a digital camera (55 percent), a webcam (55 percent), and a desktop computer (53%). (Dahlstrom, De Boor, Grunwald, & Vockley, 2011) "Their clear preference is for small, mobile devices that fit in a pocket or backpack and go with them everywhere." (p. 7) However, few students report that their instructors use technology effectively (19%) or frequently enough (20%).

College and university students are heavy personal users of technology for access to resources, productivity, and connecting to people and information. And, most students recognize the promise of technology for making learning a more immersive, engaging, and relevant experience. (Dahlstrom, De Boor, Grunwald, & Vockley, 2011) Many faculty are also regular users of technology for personal productivity, information, and communication. However, from a structural perspective, higher education has not undergone the same transformative technological changes as other sectors.

We expect that by 2052 education on all levels will be radically different from today with a far-reaching shift from education factories aimed at the masses to individual education aimed at meeting the goals and aspirations of individuals. Christensen, Horn, and Johnson argued that if schools cannot incorporate technological innovations to personalize learning, then students will pursue education *outside of* traditional schools instead of *within* them. If schools do not adapt, they will meet the same fate as businesses such as Digital Equipment Corporation, which dominated the business computer market in the 1960s and 1970s but went out of business when it failed to respond in time to the growing personal computer market (Christensen et al. 2008).

We agree with this assessment of the immediate challenges that schools face, but we go even further: we assert that disruptive change in the locus and control of education is inevitable and desirable. Just as technology has allowed consumers to find media beyond just that from traditional publishers, newspapers, record companies, television networks, movie theaters, bricks-and-mortar retailers, and others, so too students will be able to access more learning opportunities beyond the narrow and monopolistic control of schools, colleges, and universities. Colleges and universities should still provide students rigorous and clearly defined programs of study and high quality educational opportunities, but the emphasis will be on customized learning for individual students with multiple paths to show achievement.

In 2012, we already see developments driven by technology that herald a shift from a mass production education model focused on instruction to a customized, individualized model focused on learning:

- The "flipped" classroom with an inverted teaching structure where the content is delivered outside class (usually online), and engagement with the content (discussion, exercises, skill development and practice) is done in class, guided by the instructor and in collaboration with peers (Ojalvo & Doyne, 2011)

- Online lessons ranging from the Khan Academy's homespun math videos free on YouTube to Apex Learning's for-profit online Advanced Placement (AP) courses (www.khanacademy.org, http://apexlearning.com)

- Massively open-online courses (MOOCs): Free or low cost online courses offered by top schools, e.g., the joint MIT/Harvard edX partnership (DeSantis, 2012; Brooks, 2012)

This demassification and individualization will be possible due to expanding technological capabilities for managing huge amounts of data and information about learners, new forms of programs of study and educational experiences, new processing, access, and communication tools, and a sophisticated multimodal information infrastructure supported by skilled information professionals. The nature, characteristics, and scope of these areas are explored in more detail below.

The Demassification of Education

The most profound and far-reaching change in education over the next 40 years will be the move from a mass production model focused on teaching to a customized, individualized model focused on learning. As noted above, in 2012 education K-20 predominantly follows a factory approach—organized around the inputs of instruction (classes, schedules, and curriculum) for students enrolled in institutions and programs of study. By 2052, the focal point should be the individual student and what she or he needs to learn in order to achieve certain goals. Education is decentralized. In 2052, there are clearly defined learning goals and objectives for various degrees, certificates, or other programs of study, but students are able to attain and demonstrate requisite knowledge and skills via many different paths and earn credit for involvement in research and student-driven investigation that might diverge from conventional pathways of learning.

This requires a shift in the roles of the academy—transforming from sole source control of the means and ends of instruction to an open approach that facilitates learning from multiple, alternative paths. In 2052, colleges and universities will no longer be fully responsible for the delivery of instruction. Rather, beyond offering unique, high quality learning opportunities (e.g., the best scholar, teacher, mediaprod, and/or lecture), the institution is engaged as the aggregator and validator of learning and achievement. Brands are differentiated in three ways: (1) the quality, uniqueness, and quantity of learning experiences offered, (2) the ability and reputation of the institution as advisor, mentor, and guide to individual students in various disciplines and professions, and (3) the reputation and credibility of the institution as assessor and validator of student achievement. A "degree" from a top school will represent the validation by that institution that a student has attained the level of knowledge and skills deemed essential and appropriate for a program of study, not that a student has enrolled and completed a certain number of courses.

This demassification and change in emphasis from instruction to learning requires sophisticated, effective, and efficient information management systems. Customized learning requires detailed and specific data and information about the following:

- Students: personal attributes including cognition, goals and objectives, interests, experiences, activities, products, and performance

- Learning experiences: formal and informal experiences in terms of validity and reliability of the institution and/or teacher(s), content (information, knowledge and skills), logistical attributes (locus, method, time frame, etc.), and applicability to various programs of study

In 2052, the infrastructure of the academy—personnel, resources, facilities, systems—is primarily focused on fulfilling the aggregator/validator role rather than the 2012 focus on direct delivery of instruction. And, the linchpin that makes all this possible is the "personal education record" – the PER – backed by carefully established standards, protocols, and governance of data and metadata.

The 2052 personal education record (PER) bears little resemblance to the traditional academic transcript. The traditional transcript is severely limited—providing information about courses taken and grades for each course indicating a student's overall performance. The transcript is organized one way—chronologically and offers little in the way of context or specifics. Readers of the transcript might be able to infer more detail about what the student knows and is able to do if they had background knowledge about such things as the course content, examples of the student's work, the nature and abilities of other students, assessments used, and the instructor's grading approach and philosophy.[3]

The mid-21st century Personal Education Record is a completely different form of documentation. It is a dynamic, holistic knowledge system that seeks to capture all *learning* experiences – regardless of how or where the student experienced them – physical or virtual, formal or informal, purposeful or serendipitous. By identifying and tagging diverse learning experiences, the PER stores "big data" about an individual student's experiences and goals. In some ways the PER is like a portfolio, but its large-scale processing/crunching to organize and parse this data also makes it relatively easy for those who need to see a summary of evidence of a student's abilities in particular areas to do so. The PER's system of validation of learning achievements by the student's mentors and advisors also allows prospective employers or academic admissions personnel to be confident in the validity of documented accomplishments.

The PER provides a well-organized information system to connect students' goals and schools' programs of study to relevant learning experiences. Students use the system to set goals for their education, be offered suggestions for experiences to learn to apply new ideas, add records of those experiences to the PER, and have those records validated by faculty and/or other mentors.

To provide a structure for the PER, universities, colleges, and vocational schools partner with employers and other stakeholders to map the curriculum in old and new fields of study. Information professions help to create, manage, and organize these as a clear outline of certain foundational topics of which

[3] See Bill Graves's paper in this volume for his description of an Educational Positioning System which can both help students navigate through various opportunities to learn and maintain a private but sharable record of their educational data.

students should be able to show understanding when they study in a particular field. The system also maps related or tangential topics that students may want to investigate to deepen understanding as well as certain open questions in need of original research. This map provides a framework on which students can attach evidence of learning. Learning experiences have associated metadata to prompt students to connect a memory of the experience (much like a short video) to the learning map in their PER. These organized records of memories can serve as evidence of learning and as opportunities for the student to reflect on their experiences and make connections to other concepts learned.

The Changing Roles of the Academy

Universities serve a range of distinct educational roles:

1. Research - Extending knowledge through questioning and investigation
2. Curriculum - Deciding what should be learned
3. Teaching and Learning - Providing opportunities for students to engage with topics of study
4. Assessment - Checking students' understanding of specific material studied
5. Validation - Affirming, through conferring degrees or other credentials, that a student has completed a program of study with requisite knowledge and skills

Universities and other higher education institutions have carried out these roles since at least the time of Abelard. The nature and scope of content to be learned, however, is now affected by the accelerated pace of research leading up to 2012. If educators still think of the curriculum as a fixed body of knowledge in 2012, we will need to become more flexible in that thinking not just for our doctoral students, but in the work of teaching master's students, undergraduates, and vocational and technical students as well. Information and communication technologies (ICTs) are also changing so quickly that all programs of study must adapt to new ways of harnessing students' ubiquitous access to information. Current ways for structuring the curriculum and teaching courses will not be adequate for connecting students with a multiplicity of ways to learn—not just on the campus, but also in nature, workplaces, cultural institutions, and virtual worlds. If students can learn off-campus and document these diverse experiences as evidence of understanding and competence, then—to remain relevant—universities need to consider new ways to assess and validate the knowledge and skills that these students demonstrate. In this section, we examine each of these five roles of the university and consider how the vision for each role may be changing.

1. Research

Extending knowledge through original research continues to be a key role for universities. Faculty and students strive to advance knowledge by exploring unanswered questions. Professors and advanced graduate students, however, will not be the only ones doing original research. All persons need higher levels of thinking to cope with changing information and technology in 2052. Research cannot be isolated in the ivory tower. University researchers continue to guide research agendas, but they also

continue and deepen collaboration with practitioners and with students. Such collaborations, when done well, provide benefits to university students and faculty and to industry by providing opportunities to connect students with rigorous and relevant learning opportunities. Such partnerships allow students to learn from and earn credit for contributing to research and innovation.

In 2012, research is too often considered as being distinct from teaching. Instructors and others also conflate the remaining functions on the above list (particularly curricula, teaching and learning, and assessment) under the umbrella of "teaching." Such conflation often prevents us from attending to each of those functions in ways that might better support students' learning. All five of the universities' functions deserve distinct attention, but may need to be more integrated in practice.

2. Curriculum - the ends of learning

The Academy in 2052 plays a major role prioritizing what students learn—the ends—but has a smaller role in determining how students learn these things—the means. By charting the learning map used in most students' PER, the university defines curricula and helps students set clear goals. When students are considering education and career options, they can meet with a mentor and look at the related learning maps to help them set goals. The student can try out some learning experiences or meet people identified as having relevant interest and/or expertise. Using this information, students can select programs of study and immediately begin learning and recording experiences in the PER.

The structure of the programs of study in the PER define the concepts and skills that a school believes students should master as they work toward a degree or credential. Each program of study has standards that are consistent, clear on granularity, and measurable. A program of study provides a framework for connecting students with learning opportunities that are consistent with student goals and requirements of the university.[4] The frameworks used in the PER prioritize foundational concepts and procedures that all students in a particular program of study are expected to master, but they also identify extended or tangential areas that students can explore to extend their understanding, develop expertise, or distinguish themselves as having gone above and beyond the basics. Many students express interest in exploring uncharted territory. For these students, the map and frameworks provide guidelines for related foundational ideas they can study as well as open questions to explore with a mentor's guidance.[5]

3. Connecting students with educational opportunities – the means of learning

In 2012, higher education still views a program of study as a series of courses with particular topics on the syllabi, all of which must be taken by a student to earn a particular credential regardless of the different backgrounds and experiences students have prior to entering their programs of study. Schools will change, however, from a focus on course-based teaching to one of competency-based learning. In

[4] Graves also describes an Educational Leadership Commons based on the Internet Society which could guide policies for competency-based learning and evaluation.

[5] In this volume, Liz Liddy explains the need for schools to be flexible in providing opportunities for students to explore innovative ideas, and she presents the iSchool at Syracuse's Certificate of Advanced Study in Information Innovation: _____ as a model of agile credentialing.

2052, a university's learning spaces look very different. Lecture halls seem like quaint relics, used for special presentations and events. Learning is not organized around courses in the traditional sense, but around menus of potential experiences that could be associated with programs of study. Students and their mentors consider various opportunities for the student to engage with simulations, interactive study rooms, other people, and real world experiences related to the goals in their learning plan.

Universities remain communities where students can engage with other people in conversations in which they encounter new ideas, confront misconceptions, deepen their understanding of concepts, and hone skills. Colleges and universities, however, no longer have exclusive control over the means of education. Based on the complete and holistic PER, students have a range of options, which besides talks and colloquia within the school's community, also include opportunities to connect with people, workplaces, and media from all corners of the physical and virtual worlds.

In 2052, for example, a person interested in becoming a library and information science professional is able to request a preliminary degree audit that compares their learning accomplishments with the baseline of defined learning goals (knowledge and skills) for the profession created and validated by professional and accrediting organizations working in cooperation with the schools and employers. Based on the applicant's PER, the audit authenticates relevant attained knowledge and skills and gaps to be addressed in a program of study. Various accredited, degree-granting institutions can then offer program of study "quotes" – the learning goals and objectives that must be attained as part of the program and the various paths open to the student to attain them. Schools and programs vary greatly in terms of unique learning goals beyond the common baseline, special areas of expertise, emphasis or focus, reputation of core faculty, and preferred learning experiences and options. Innovation and alternatives are encouraged, and applicants could choose the school, program, and options that best meet their needs. This is all made possible by a massive data and metadata infrastructure that fully integrates with individual learners' PER.

4. Assessment of students' understanding of concepts, skills, and topics studied

Already, in 2012, we are beginning to see how people and systems can work together to give students prompt feedback on their understanding of the content they are studying. The Coursera project (Stanford, Princeton, and others) and EDx (MIT and Harvard) are already building inter-institutional systems in which machines and crowd-sourcing help professors grade and give immediate feedback on students' formative work in massively open online courses (MOOCs). (Koller, 2012; DeSantis, 2012) Cathy Davidson of Duke created a stir in 2009 with a blog post titled "How to Crowdsource Grading" in which she announced that instead of giving all the grades in one of her classes, she would have students do peer-grading so that they "learn how to be responsible judges of quality and … learn to be responsive to feedback as well." (Davidson 2009) The story went viral, with many people criticizing Davidson for abdicating her responsibility as professor of the class, but she later wrote about how she was able to see the quality of student work improve when they felt they were writing for a genuine audience of in-class peers and external online readers. Stepping back from micro-assessment allowed Davidson to see the bigger picture of each student's contribution not only in his or her own assignments but also in their

responses to the work of others. Crowdsourcing the micro-assessment facilitated Davidson's macro-assessment of each student's engagement with the topics covered in the course. (Davidson, 2011)

In 2052, students engage in many different activities that provide ongoing evidence of learning the specific objectives associated with their learning plan. When students have gaps in their understanding or do not demonstrate learning on a first attempt, they have repeated real and virtual opportunities to review the material and/or meet with tutors. Assessment of learning includes digital evidence of students' work and experiences as well as annotations by faculty, mentors, workplace supervisors and others who attest to specific knowledge and skills that the student has demonstrated.

Standardized testing, teacher quizzes and tests, performance observation, and other methods have long been used to check if students can demonstrate a particular understanding or skill. Before 2012, however, there was no practical way available for students and teachers to store all this data within a framework that helps show the larger picture of a student's knowledge and skill. A traditional transcript may be intended to provide this bigger picture, but the transcript does not provide the option to go back and see which standards were actually assessed in a course—and which of those standards the student mastered. The PER system, by contrast, gives the viewer the ability to zoom in to show the specific standards students have achieved and to view some of the evidence that was the basis for the assessment of the student's competencies and achievements.

5. Validation

One significant role that universities play to is to grant degrees and other credentials which confirm to employers and other stakeholders that a student has met or exceeded requirements to show proficiency in a given field of study. This role is even more important in 2052 as students bring together learning experiences from a wide variety of contexts.

To determine whether a student has fulfilled the goals on his or her program of study and met the requirements to earn a degree, faculty members who have worked with the student review the evidence in the PER and discuss it with the student and with one another. Mentors affirm achievement and highlight learning experiences that have distinguished a student's personal achievement in their program of study. Faculty working with the student also look at the big picture to confirm when the student has shown all of the essential knowledge and skills that a credential certifies. Such review assures the rigor that the institution expects of its graduates and helps assure future employers that a graduate has the knowledge and skills that the degree represents.

Technology - Tools and Environments

Before projecting forty years into the future, it is revealing to reflect on the extraordinary developments over the past 40 years. For example, Intel introduced its first 8-bit microprocessor in 1972 (the 8008 chip) which IBM used it in its first personal computer in 1981. In the late 1970s and early 1980s, Atari video game systems and cartridges became common in many homes. In 1982, TCP/IP (the Internet protocol) was standardized and a world-wide network (the Internet) was introduced. ("History of the Internet," 2012) The 1990s saw the emergence of the World Wide Web, Wi-Fi, and Google followed in

the first decade of the 21st century by such innovations as the iPod, Facebook, YouTube, Twitter, the iPhone, iPad, and Kinect. These and related technologies have profoundly affected the nature of human interaction, productivity, commerce, creativity, and recreation.

We have not yet seen the same level of impact of technology on education as in other sectors. In 2012, there are still concerns about technology access, availability, and infusion into instruction (K-20). With the exception of PowerPoint and the recent increase in availability of online classes, the adoption of technology for teaching has been modest. However, as noted, college and university students have embraced technology for productivity, access to resources, and connecting to people and information. Word processing, e-mail, the Web, and search are indispensable tools for students and faculty in 2012, and their impact on writing, information seeking and use, and communication cannot be overestimated.

Fully aware of the awe-inspiring explosion in technological innovation and creativity over the past 40 years, we expect even more world-changing developments in the next 40 years. Examples include:

- For productivity, from processing words to processing knowledge via a personal digital guide (PDG) in the form of an avatar or hologram that supports, guides, and facilitates creating and communicating knowledge. Beyond the use, processing, and presentation of information in all possible forms, the key capability of the PDG knowledge processor is the collaborative, continually evolving relationship between the PDG and the user to improve framing tasks or problems, information gathering and use, and synthesis and presentation of knowledge.

- For information, search tools that are aware of context and user needs make highly relevant and credible information and data of almost any kind instantly available and customized in style, language and format (including massive data sets displayed as virtual or physical 3D objects) to the needs and preferences of the person.

- For communication, wearable or implanted nano-devices respond to thoughts and transfer data, information, or ideas effortlessly as well as manage, process, and store incoming messages according to personal preferences.

In 2012, we already live in an increasingly intelligent environment with a parallel information universe that monitors, interacts, and provides feedback to humans. This continuous connectivity will expand many-fold over the next 40 years as more and more physical objects (such as walls, windows, desks, tables, and even chairs) become digital and “intelligent” in terms of capable of carrying out processing and being addressed (i/o). In 2052, we routinely use digital paper and books that look and feel like physical paper and books, and nano-devices are embedded in our possessions for access and use that are directly brain-controlled and manipulated. We even have digital paint (digipaint) that can coat any surface to make it connected, addressable, and smart.

One development has particular relevance and impact for the information field and education: the virtual study room. The virtual study room is a flexible and customizable space in a virtual environment

that facilitates individual (or group) information problem-solving. Similar in purpose to the small, private, isolated, and highly popular study rooms found in some university and libraries in the physical world, the virtual study room offers the same advantages of the physical study rooms. It is a place for focused study and thought, to store and organize gathered resources and materials, and to be able to leave and return to find your materials and work exactly as you left them.

At the same time, the virtual study room overcomes the constraints of restricted numbers of physical study rooms, the small size and limited furniture and contents, and the need to eventually put away your materials and give up the study room so others can use it. In a virtual world, users can even have a different study room for every major topic, project, or question they wish to investigate. Virtual study rooms help to immerse users in their work—easily remembering where they left off, surrounded by content, self-organized for their own work styles, and conditioned to focus, think, and create while in the room. (Eisenberg, Lin, Marino, & Karlova, 2011)

By the mid-21st century, virtual study rooms are a common feature in academic libraries. Many faculty and students even choose to present their room (or part of their room) as a public space for sharing their thoughts, knowledge, and ideas. These public virtual areas can be temporary or the creator can petition the librarians to consider the room as a permanent part of the library collection. In this way, the academic library becomes directly involved with local knowledge creation and sharing, contributing to the global knowledge network.

Implications for the Information Field and Information Education

The culminating conclusion from all the preceding points, speculations, and arguments is that education in 2052 will be fundamentally and radically different than in 2012. The change in overall structure and organization and many of the specific differences in education requires a sophisticated information and technology infrastructure and numerous systems, devices, resources, and tools. Therefore, the information field and information schools can and should play a leading role in the transformation of education.

Content-wise, information and information technology are the underpinnings for transformation of education. The information field *has* gone through a revolution, and the scope and content of the field is profoundly different today than it was in 1972 before personal computers, the Internet, and the Web. The change is more than just the move from large mainframe computers, proprietary dial-up databases and services, with limited and restricted access to 2012's powerful, hand-held digital devices, the WWW, and thousands of online databases with fast, direct, and easy access.

One of the biggest and most fundamental differences is the change from scarcity to abundance to overload. The challenge today is not one of finding or locating information; it is sifting through all the sources and information to determine what is the most relevant and credible. In Project Information Literacy, Head and Eisenberg found that students are comfortable and able to search out information. They report difficulties, however, with clearly defining their task or problem, filtering through all the irrelevant results, and applying quality information to their tasks. (Head & Eisenberg, 2010)

This points to a very different role and emphasis for libraries and librarians—from traditional collection development, management, and access to customized, individualized, and targeted information services and instruction. It also reflects important new areas of professional engagement as well as research and development opportunities for information professionals and scholars across the broader information field. For example, as described earlier, the transformation of education from factory to individual requires an elaborate, powerful data and information infrastructure. From an information perspective, there is major work to be done in terms of fully understanding: the needs and behaviors of learners, teachers, and other players; information and knowledge organization; large- and small-scale systems design; developing policies and standards; institutional coordination and management at all levels; and envisioning and planning new forms of information and learning services.[6]

By 2012, many information schools have earned positive reputations within their institutions as innovators in implementing online learning programs, integrating technology into the classroom, and cross-disciplinary collaboration. Information schools also work well together, for example, through the iCaucus (www.ischools.org) and cooperative efforts such as the WISE consortium for shared distance education opportunities. (www.wiseeducation.org)

Because the essential elements for radical innovation in higher education articulated in this paper are core academic and professional concerns of the information field, information schools can lead the way in terms of studying, designing, and implementing new approaches, structures, and systems. In addition, information schools encompass both the professional and the academic. While this has been a point of contention at times in the past, this should be a strength moving forward. Information schools can lead the way in terms of celebrating the professional and the academic, for example, infusing R&D into learning at all levels.

Work and life in the 21st century requires both the theoretical and the practical, and information schools can serve as a model for the integration of professional and academic content, skills, issues, and concerns. This includes new relationships with business and industry—going far beyond internships or placement of graduates. The private and public sectors work together to provide students opportunities for learning from direct involvement with real-world activities and to give employees recognition for workplace learning.

There is a tremendous amount of work to be done to make individualized education the norm. Most of this work intersects with the scope and interests of the information field and information schools. Cutting-edge topics such as big data, social media, privacy, security are directly relevant, but the information field and schools also need to articulate and champion the broad vision, actively seek out

[6] Moran and Marchionini list six core values which iSchools draw from the tradition of librarianship: organization of information, universal access to knowledge, collaboration to share knowledge, intellectual freedom and diversity of thought, self-directed learning, and stewardship and preservation of knowledge. To successfully transition to the flexible and individualized model of education we describe here, these six core values may need to drive not just iSchools but whole institutions and collaborative networks of organizations with a stake in higher education.

partners on campus, and get buy-in from those engaged in top-level decision-making and strategic planning. Now is the time to take the initiative.

Discussion: Warnings and Limitations

The idea of individualizing instruction through the PER is not without problems. These potential difficulties, however, are ones that information professionals are well-poised to help colleges and universities address successfully. One such problem is balancing information abundance and information quality. In designing the PER, learning experiences will need to be catalogued or tagged in such a way that high-quality, relevant options float to the top of a student's menu of choices. Information professionals' expertise in evaluation and use and knowledge organization will be key to effective design and implementation of the PER.

Another potential difficultly is the Big Brother problem. The ubiquitous nature of the systems discussed could make it difficult for students to access content and record evidence of learning while still maintaining personal privacy. Again, library and information professionals have a long tradition of providing users with open access to information while maintaining confidentiality of patron records—expertise that will be important if schools are to successfully deploy such systems. Unfortunately, individualization of education with a PER system could potentially reify existing social inequities if it is easier for socially-connected, upper class youth to find mentors to attest to their learning than it would be for youth from poverty to get equivalent recommendations. While inequity is not an easy problem to solve, information professionals have a long history of extending information services to impoverished communities—experience salient to helping address this problem. Giving students more control in selecting media and experiences from which to learn will make it ever more important to ensure that students are effective users of ideas and information. The information field's commitment to information literacy can also help students to be better prepared with the research and critical thinking skills essential to be successful in these new learning environments.

Personal education records should be used for individualization of education, but if done badly, the PER has the potential to promote conformity. This is yet another area where information professionals' commitment to intellectual freedom and our history of building and providing open access to resource collections that represent diverse viewpoints will be important to helping colleges and universities successfully design and implement systems to effectively support the future of learning.

Conclusion

While it is impossible to predict the specifics of technological change 40 years in the future, we have identified some key trends, scenarios, and desired outcomes. We have tried to provide a glimpse of potential for radical transformation for education in 2052, but the reality is likely to include more profound innovations than we can possibly imagine today.

We believe that education in 40 years will be radically altered, disrupted, and different in both structure and delivery. While technology is a major force driving these changes, they are not primarily about systems or devices. Connectivity, machine learning, and interactivity will be marshaled to individualize

highly motivating learning and facilitate communities of practice. The PER should not replace human contact and interaction; it should facilitate mentorship, discussion, and social learning. This revolution is about replacing a system that treats students as mass-produced widgets rolling off an education assembly line with one that supports a network of mentors who recognize each student as an individual and who are empowered to treat them as such.

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Is Education's Past Its 2050 Prologue?[7]

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I ask you to consider the future of education, especially of postsecondary education. If you choose to extrapolate from familiar paragons of academic excellence, you may gloss over a challenging policy conundrum. Progressive leaders around the world are asking for help from education leaders. Their policy goal is to scale up, often to unprecedented levels, the intellectual-capital pool of postsecondary credentialed adults. They also want the scaling process to address pressing workforce and economic development needs that often depend on expertise in science, technology, engineering and mathematics (STEM) – or their applications.

The observations that follow suggest that the demographic, economic, and cooperative dimensions of scaling present a conundrum unlikely to be resolved by extrapolating forward with ongoing incremental improvements to today's credentialing paradigms. Indeed, I argue that new paradigms will be needed and will require technology-enabled redesigns of economic governance and information governance of the credentialing market.

Educational Attainment

We, the higher educated, must globally grow our ranks in order to resolve threats to the common good, thereby building enough trust to make intellectual capital itself a common good. Hoping for such a virtuous cycle, H. G. Wells wrote in 1920 that, "Human history becomes more and more a race between education and catastrophe."

Over 90 years later, education is more important than ever, not only to its internal stakeholder groups, but also to external stakeholder "investors" – students, parents, governments, donors, employers, and suppliers. Indeed, external investors are expecting their collective investments in organized learning to yield far more than the aggregate of the private returns that accrue to individuals who complete a trusted postsecondary degree or certificate. People with advanced learning want advanced jobs, and advanced jobs "want" people with advanced learning! Equal-opportunity governments want both! We

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[8] Most of the evidence and logic that justifies the holistic thinking in this paper are in the author's two recent EDUCAUSE papers: 1) "Facing Education's Mounting Challenges with Collaboration and IT," ECAR Research Bulletin 5, 2011 *http://net.educause.edu/ir/library/pdf/ERB1105.pdf+, and 2) "Waste Not the Learning Productivity Crisis: Transforming Educational Opportunity into Educational Assurance," EDUCAUSE Review 45, No. 1 (January/February 2010), Web Bonus [http://net.educause.edu/ir/library/pdf/ERM1014.pdf]. The first of these papers addresses the need for new forms of cooperation and collaboration and then proceeds to lay the foundation for this paper and others.

need more lifetime learners who can add value not only to the churning global economy and polity, but also to the deepest expressions of learning: the research discoveries and resulting innovations that create new value in the economy and in the common good. Advanced learning accordingly must become a common good – both a public and private good – that ranks in importance alongside the world's inter-connected economies and ecosystems and individuals' physical health and security. In this context, ***educational attainment*** – *the proportion of an adult demographic holding a trusted postsecondary credential (degree or certificate)* – is a rational proxy for the capacity to avert or mitigate Wells' catastrophes, while striving always to advance and sustain social, economic, and environmental justice.

Some Conundrums of the Attainment Challenge

To muse on the *attainment challenge* in your geopolitical context, substitute the relevant data (for the U.S. data) in the following interconnected observations:

1. Various policy and business leaders in the U.S., including President Obama, are supportively pressuring education leaders to scale up the proportion of adults who hold an accredited postsecondary credential (a trusted degree or certificate) from 40% to 60% over the next 10-15 years – thereby swelling the population of credentialed adults from around 80 million to over 120 million, which is a tall order.

2. Were the 40% proportion to scale up to 60% by 2020 – President Obama's original goal in 2010 – then it would have increased at an exponential rate averaging at least 4.1% per year. In the process:

    a. Today's copiously leaky lifelong education pipeline would have scaled up in absolute terms to enable an increase in the attainment proportion from 40% to 60% of the adult population.

    b. The proportion of low- and middle-income students in the pipeline would have increased in response to prevailing economic demographic trends.

    c. Funding demands for needs-tested student grants and loans accordingly would have increased and thereby further exacerbated today's ***conundrum of three-way affordability***:

        i. affordability of net tuitions or net credential costs to the growing proportion of low- and middle-income students and families,

        ii. ii. affordability to governments and other funding sources of their investments in making education more affordable to these same students and families, and

        iii. affordability of the operating costs incurred by institutions offering credentialing "opportunities" in which both tuition pricing and presumed quality are based on

credit hours, thus forcing net tuition upward in response to a growing proportion of needy-student enrollments and declining per-student contributions from government.

3. Annual credential completion rates are not necessarily a proxy for national attainment rates! In spite of concerted efforts – many successful – to improve annual credentialing rates at the institutional level, annual national attainment proportions have stagnated at around 40% for at least three decades.

4. There is no evidence that incremental, continuous quality improvements in annual credentialing rates at the institutional level will automatically aggregate up to improve upon attainment proportions at the targeted regional, national , or global scale. Widespread, achievable improvements in credentialing rates at micro levels may not improve attainment rates at targeted macro level!

Think Globally, Act Locally: A Necessary but Not Sufficient Strategy

The preceding overview analysis will vary from one geopolitical context to another. Key variables include population size, growth rates, and economic demographics, along with initial attainment proportions and targeted attainment goals. Several structural issues nevertheless emerge to give pause to educators and policy leaders who are focused only on extrapolating to increased credentialing rates in their contexts. These issues include the following ones:

1. The three-way affordability conundrum must be resolved in order for education and its external investors to share equitably in the total expense and benefits of educational attainment at scale.

2. Attainment proportion and credentialing rate are different metrics. Credentialing rates are but one variable in any dynamical system of attainment proportions that depends on collective results from thousands of institutions. Little is known about what realistically achievable average annual credentialing rate, if any, might lead to a targeted attainment proportion during a targeted period of time. Consider that the Lumina Foundation's Goal 2025 is "to increase the proportion of Americans with high quality degrees and credentials to 60% by 2025." Lumina recently announced that 38.3 percent of working-age Americans (ages 25-64) held a two- or four-year college degree in 2010, which is up only modestly from 2009, when the rate was 38.1 percent, and from 2008, when the rate was 37.9 percent. These results defy well-intended, ongoing work to improve credentialing rates.

3. Improving attainment proportions is a dynamical systems challenge that should be studied to understand which interventions predict targeted attainment proportions within the constraints of three-way affordability.

4. Student success (improvements in institutional persistence and credentialing rates) is necessary but not sufficient for institutional success.

5. Institutional success is necessary but not sufficient for national success (or success at other macro levels of meeting attainment challenges).

Attainment at Scale: *Consumerizing* the Credentialing Marketplace

Closing the financial and scaling gaps in the common-good attainment challenge will not be easy, especially when so many institutions aspire to join the top ranks of today's paragons of academic excellence. Only ten institutions, after all, appear in any top-ten list! Large endowments or wealthy oligarchies and monarchies may permit a few institutions to serve a well prepared student body with practices and processes coveted by, but not affordable at, most other institutions. The vast majority of tuition-dependent institutions, and even some well-endowed public universities, are constrained by public charters and/or limited external support. These majority institutions, especially the public ones, are expected to become the engine for scaling up attainment. They will thrive only by proactively playing a major role, alongside government, in improving the three-way affordability of net tuition to low- and middle-income students and of the expenditures to the institutions and governments that together subsidize that growing student low- and middle-income economic demographic. The credentialing marketplace accordingly needs to become a *consumer marketplace* in order to serve the growing ranks of needy and middle-class students. *Consumerization* can be addressed through a number of strategies, some involving extrapolation and some involving more progressive, non-incremental innovations.

Adult Learner Strategy

In many nations, the adult population itself is one key to scaling up attainment. Many adults want or need affordable access to a trusted credentialing market, whether in pursuit of a first credential or an additional credential from which to improve upon their socioeconomic status or empower their contributions to the world.

"Flexing" for Institutional/Personal Optimization of High-Tech/High-Touch

We already know that credentialing programs that use the leverage of technology can be as effective and efficient as traditional programs. By being more purposeful about costs and flexibility, however, more can be accomplished. The ***flex strategy*** provides a full array of scalable, online (asynchronous) academic and administrative *self-services* to *all* students, as a means to reduce per-student cost structures while focusing high-touch faculty efforts on designing and affordably delivering the individualized expert help that most students need (and expect) as they advance along a learning pathway tailored to meet individualized needs and circumstances. Self-service permits expertise to be reallocated to the more pressing needs of the individual student. The resulting ***personalized-credentialing*** mantra for student, faculty, and institutional success might then read:

High-tech self-service anytime; high-touch individualized help when needed.

Competency-Based Learning: Defying the Tyranny of the Credit Hour

Competency-based learning puts the focus on learning outcomes and their evaluation, rather than on access and credit hours compensated. Transitioning away from the credit hour as the basis for credentialing to individualized competency-based credentialing programs can combine with the flex strategy and other strategies described below to lead to more open and affordable credentialing paradigms. Competency-based credentialing thus presents an opportunity for improving trust in credentialing – by unbundling education into learning services and independent services for evaluating learning outcomes, at least those that are part of the common core of basic fluency and critical-thinking skills. Unbundling is at the heart of the trend to help students when they need help, which is the high-touch leg of the flex strategy and which can modularize and shorten the traditional course- and semester-based pathways to a credential.

Common Core Redesign Strategy

A ***common curriculum of core knowledge and skills*** is broadly considered by educators to be a solid foundation for learning to learn and conducting a lifetime of learning. At various levels of experience and age, these skills and core content are required or highly recommended to almost all learners and represent a significant proportion of all enrollments worldwide. By using technology to redesign the common core and pathways through it, learned competencies and delivery costs structures can be improved. In combination with the other strategies touched upon here the common core redesign strategy can measurably improve learning readiness and, if learning competencies are independently evaluated, also improve the overall productivity and trustworthiness of attainment. The National Center for Academic Transformation has led and demonstrated the efficacy of this key strategy in the U.S. and beyond.

Actionable Accountability: Learning and Attainment Analytics

We now know that ***learning analytics*** tools can help improve student success and learning outcomes. The concept uses predictive analytics and other forms of analysis to help institutions move beyond periodic summative reporting into more immediately actionable formative evaluations and interventions – from the modular level to the course level to the institutional level. We also need ***attainment analytics*** tools (formative and summative) to help bridge the gaps in the pathways from student credentialing success to institutional success to national attainment success to global attainment success. The challenge is to formulate the questions and related indicators that can help measure the gap between, for example, institutional success and national attainment success. An even larger challenge, one that will determine how effective learning and attainment analytics can become, is the extraction of a student's data from various institutionally-proprietary systems into a distributed and privacy-secured ***unit-record database*** designed to give students full rights to their privacy-secured individualized, integrated educational record and to share any parts of that record at their discretion, whenever and wherever a lifetime of learning takes them. Analogous to a unit-record database in education is a digital, privacy-secured, personal health record that is under the control of the patient.

"Flattening" Strategies: External Sourcing and Institutional Partnering

In the global service economy, excepting the education and health care sectors, scale and consumer affordability have derived from innovations and service redesigns enabled by information technology. Productivity in the service economy has increased accordingly. To achieve similar results in postsecondary education, new forms of cooperation will be needed, first among faculty and administration and then among institutions willing to source non-core services externally or to share services with partner institutions. Thomas Friedman described external sourcing and partnering models as the ***flattening forces*** of *out-sourcing*, *in-sourcing*, *work-flowing*, *supply-chaining*, *off-shoring*, *open-sourcing*, *in-forming*, and *steroid-ing*. These models have not been broadly used in the credentialing market, where flattening has been interpreted to refer to institutionally-sponsored study-abroad programs or to recruiting foreign students to a traditional campus or its branch campus(es) abroad.

By adopting and sharing a common platform of flex services (see above), perhaps to include massive, online, open courses and modules (see the examples below), cooperation among institutions can increase economies of scale and per-student productivity results for each institution. By acknowledging that scale is no longer the inverse of quality, shared-service collaborations have an advantage over stand-alone institutions.

Examples of Strategies in Action

The U.K.'s Open University is a prescient, now mature and globally admired innovation. The OU has opened up tertiary access to low- and middle-income students (adults and otherwise), while also doing more than its part to scale up the proportion of adults holding postsecondary credentials. The OU also addresses attainment's escalating ***three-way affordability conundrum***: the need to lower the costs of attainment not only to low- and middle-income students, but also to the institutions and governments that financially support them.

The OU arose from rethinking teaching, learning, and credentialing in a context not unlike the interconnected challenges encoded here as the attainment conundrum/challenge. The result was a new institution, not the pursuit of incremental improvements to traditional credentialing practices among UK universities.

The OU, Athabasca University (Canada's Open University), and Western Governors University (WGU) in the U.S. are making inroads into competency-based credentialing, in some cases coupled with independent learning evaluations. These institutions and others are learning how to credential learning that draws significantly on ***open educational resources*** (OER) – *content and other resources openly and, typically, freely accessible*. At an extreme of OER are ***massive online open courses/modules*** (MOOC) in which one expert or a network of cross-institutional experts facilitates learning among thousands, even hundreds of thousands, of students at one time. The OU's OpenLearn, the Khan Academy, and ISKME's OER Commons are OER examples, while Connectivism and Connective Knowledge 2011 is an interesting MOOC from Athabasca University.

The Business Higher Education Forum in the U.S. is a nonprofit, non-governmental organization that brings together business and higher education leaders, along with leadership from government and other nonprofit sectors, to work on selected issues that are central to the national attainment challenge from both a business and education perspective. Current BHEF initiatives focus on a range of attainment issues in STEM education and on college readiness more broadly. These initiatives rely on the strategy of thinking globally, while acting regionally. The BHEF, moreover, is a partner to its project teams to ensure that regional projects can be synchronized at the national level around sharable innovations and effective practices. BHEF also has developed the STEM Research and Modeling Network that provide open access to the dynamical systems modeling tool created by Raytheon that has benefited a number of STEM attainment projects. A similar modeling tool might improve our understanding of the broader attainment challenge and its complex interdependencies and dynamic nature – see item 3 in the section "Think Globally, Act Locally: A Necessary but Not Sufficient Strategy."

The IMS Global Learning Consortium advances "learning impact by enabling the open foundation for seamless, agile and information-rich educational technology integration." Initially an open standards organization dedicated to interoperability among educational technologies, IMS has expanded its open mission by fostering an executive level, non-technical understanding of the necessary role of technology interoperability in achieving mission success, from the micro (institutional) to the macro (national) level of credentialing and attainment.

The BHEF and the IMS are examples of a nonprofit, nongovernmental organization built around relatively open governance models that guide a shared agenda and action plan to the mutual economic benefit of all stakeholder investors. Primary stakeholders are interested businesses and postsecondary institutions, in the case of the BHEF, and education providers, governments, and suppliers of educational technologies and services, in the case of the IMS. BHEF and IMS are practicing many of the principles of an open economic governance process for a common good.

A New Angle on the Attainment Challenge: Open Economic Governance

Affordable access to earning a trusted postsecondary credential has become nearly synonymous with the democratic value of equal opportunity. It's nonetheless tough to imagine postsecondary education – as currently operated, governed, and regulated – becoming a fount of *exponential* growth in new economic and social wealth. Policy makers who find attainment at scale to be an urgent goal in the global race for intellectual capital are accordingly wary of leaving accountability to educators and are increasingly inclined to legislate or regulate desired results. For some insights into how to dampen current trust and three-way affordability tensions between educators and education's external investors, consider two examples of undeniable progress for the common socioeconomic good: the Internet and the World Wide Web,.

Far from resembling the patchwork of gated communities that describes the organizations comprising today's credentialing marketplace, the common-good Internet is a network of networks that operates around the world as if it were one. The Internet is a paradigm of open, global self-regulation. It is

controlled by no one entity, but continues to race forward in response to the common-good interests of all of its economic beneficiaries. Through a Web browser connected to the Internet, the Web becomes a self-service access point for a wealth of resources and services – some free and some for a fee, some open and some by permission. The result has been exponential growth in economic and social "wealth," both private and public – the same result that we seek from scaling up attainment!

The explosive growth of the Web/Internet in both scale and impact would not have been possible solely by "thinking globally and acting locally" (as networks and network applications proliferated randomly at micro levels around the world). Open cooperation and coordination were required. The Internet Society was created as a nonprofit, non-governmental ***open economic governance organization*** for self-regulating, advancing, and sustaining the Internet.

For those who are interested, here is a brief overview of the Internet Society, which:

- is a global *cause-driven* organization governed by a diverse (elected and appointed) Board of Trustees dedicated to ensuring that the Internet stays open, transparent, and defined by you,
- is the world's trusted independent source of leadership for Internet policy, technology standards, and future development,
- works to ensure that the Internet and the Web that is built on it:
  - continue to develop as an open platform that empowers people to share ideas and connect in new and innovative ways, and
  - serve the economic, social, and educational needs of individuals throughout the world , today and into the future, and
- works with more than 55,000 members and nearly 90 Chapters around the world, as well as more than 130 Organization members, to achieve change through partnership and expertise in policy, technology, and communications.

The Web/Internet is thriving precisely because of its common-good paradox: for Internet access, resources, and communications to be available at unprecedented levels of self-service convenience, affordability, and scale to both individual and organizational option requires globally coordinated economic governance processes to advance and sustain the policies and the infrastructure and application standards that permit the effective exercise of such options. Do the postsecondary credentialing opportunities that are increasingly available to individual option through an unprecedented number of institutions and nations require open, globally coordinated economic governance processes in order to scale up attainment, affordability, and accountability around the world? My answer is "yes!" We should learn not only to think globally while acting locally, but also to cooperate purposefully and openly within a global economic governance entity in order to achieve measurable global educational attainment results.

The credentialing marketplace should not be allowed to become what economists call a "tragedy of the commons," a phrase connoting the intentional or unintentional abuse of a common-good resource by some individuals or organizations to the detriment of the resource and all of its economic beneficiaries. For educational attainment to help advance and sustain our world, the educated (educators included) must find a way to save education from its own complacency, weak attainment productivity, lack of transparent accountability, and failure to confirm through independent evaluation that students are learning to be lifetime learners as they work their way at scale through the credentialing pipeline and its myriad pathways.

Enter Elinor Ostrom, a 2009 Nobel Laureate in Economics. She was recognized for her work on the "economic governance of the commons." Her findings (for how best attempt to moderate the risks of a tragedy of the commons) favor an economic governance model having participation from each economic beneficiary group in the development and enforcement (by consensus) of "rules of the road" designed to advance and sustain common-good natural resources. Ostrom's work refutes the popular belief that economic governance for a common good should be left either to government (through regulation and legislation) or to entrenched non-governmental organizations.

Education Leadership Commons

Learning credentials are not natural resources, and education is historically entrenched and change resistant, unlike the Internet/Web marketplace. The attainment pipeline and credentialing marketplace nevertheless are common-good resources, and the attainment challenge, with its three-way affordability conundrum, is bearing down on "business as usual" in education. The time is right to look for innovative, structural, systemic solutions that might accomplish what extrapolation from the present is unlikely to accomplish. There are many ways to think about this possibility, but I propose the creation over the next few years of a nonprofit, nongovernmental, Ostrom-like, open, global economic governance entity for the credentialing marketplace – a global ***Education Leadership Commons***. The collective purpose is to develop and advance open interoperability of credentialing services, processes, and accountability metrics – all through minimally intrusive, consensus-based, trusted, cause-driven cooperation.

The ELC would coordinate the micro-to-macro scaling of attainment, while helping to quality-assure learning outcomes and maintain the mutual affordability of credentialing processes to credential providers and their external investors. The ELC would be a safe-haven where progressive education leaders could collaborate with like-minded policy, business, student, and foundation leaders to create (and provide stewardship for) rules of the road designed to advance educational attainment and its potential to exponentiate economic and social progress. The open ELC would face the challenge of rebalancing rights and responsibilities among the economic and social beneficiaries of the credentialing marketplace, while diminishing neither distributed educational autonomy nor expectations for individual student initiative and needs-tested funding from governments.

The ELC could be modeled along the lines of the Internet Society's successful governance mechanisms and standing working groups, such as the Internet Engineering Task Force and Internet Architecture Board. The ELC could be operationalized through standing working groups, their advisory or governance committees, and other nested and loosely-coupled efforts to advance and sustain educational attainment. Several of many possible ELC standing working groups are described below to illustrate how the ELC might function to address some of the challenges in the attainment conundrum.

1. Establish an ELC standing ***Attainment Productivity Task Force*** to develop and maintain accountability processes and metrics for monitoring productivity in the credentialing marketplace in alignment with attainment goals and in ways that can be trusted by all of its economic beneficiaries, yet also support local autonomy. A starting point for such an agenda could be to:

    a. Publish summary institutional-level productivity metrics formulated both to be universally transparent and to become meaningful benchmarks when compared within peer groupings. Such metrics, for example, might be as simple as the annualized ratios of:

        i. Credentials granted to unduplicated student headcount

        ii. Operating expenses to credentials granted

    b. Evaluate learning readiness independent of learning providers and governments and in the longitudinal aggregate to profile various population demographics and student bodies of peer-grouped education providers. This could be accomplished, for example, via the data from periodic, age-based, independent, constructivist evaluations of students' critical thinking and basic fluency skills. (Such evaluations are already available from various sources, even at the global level via the work of OECD's AHELO project.)

    c. Agree on some subgroups of the adult population for which the proportion of trusted postsecondary credentials should and could be tracked in the aggregate and within most geopolitical boundaries. (The OECD and the NCES already report such metrics.)

    d. Develop guidelines for mapping attainment production to professional and workforce needs.

    The simple metrics in 1.a are applicable in a macro context. Within micro peer groupings defined in consideration of various geopolitical and education-sector boundaries, however, ever more detailed throughput metrics and cohort-based approaches could be formulated to drill down into those in 1.a, which are productivity metrics for today's credentialing processes at a micro level of throughput.

Similarly, the learning readiness evaluations referenced in 1.b are meant, not to be one centralized series of multiple-choice assessments, but to be drawn from a pool of learning readiness evaluations that are independent of governments and education providers while admitting to age-based concordance among instruments of common purpose. Any number of other evaluations could be utilized by governments and institutions to track learning outcomes at various levels of content and geopolitical and education-sector peer groupings. The intent is not to stifle such micro activities, but to encourage them to roll up into a macro population that is as ready as possible for a lifetime of learning.

2. Establish an ELC standing ***Competency-Based Learning Task Force***. (See the previous section on "Competency-Based Learning: Defying the Tyranny of the Credit Hour.") The purpose is to examine and identify effective, scalable practices that draw on competency-based learning and, to some degree, on independent evaluation of competency. Also examine how competency-based learning can be made more effective and less costly by applying some of the other strategies outlined in previous sections – the actionable accountability, common core redesign, flattening, and flex strategies.

3. Establish an ELC ***Information Strategy and Governance Task Force*** to advise on how to make key credentialing information and application resources ubiquitously accessible and useful and how to govern such resources (***information governance*** for the common-good credentialing marketplace). We know, for example, that parents from low-income groups are frequently challenged by circumstance to nurture children who value and participate enthusiastically in education inside and outside the school. The haze that conceals the performance accountability of schools and colleges has political dimensions, but is also catalyzed by the difficulty of finding and accessing coherent information about education and the burgeoning library of online self-service learning resources. We need not only to market the value of credentials and attainment, but also to cut through the clutter that makes it difficult to learn more about access processes, net-tuition costs, and the myriad pathways to educational attainment – and do so in context for interested students and families. (See the brief comments about the Educational Positioning System in the subsequent section on "Goals as Outcomes.")

4. Establish an ELC standing ***Economic Governance Task Force*** tasked with making participation in the credentialing marketplace mutually affordable and economically beneficial to education and education's external investors. This is a critical task, and will require identifying an economic lever that can be used to drive changes that are economically beneficial for each of the parties involved. How else could we expect all of the parties to accept transformational change? One obvious lever is government funding in the form of needs-tested financial aid (taking the form of promissory grants, loans, and/or tax deductions). If such funding had to be earned by both the student and any education provider choosing to admit the student, then funding sources might be more inclined to stabilize and sustain their support. An earned right carries a responsibility and might be funded with greater unanimity than a pure right in the form of an entitlement.

Funding Sources for the Leverage of Earned, Needs-Tested Aid

That governments could shift their financial support for education to promissory aid that eventually flows directly to needs-tested students is an old idea that deserves renewed attention, even if it would be resisted in many geopolitical contexts. There are several differences proposed here that could make a difference. The most critical difference is that students would earn and re-earn promissory needs-tested aid through periodic evaluations of their learning readiness, but not through percentile ranking on any evaluations. The student who values education enough to submit to periodic evaluation of learning readiness would, without prejudice and as needed, have access to needs-tested promissory aid, while pursuing a form of happiness that is cultivated through higher learning and the self-respect it engenders.

Where government funding for attainment is declining and/or becoming more erratic, it might be possible to attract stabilizing funding from a "we-the-people" micro contribution infrastructure designed in collaboration with the ELC Economic Governance Task Force on the basis of the needs-tested, earned aid concept. According to recent public surveys, after all, most people value education as an individual good, even though it may appear unaffordable and opaquely unaccountable to many. The phrase "we the people," moreover, has again become a call for populist action on critical common-good problems. For example, Starbucks CEO Howard Schultz and his leadership team recently came up with a workable idea for creating new job opportunities while government funding and bank loans remain frozen. They have found a way to encourage and enable citizens to loan money to small businesses that have plans to pursue job-creating growth opportunities.

From some combination of government and other external sources, a start-up economic governance matrix of rights and responsibilities in the credentialing marketplace might then be based on responsibilities incurred by the financially supported student, responsibilities incurred by the education and learning evaluation providers that accept revenues from that student, and rights earned by the funding source(s) financially supporting that student. Below is one possible matrix of rights and responsibilities. Notice that the student is asked to submit periodically to the independent learning-readiness evaluation process described above in order to be eligible and remain eligible for a needs-tested promissory aid from government or other funding source. The value of the aid is estimated at birth from tax data and thereafter updated annually.

Economic Governance Matrix of Rights and Responsibilities for the Credentialing Market

Economic Beneficiaries	Responsibilities	Rights
Student	Submit to periodic, independent, age-based, constructivist evaluations of learning readiness starting no later than, say, age 15 and persisting for as long as the student wishes to qualify	Defray the costs of services provided by participating evaluation and education providers from a promissory individual account having needs-tested value estimated annually from tax

	for a means-tested aid.	data, starting at birth.
Evaluation Provider	Remain transparently independent from government and education providers while privacy-securing and maintaining evaluation data and concordance tables for age-based learning-readiness evaluations of like purpose.	Bill a participating student's aid account to help defray evaluation fees incurred by the student.
Education Provider	Track and openly report the shared accountability metrics maintained for peer-group analysis by the Attainment Productivity Task Force. Permit privacy-secured extraction in the aggregate of student and instructor data in support of longitudinal research by funding sources.	Bill a participating student's aid account to help defray the cost of learning services provided to the student.
Government and Other Funding Sources	Commit to promissory needs-tested aid to help students pay the costs of completing learning-readiness evaluations and academic programs (from participating evaluation and education providers).	Extract privacy-secured data (from participating evaluation and education providers) for research into learning readiness, attainment, and their costs to the economic beneficiaries of attainment.

The above matrix is based on the leverage of earned, needs-tested promissory aid. There are other possible leverage points or hooks for establishing trusted relationships among education providers and their external investors by rebalancing the economic benefits of attainment among the parties involved. To be sure, there will be devils lurking in the details of how to integrate economic governance across various geopolitical and educational boundaries. The possible outcomes of the above approach, however, may clarify the potential value of such rebalancing efforts.

Goals as Outcomes for the Education Leadership Commons

1. Unbundle and virally expand the credentialing marketplace through open, voluntary compliance with technical (IMS) and non-technical (ELC) interoperability standards and protocols for extracting and transferring, by mutual consent, core data about educational outcomes and costs into a distributed longitudinal data system in which:

    a. Each participating education provider and independent evaluation provider has the right to capture selective privacy-secured data about its participating students and instructors as part of the contract among the parties involved.

b. Each individual (for example, student or instructor) controls a privacy-secured record and portfolio of personal educational accomplishments to share selectively with sources of funding for education and employment – again as part of a trusted relationship of potential mutual benefit to the parties involved. (See the Educational Positioning System in the next item.)

2. Lay the framework for creating what Mike Mathews, a friend, has imagined as the ***Educational Positioning System*** of the future. The EPS gets its name by analogy to the myriad of applications that rely on the universally available and familiar Global Positioning System. The EPS could enable a suite of integrated technologies and massively interconnected data that would help ELC participants, especially students, to navigate the credentialing marketplace more effectively and efficiently. The student would know her educational position and have immediate access to opportunities and information to help chart informed pathways to an educational destination. The above matrix of rights and responsibilities would go a long way towards meeting the challenge of the unit-record database by giving students full rights to their privacy-secured individual educational data and to share that data throughout their lifetimes at their discretion.

3. Encourage parents and, eventually, each of their children, to make postsecondary completion a shared life goal. We now know, after all, that early exposure to education is especially effective for improving educational readiness and attainment among low-income children. The ELC provides such encouragement as a corollary of using annual tax data, starting at a child's birth, to estimate and annually update the value of needs-tested promissory aid that can be earned as long as the child submits periodically to the learning readiness evaluation process.

4. Support an open, digital ***learning cloud*** to provide gratis access a) to comparative information about education (and all its implications for personal and collective success) and b) also to informal, online, asynchronous learning opportunities and resources, such as free content and learning portfolios for students and instructors. The ELC's Information Sciences Strategy Group could help design these services.

5. Focus and stabilize government funding for postsecondary education on needs-tested aid that has to be earned by individual commitments to learning-readiness evaluations on behalf of the attainment priority and its attendant value of actuating equal opportunity on a widespread basis.

6. Meet market needs for professional and workforce expertise through employer credentialing incentives offering supplement value to earned aid (based on projected employment needs).

7. Remove the already blurred distinctions between nonprofit public, nonprofit private, and for-profit private education providers by encouraging ELC participation at all levels of government

and market needs (demand). Needs-tested aid is earned by the student, who has the discretion to spend it at any ELC-compliant institution interested in enrolling the student.

8. Encourage education providers to compete in learning-centric accountability terms that are also learner-centric by providing options for an affordable, flexible, and successful learning experience.

9. Preserve accreditation's formative peer-review process for education provider self-improvement by *a priori* requiring adherence to the above voluntary, minimally invasive ELC external accountability protocols and metrics.

Conclusion: Scaling Attainment, Affordability, and Accountability

Not to engage the economic governance issue for the credentialing marketplace risks a tragedy of the commons. An open economic governance entity could earn trust from, and be mutually economically beneficial to, education providers *and* their external "investors" – students, families, governments, donors, employers, and suppliers. Moving from concept to creation of an ELC, however, will require breaking down the parochial protections that limit many entrenched marketplaces, such as the credentialing marketplace with its thousands of "gated communities" protected by combinations of geopolitical, education-sector, and education-provider forces. The Educational Positioning System is a succinct metaphor for bridging the gates with the immediacy of pathways constructed on demand to interconnect people, institutions, and relevant information.

The time is right for the vested beneficiaries of attainment, especially visionaries and entrepreneurs, to create "trust-but-verify" economic governance cooperation as a means to accelerate education's pace in Wells' race between education and catastrophe. Millions of us want education to win. If government can't provide the funding stability required for victory, then we the people should act – perhaps through a social networking micro-contribution mechanism. We are collectively the wind that could make tilting at the attainment windmill not only a priority, but also an achievable one. We need to summon the "wisdom of a willing crowd" – the leaders and visionaries who recognize that credentialing for attainment is a common good and know that it cannot be advanced solely from inside today's gated credentialing community.

Educational attainment is the holy grail that makes education's current credentialing practices a barrier to a more open, scalable credentialing marketplace, which, as a common good, could inspire individual and organizational commitment to learning that can help advance and sustain social, economic, and environmental justice and to an open self-regulating economic governance entity (ELC) for scaling attainment, affordability, and accountability. We need to retire the rusty "iron triangle of access, costs, and quality," which lost much of its relevance as new technology-enabled strategies demonstrated that enrollments and quality can measurably increase together, even as per-student cost structures decrease. We now need to marshal the cooperation and ideas required to demonstrate the ***mutual scalability of attainment, affordability, and accountability***.

An Entrepreneurial Stance Towards Education of Information Professionals

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Context

Two points I'd like to make up front. First, while I dislike being contrary, I do not think it possible to think forward in any reliable way as to what education for an Information Professional in 2050 will be. How can we do this when in 2007 we could hardly have predicted 2012! Second, my thoughts are going to be highly reflective of the personal experiences I've had and learned from – both preceding my time as a dean and the broader perspective I've gained in the last 4 years as Dean of just one of the 36 international iSchools. Although my role as the Chair of the iSchool Caucus does impact and inform me – I will reflect much more based on my experiences as Dean of the iSchool at Syracuse – which may or may not be typical of the broader information education arena.

So if I can't do what I was assigned in this position paper – what can I do? If we can't plan for a future that is 38 years away, what can we do? My answer is that the best thing we can do is to take an **entrepreneurial stance**. To those who know me, this will not come as a surprise – in fact I describe myself in my Twitter profile, @lizliddy, as "Entrepreneurial Academic". So the question is, how do we do that, or if in fact have we actually done that, and if so, how?

First we need simply to adopt an entrepreneurial mind-set. That is – be alert, stay attentive, receptive, willing to risk, able to recognize and sustain competitive advantage, and most of all – be agile. We need to be open to all disciplines, methods, programs, partnerships, problems, and new ways of leading our schools. The biggest risk to our schools, our faculty, and our students of not being as successful as there is potential to be, would be if we are not open to new ways of thinking and acting.

Challenges

As I stated above, I prefer to talk about that which I know well and which I have seen work successfully. And I truly believe, based on everything I've seen, read, or experienced, that an entrepreneurial stance is exactly what the academic information field must take. But the issue is how to do that within an academic environment. I know it is challenging within what can be very bureaucratic, slow-moving universities, but I think that an increasing number of them are becoming more agile and open to more empowering models. The most important of these is the financial model, and those fortunate enough to be in a university with Responsibility Centered Management (RCM), which couples school-level decision making directly with financial responsibility, vs. the older model where a Dean has authority but not control of their own budget and financial decisions, can attest to the increased ability to be entrepreneurial in a RCM-based university.

Additionally, while planning and implementation of new initiatives in the academic world has been traditionally slow, this must be overcome if universities are to be optimally successful in today's quick

changing environment, and I do see this increasingly as a trend, but frequently academia is not sufficiently quick-moving to support the most entrepreneurial of ideas. Fortunately, private universities are better able to take advantage of new opportunities because they do not have the extra layers of bureaucracy and needed approvals that exist for state universities.

But even if a University is supportive of entrepreneurial initiatives, we must also have both faculty and administrators within our individual schools who are empowered by their Dean, and an environment that the Dean creates which is ready, willing, and able to react quickly to the opportunities that abound in a world environment which is increasingly information dependent. Furthermore, the fact that information schools typically have very talented IT staff provides an advantage in that our schools are able to quickly adopt new technologies as they are introduced, or invent them ourselves to provide new modes and methods of instruction and research. We can more easily flip classes, provide innovation studios, create sandboxes for student start-ups, and stay on the leading edge of collaboration toolkits and online learning technologies.

Recommendations for Courses, Activities and Experiences

So given an entrepreneurial stance, what courses, programs, and experiences are / can the iSchools offer to ensure that our students will succeed in the ever-evolving professional world they will face for all of their unforeseeable future?

What I feel I can say is that we don't know now all of what these will be – but I can predict that they will be ever-new and changing. I know this from very recent experience – our 3 fastest growing curricular areas of focus, research, and attraction were not in existence just a few years ago – namely Social Media, Information Entrepreneurship, and Data Science. While these 3 are going strong, we also know that there will be even newer ones every year. To enable us to make new domains of offerings available quickly, we get them started as very 'light-weight' options that do not require multiple levels of review and approval, but can be quickly mounted as specializations within our degree programs. Waiting for the arduous, formal process would mean that we would not be the innovative school that we aim to be. In the traditional many-staged process which schools have followed, there are typically at least six steps:

Traditional Academic Offering Approval Process:

Faculty Member Proposal →Department → School → Senate → Trustees → State → APPROVAL

However, by choosing 'light-weight' options, such as specializations and Certificates of Advanced Study (CAS), we have successfully shortened this process to two steps:

Agile Academic Offering Approval Process:

Faculty Member Proposal → School → APPROVAL

In addition, to enable us to quickly mount new CASs at the graduate level, we proposed and got university and state approval for a CAS in Information Innovation: _____. That colon is key, as we can particularize it by adding an extension without the need to go back for approval when we do so.

Social Media

As a first example – a few years ago, one of our school's IT staff who had been teaching for us as an adjunct, asked if he could offer a course in Social Media, and, being a SM fan, I immediately said yes. Only 5 students enrolled that first semester, but I said we would go with it anyways. Slowly, the tweets and posts from this course attracted a lot of followers amongst our own students, plus students from communications, management, and design who started dropping in until the room was full for each class. We now have multiple highly-rated and well-subscribed Social Media courses. Social Media is now both an undergrad specialization and a graduate CAS in *Information Innovation: Social Media.*

And that IT person was hired onto our faculty as a Professor of Practice, and was subsequently invited to brief both NASA and the US Senate on appropriate use of Social Media for their particular environments. Such Professors of Practice (full-time, non-tenure-track faculty), of which we now have 17, offer another means for staying agile, that I believe will trend, as Professors of Practice are on 3 year contracts, and while many of our Professors of Practice have been with us for quite a while, we can always choose to not renew their contracts if and when their area of practice and expertise is no longer in demand by our students – all of whom are professional students seeking to learn the latest technologies and skills that will enable them to get the jobs that are so well-paying, or advance in the jobs they are already in, who highly value the real world expertise that Professors of Practice bring to the classroom. Quite different from some tenured faculty, for whom curriculum is frequently faculty autobiography.

Entrepreneurship Minor

Once we take an entrepreneurial stance as the optimal strategy for the iSchools, I believe it essential for our schools to be actively creating enterprises themselves – for, with, and by our students, as well as our faculty. While this is encouraged and supported at a number of universities, as Thorp & Goldstein point out in their book *Engines of Innovation*[9], these programs at MIT, Stanford, etc. have typically been located in engineering or management schools, with other disciplines recently joining in. I strongly recommend that the iSchools exercise their acknowledged centrality to optimal business success today, and become the natural locus of academic entrepreneurship specializations.

As an example of the entrepreneurship education opportunities that we have been very actively pursuing since 2009, we offer an inter-disciplinary, 18-credit minor in *'Information Technology, Design & Start-Ups*' – referred to as IDEAS, which prepares students with the knowledge and skills required to start and run their own information technology-oriented ventures. It is an inter-disciplinary minor led by the iSchool, along with the School of Management, and the Design Program in the College of Visual &

[9]Thorp, H. & Goldstein, B. (2010). Engines of Innovation: The Entrepreneurial University in the Twenty-First Century. University of North Carolina Press.

Performing Arts. The minor consists of 4 entrepreneurship courses (along with electives), culminating in a full-time summer course in the Student Sandbox. These are:

What's the Big Idea? Technology Innovation (3 Credits)

Entrepreneurship Fundamentals (3 Credits)

Idea2Startup: Technology Entrepreneurship (3 Credits)

StartUp Sandbox (1 – 6 Credits)

In the Student StartUp Sandbox experience, a full time Entrepreneur-in-Residence coaches the student teams through their venture-creation and serves as a conduit to the community. Each team has up to 5 assigned community mentors who are entrepreneurs, technologists, subject matter experts, attorneys, and accountants. At the Ray von Dran IDEA awards at Emerging Talk, student teams from SU and 4 other upstate New York colleges compete for seed-funding for full time summer support in the Sandbox, and other student ventures can and do self-support themselves. Table 1 displays some of the vital growth aspects of the SandBox. Several of our Student Sandbox ventures have received substantial angel or venture funding. To date, receiving close to $3M in investment funding.

	2009	2010	2011	2012
Applicant student company teams	5	18	39	129
SandBox companies / teams	5	12	32	45
Mentors	4	40	70	100+
Start-Up Competition winnings	36K	90K	135K	150K

Table 1: Growth of Student StartUp SandBox since creation

Faculty Entrepreneurship

In addition to supporting student entrepreneurship, I believe that our information schools need to be equally encouraging of faculty entrepreneurship. There are obvious trends in universities being more supportive, and again I believe that the faculty we have in information schools make us ideally situated to reap the amazing benefits when faculty do start-ups simultaneously while carrying out their responsibilities as faculty. I know this first-hand, because I myself formed and led an early internet search engine company (which I exited successfully after 5 years of growing the company, which is still in existence) all the while being a faculty member in the iSchool at Syracuse, and housing the technical side of the company (50 people) within the iSchool, all while teaching and supporting numerous students.

Another such example is our Associate Professor of Practice, Jeff Rubin, who was a product of both our undergrad and graduate programs, and who as a Masters student started his own company (*Internet Consulting Services*), while also teaching as an adjunct. As Jeff tells it, the faculty were his mentors then – and now as a faculty member, he is a mentor for many student start-ups. His company (which now has a division called *SideArm Sports*), has 572 college athletic departments as its customers, to whom he has licensed his website software & who continuously buy ongoing service. ICS is or has done work for the World Bank, SONY Music, the Discovery Channel, and the New York State Department of Health, among others.

Jeff's company is situated within the iSchool where he pays rent for the space he occupies, employs 21 full-time employees, as well as 25 part-time student employees. In parallel, he teaches courses of 200+ UGs from across campus, and is a very supportive donor to our Ray von Dran IDEA Student Start-Up Program. Jeff recently did an interview which I participated in, during which he shared some thoughts which I believe encourage us all to seriously invest in support of our faculty entrepreneurs. For example, Jeff said "There is no way I would be where I am now without the relationship with the university." As well as "You can't put a value on what it means to be part of the university – while it's a win-win, you can't say who wins more than the other." And thankfully for me, since Jeff is one of our most highly-rated professors, he said "I could never imagine a day when I would stop teaching".

So, not only do faculty entrepreneurs contribute tremendously in their own right – in terms of the prestige and reputation they bring to the school, but they contribute to the excitement and eagerness that our students pick up on regarding the 'real life' aspect of the information field, which they learn from faculty entrepreneurs who openly discuss their experiences in classes.

I share these individualized stories because I believe they are good exemplars of what we and all the schools in our field can do, and which I personally think we must do – both for the health of our schools, as well as the most appropriate preparation of our professional students.

Conclusion

So where will an entrepreneurial stance towards education for Information Professionals take us in the years ahead? As I've said, I base my comments on what I've learned from what we've done in the iSchool at Syracuse University. In summary, what we have experienced by being entrepreneurial is tremendous growth in student body, faculty, and staff; financial success; strong reputation, and; an appropriately wider diversity in academic programs given the centrality of information to so many professions.

A little history illustrates this – our school was founded at Syracuse University in 1896 as a Library School, and then in 1974, it was the first to become an Information School. In subsequent years, we have added a PhD program, a BS in Information Management & Technology, two dual undergraduate degrees, two more Masters degrees (Information Management; Telecommunications & Network Management), an Executive Masters, a Professional Doctorate, and 9 Certificates of Advance Study.

In addition, as we look to our future of library and information science education, how and where we teach has changed and will continue to change. For example, we began offering online programs 17 years ago, and today approximately one third of our masters degrees are earned fully online, and of our main campus students, approximately 65% of them took at least one online course in the last 2 years.

So, up until 1969, 100% of our 113 students were Masters of Library Science students, while today, although the absolute number of MLIS students has grown, they comprise only 13% of our total student population of 1,394 students. And looking at just the Masters level programs, only 35% of the masters students are MLIS. I believe this suggests something for the breadth of where the future lies for Information Professionals, amongst whom you will find high-performing information graduates of all types, including many from our new Entrepreneurial Librarianship Program.

Digital Natives on a Media Fast

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In fall 2011, I taught two sections (forty students each) of Introduction to Media Studies, a brief, fifteen-week overview of mostly Western and U.S. media history. We began with the printing press, marched through newspapers, magazines, and the book industry, and sailed through radio, film, and television. We spent the last third of the course with "everything else" – the personal computer, email, the information superhighway, the internet, the Web, Web 2.0, computer games, Facebook, Twitter, smart phones, apps, and i-everythings – essentially, anything digital, networked, and, increasingly, mobile.

Towards the end of the semester, I gave my students a fairly straight-forward homework assignment. It was a media fast.

> Media Fast Homework Assignment
>
> 1. Sometime between Thursday, October 27 and Monday, October 31, stop using all modern media. You can read books and magazines and papers, but stop using media that is electronic or digital. No iphones, no facebook, no text. No computers, TVs, or radios. Mark the time your media fast begins.
> 2. Continue your fast for as long as possible - the longer, the better.
> 3. When your absence from media becomes dangerous, impossible, or unbearable, return to them. Note which device you broke your fast with and record the time.
> 4. Calculate how long your media fast lasted.
> 5. Take some time – a few hours, a day – to reflect upon what happened.
> 6. In no more than one page, share your findings. Make sure your name is on the page and bring it to class on Tuesday, November 1.

The students' reflections were staggering. With a few notable exceptions, their all-the-time and everywhere dependence on and desire for media was distressing, depressing, and dangerous.

I decided to give them a second media fast – this time as a take-home final. The assignment was essentially the same as the first media fast except students were required to select a brief portion of their reflection and cut-and-paste it as a comment to the online assignment hosted on my blog, *silver in sf*. (To see the assignment and over seventy student comments, visit: http://bit.ly/mediafast2)

Although I cannot fit a full discussion of the students' reflections into this brief position paper, I do want to spotlight a few key facts and findings.

The shortest media fast was for "about an hour." The longest was three and a half days.

Multiple students reported having long conversations with their friends, family members, or roommates. One student, AC, wrote: "I told my roommate about this assignment and she wanted to try the fast with me. So around 6:30 we closed our laptops, put down our phones, and turned off our room iPod stereo system … At first it was a little awkward being so quiet in the room but after a little bit, my roommate and I had a really nice roommate talk where we talked about our day and our problems. It really made us feel like we knew each other much better and it was kind of nice not having something distracting me on the other side of my mind." Another student had her first ever conversation with her roommate, a fellow student with whom she had lived for the last two months.

Many students wrote that the most difficult times were "when strange and funny things happened to me and I had no one to tell!" One student wrote, "I learned something new and wanted to share"; another wrote, "I saw something funky and wanted to share (via Instagram, Facebook, or flickr)." Our students are sharers.

Through the media fast, many students witnessed first-hand how pervasive media is in their (and our) everyday lives. One student, SM, wrote: "There was a TV on at the party, my roommate was trying to show me pictures online, my boyfriend was trying to get me to look at a map online, an acquaintance was asking me for help with their phone, and I was surrounded by phones and computers at Starbucks." Many students realized, *Matrix*-like, that all of their friends, roommates, and acquaintances are always on their phones. "OMG," one student wrote, in caps, "ALL OF MY FRIENDS ARE ALWAYS ON THEIR PHONES. LIKE, ALL OF THE TIME."

And then, of course, many students realized that, well, *they* were always on their phones. Many students, including DB, described a nervous tick when away from their media, especially their smart phones: "Something that struck me during my fast was a nervous tick I have with checking my cell phone. Any awkward moment, walk up the stairs, wait in line, basically any insignificant moment of inactivity gives me the sudden urge to check my cell phone. This is almost ALWAYS done even though I am aware there is nothing to check on my phone."

Perhaps the most frightening finding, for me at least, was multiple students' expressing their fears of silence. RT wrote: "I began my media fast at 7 pm on Friday night when I was getting ready to get coffee with friends. It was really weird not listening to music during that time, silence creeps me out." And CK wrote: "On Friday night I felt too in my head during this media fast. At the end of the night I was home just laying on my couch. I couldn't turn on a movie or play music. I felt uncomfortable sitting in silence. All I could hear were my thoughts. It was weird to be stuck in my mind and I didn't like it."

As librarians, educators, and information professionals, we need to understand the all-of-my-media-all-of-the-time ecology our students – and ourselves – live in. In addition to understanding this phenomenon, we must challenge it – which, if this position paper contains a position, I guess that's it.

As discussed briefly during the Information Professionals 2050 symposium and conference – and in more depth as a keynote talk for BayNet 2012 at San Francisco Public Library (video here:

http://bit.ly/baynet2012) -- I challenge my students (and myself) using two teaching strategies. The first is what I call *log off before you blog off* – any kind of assignment that require students to have senses-driven experiences in physical spaces prior to sharing their experiences online. For example, in my Green Media course, an advanced social media production class focused on making media about making food, my students are required to physically visit a local farmer's market and walk around, talk to the farmers, and see, smell, touch, and taste the purchase. The idea is to encourage (by requiring) students to unplug for just a moment or an hour or an afternoon to experience something offline before they jump back online to share their observations.

The second pedagogical strategy is what I call *seasonal syllabi*, a collective effort my Urban Ag faculty colleagues Melinda Stone, Justin Valone, and Seth Wachtel and I have been working on for the last five years. Here, class readings and activities – the "stuff" of syllabi – are influenced highly by the seasons. If the lesson involves planting a crop or harvesting a bed or cooking up a meal, we begin with an obvious question: What's in season? While we certainly wish to heighten our students' awareness and appreciation of the seasons, another goal is to engage our students' attention spans beyond "about an hour," beyond a single lecture or class discussion, beyond a class. We want our students' attention span to be – at least – a season.

Education Trends Panel Summary

Susan Nutter	Julia Khanova	Ericka Patillo
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The opening panel of Mike Eisenberg, Bill Graves, Liz Liddy, and David Silver (moderated by Susan Nutter) addressed the impact of education trends on the future of information professions and professionals. After these four thought leaders presented a five-minute summary of their positions, discussion ensued among the whole body of participants.

Generally, the panelists envisioned an educational system that is organic and entrepreneurial and relies less on bureaucratic and rigid business and economic models. Everyone seemed to agree that the rigidity of the current higher education system, especially in public institutions, is an impediment to change and effective learning.

The discussion was not focused solely on Library and Information Science (LIS) education but on the broad education trends that would and perhaps should impact the role of information in learning for future LIS students as well as students in any discipline. The primary thrust was on higher education, but several panelists gave examples of learning among younger students to illustrate their points.

There was ***general consensus*** among panel members and symposium participants that:

- It is impossible to know for sure what things will be like in 2050;
- It is possible to extrapolate from analysis of past development and present trends (social and technological);
- There is a need for substantial changes in education and these changes would require significant expansion of information infrastructure, which would depend on having skilled information professionals;
- Education (and educational assessment) should be competency-based.
- Education should be more student-centered, individualized.

The ***four panelists*** brought the following ***salient ideas*** to the table:

- Education as common good (and proposal for restructuring educational funding and re-defining the social contract between society and individual students) - **Bill Graves**
- Individualization of education organized around a lifelong Personal Education Record (PER) emphasizing and facilitating learning through a myriad of formal and informal experiences – **Michael Eisenberg**

- Entrepreneurial approach to education, which encompasses teaching entrepreneurial skills to students and being entrepreneurial in how educational organizations are run – **Liz Liddy**

- Importance of developing in today's students the awareness of non-media reality through engaging the senses and promoting longer attention spans – **David Silver**

Some of these ***ideas harmonize with each*** other, such as:

- Idea of lifetime PER (M.E.) and educational contract between student and society that starts at birth and continues, with modifications, throughout academic path (B.G.), or

- Entrepreneurial approaches (L.L.) and doing away with "tyranny of credit hour" (M.E.), or

- Taking seasonal view and watching vegetables grow (D.S.) and developing ideas from "seed" idea to fruition (L.L.).

Most importantly, the student-centered, contextually aware, individualized life-long education vision is impossible without elaborate information infrastructure to keep track of all the facets of each student's learning experiences and competency attainment throughout his or her lifetime. There is a lot of work for information professionals in the future! The education of information professionals can and should be the area in which these innovations are developed and tested – information education should play the leadership role in education transformation.

Despite the above described agreement and complementarities of ideas, there was also clear ***polarity in the panel.*** Two members were in the, somewhat radical, "out with the old, in with the new" camp and two members were, in a way, more traditional, emphasizing centuries-old ideas of importance of learning through the senses (which has been advocated by Aristotle) and social contract/public good view of education (which is rooted in the philosophy of the Age of Enlightenment).

While a radical statement questioning value of student's learning philosophy and history did not capture much of symposium members' attention, statements about writing being no longer an essential and important skill, and equivalency between media (such as video) and written expressions of ideas generated a lot of discussion. Overall, there is agreement that newer forms of expressing and sharing ideas, such as videos are good for some contexts and should be included more in academic process, many of the discussants disagreed with dismissing of the value of writing altogether. Some of the forms of writing, such as more traditional business letters may be declining, but being able to clearly express and share important ideas in writing will continue to be an important skill – all truly powerful ideas, historically and today, are ultimately expressed through written word.

Not surprisingly, the more traditional ideas were greeted with all around agreement. Particularly, the notion of importance of students learning though their senses was enthusiastically embraced. Perhaps this is due to many of the discussants feeling concerned about the engineering of new human beings (the re-wiring of the brain through exposure to media and information technologies from early age) and

the implications of this for the future of humanity. People see education as having to strike the balance between taking advantage of exponential technological progress and ensuring we don't lose what it means to be human in the process.

Employers have always played an important role in education in that the skills and competencies that they seek inform the curriculum. However, in the world of the work of the future, competencies and credentials will take a back seat to personal characteristics: employers will seek entrepreneurial problem-solvers who are curious, creative, interpersonally agile, team-oriented, passionate, and can communicate their ideas compellingly in whatever the media of the moment.

Ways in which LIS education in particular and higher education in general can respond to these trends are to develop an educational process that is not limited by the classroom model; incorporate seasonal thinking and learning models that reflect natural rhythms of life; recognize that entrepreneurship and risk-taking are essential in educational systems and enterprise; and embrace the shift of focus from generalist librarianship to the infusion of information expertise throughout institutions and organizations.

PART TWO

Library and Archives Trends

A Core for Flexibility

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THE PROPOSITION: *Imagine what kind of future you want to see and how to prepare information students to invent that future.*

I address this thought problem not from the perspective and perceptions of a library science educator, a scholar, or an academician, but rather from the perspective of a practitioner: a state librarian, a public library director, and a government official. Over the course of my career my work product has been less focused on specific preparation and credentials of our library workforce and more concerned with designing, developing, and delivering services that make a difference. My strategy has been one of planning for desired outcomes. With this type of approach one envisions the desired state of affairs, assesses reality, determines the gap between the ideal and the real, and more or less reverse engineers a service intended to provide resources that lead to change.

In the model of past experiences, the questions considered would include: What do we determine are the current and will be the future needs of our communities of users, today and tomorrow? What services and products might we produce to address those needs? On delivery of services developed in response to those real and anticipated needs, what difference could be made? What other players, competitors, or partners may have a role in this space? What might be the impact on unique individuals, groups, or families, and on the community as a whole? In my prior experience, the answers to these questions have provided a "backwards" path to determine the desirable outlook, approach, and skill sets for the most effective staff assignments. I propose that similarly this approach will inform our preparation of the information and service oriented professionals for 2050.

THE PREDICTION

I have always found the concept of predicting the future to be energizing and exciting. At its most frivolous, the activity presents a hybrid image somewhere between a carnival fortune teller and futuristic science fiction. But when it comes to imagining the future of our professions, this is not frivolous fun and games, but rather, serious business. Being tuned into trends and stretching our imaginations to anticipate subsequent developments are about being aware and being prepared. Envisioning the future is grounded not in guesswork regarding what might occur, but hinges on our awareness of the present—and the past. Those who succeed at this thought problem exercise may well contribute to the vibrancy and viability of the information service professions about which we are all concerned.

Information Professionals 2050—Over the past 15 years, "long range planning" has shifted from referencing a 10-year plan, to a 5-year plan, to a 3-year plan. And when we venture into imagining 3 years out, chances are good that our actual action plan will be targeted at a more conservative 12–18

months. Looking forward 38 years, anticipating the needs of and technologies available to the information seekers of 2050 simply is not feasible. In today's era driven by exponential growth in information and ever-changing technologies, can we possibly imagine and strive to design a curriculum for the descendants of today's information professionals? Perhaps not exactly, but I would propose that we can indeed design a core of subject areas that will provide a strong 21st century skill platform for our heirs.

At the Institute of Museum and Library Services (IMLS) we have just completed our strategic plan for 2012–2016. The document is available on the IMLS Web site and is entitled *Creating a Nation of Learners.* The plan presents a vision of "a democratic society where communities and individuals thrive with broad public access to knowledge, cultural heritage, and lifelong learning," and expresses the mission of IMLS as providing leadership through research, policy development and grant making, and inspiring libraries and museums to advance innovation, lifelong learning, and cultural and civic engagement. This vision and this mission are not new concepts. Although perhaps articulated differently at various stages in our history, I propose that they have been embedded in the purpose since the middle of the last century, since their first iteration of the federal aid programs that have provided support for the nation's libraries, archives, and museums. Likewise, and perhaps more directly to the point, IMLS's *new* three primary outward facing goals designed to further the vision and mission also can be seen as timeless. These three goals focus on the roles that our institutions play as places that support the development of and engage the learner, promote discovery of knowledge and access to cultural heritage through their stewardship, and serve as community anchor institutions that strengthen community by helping individuals help themselves and others. This last goal in particular is revealed through many diverse functions ranging from high-speed broadband access, to preschool support for early learning, to providing resources and a forum for community discussion and problem solving.

THE CHANGE

We all recognize that information professionals dealing with change is not a new concept. For decades we have been inundated with change on every front: changing technologies, changing demographics, changing expectations. When I first arrived at IMLS in 2002 we were just beginning to lay the foundation for what later became the *Laura Bush 21st Century Librarian* grant program. We were studying how the professions themselves were changing. The director of IMLS, Dr. Robert S. Martin, who was an archivist and librarian, provided key messaging that we used on multiple occasions over his four year term regarding the "blurring of the boundaries." I would maintain that although this fluid state of professional boundaries exists today, and I anticipate it will continue into the future, the nature of the fluctuation has changed.

In 2002 the boundaries being referenced were the boundaries among libraries and archives, and even museums. By 2010, under our next director, Dr. Anne-Imelda Radice, a museum professional, IMLS hosted a symposium which came to be nicknamed "CHIPs" (Cultural Heritage Information Professionals). At this stage there was an awareness of potential for a base curriculum designed to prepare students for

one of several ultimate careers and even allow for mid-career growth and career change without starting over.

Today, in 2012, new alliances are being made and different boundaries are blurring. This blurring is totally understandable in that "information" has become increasingly important. Information is the foundation for most activities in today's world. With limited and diminishing economic resources for critical social services, partnerships are being formed around employment services, early learning, multicultural integration, school readiness, youth development, and an increasing demand for senior services. For today's libraries the permeable boundaries seem to be more in the area of social and educational support services and less strictly in the cultural heritage arena. I would predict that tomorrow the responsive nature of our libraries will continue to evolve. One of our libraries' greatest strengths over the decades has been their commitment to adapting to new technologies, changing needs, and evolving communities. The coming decades will bring the next generation of information professionals a whole new set of issues and fresh partners that will draw them across different boundaries.

THE CONSTANCY

In my personal prediction of the future, the precise issues, the exact partners, the particular constituent groups, the pressing information needs may all change, but the mission, the purpose, the heart of the craft of connecting people to each other and ideas will endure. The specific skill sets, the vehicles, the tools will evolve even more rapidly than today, but the purpose and goals of the profession will continue and be played out in different ways.

Over the last decade IMLS has been working with libraries, archives, and museums to promote and hone their role in supporting the 21st century learner. And over the past five of those years we have focused specifically on 21st century skills. These skills are not, as one might anticipate, tethered to particular burgeoning technologies. They do not include detailed specific subjects such as computer engineering, software development, or even troubleshooting mobile devices. The key areas of development for today's learner that will best position them for success in the 21st century are broader capabilities and approaches to growth and learning. Keys to success include development areas such as critical thinking, curiosity, creativity, the ability to communicate effectively, teamwork, flexibility, the ability to collaborate, and at the base of it all, global awareness. Although they likely have always been the hallmarks of success throughout the ages, these skills are even more important as we look to a future that presents technologies and possibilities that are evolving so rapidly we can hardly imagine how to prepare for them. Like the learner of the 21st century, the information professional of the mid-21st century needs to be equipped with attitude, outlook, and analytic capabilities that position him or her for problem solving, and constant adaptation, for independent work and to collaborate effectively in teams.

THE CORE curriculum

As the essential areas of subject area familiarity and expertise both broaden and deepen, librarianship is becoming an umbrella profession. There are many ways to *be* a librarian. I would like to expand on two major, almost conflicting trends. The first leads to familiarity with an increasingly broad range of information in terms of subject and format. Following this trend would prompt us to prepare and equip the information professional of 2050 to be a generalist who is the master of the overview and is adept at making the connections between people and the vast variety of information they need. The second trend focuses on the increasing need for in-depth subject understanding and would prompt us to shape the profession in a way that requires multiple degrees and would encourage the information professional to pair their information navigation skills with a second (or third?) area of intense study so as to provide deep subject matter expertise. For either of these career paths; the information generalist or the information specialist, we are challenged to accurately imagine the exact content. I propose that from this distance our energy needs to be focused not on the evolution of specific content, but on developing the best approach to the information professions.

What are the critical components of a curriculum designed to prepare the information professional of 2050—or any decade, before or after—to fulfill the primary purpose and goals of their chosen career? I propose the following four areas as a starting point. First and foremost comes strategic thinking and facility with evidence-based planning and evaluation. This is today's terminology for an approach to developing and sustaining an enterprise through planning based on substantiated need and design for problem solving and impact. Closely interwoven with strategic thinking, yet worthy of standing as a separate category, are the ability and skills necessary to engage in trends analysis. The third might be "pedagogy." The ability to effectively teach, train, and empower the learner of tomorrow is essential. We can already anticipate myriad learner types: early learners needing at least basic understanding in multiple languages, adult learners retooling for unanticipated and as yet unimagined careers, and communities consisting of learners with little in common. And lastly, the driving force behind the other three is the skill and ability to respond to the needs of each unique "customer." This customer service responsiveness, with the ability to relate to each of many varying segments of the population, and connect each one or each group with the particular information, resource, or conduit that is needed to meet their needs, is—and always has been—what positions the best information professionals at the top of their field. In a world of expanding options and resources the information professional will need to be even more expert at the "concierge" role of connecting individuals to the precise resource or data that they need.

A notable added value to a core curriculum approach would be the almost universal applicability of what is being taught across this field and others. In our information professionals we are creating the ultimate 21st century learner. I can only guess, but I would like to think that this type of preparation not only would draw students to the profession, but that the flexible applicability of the skills would add to the duration of their engagement within this cluster of information service careers. There is a recognized tendency for today's student to adopt multiple careers over his or her lifetime. In light of this consideration, we add value by designing a course curriculum that prepares tomorrow's student with

the most flexible background possible. In addition, as noted above, the expertise desired in information professionals is becoming ever broader. It includes technologies that range from papyrus to "the cloud." If the information professions are to be seen as *one* umbrella profession, we need to acknowledge that it provides a spectrum of opportunities, from preservation to digitization to reference to technology training and development; from community anchor to digital steward. Once invested in a core of skills that offer a variety of opportunities, it is not hard to imagine that the information professional of tomorrow may well engage in multiple information professions. This being said, it is notable that we need a more robust system of continuing education beyond degrees. The degree is the beginning and the field will need more than the occasional conference to prepare, engage, and reward those who continue to grow and develop.

THE CRAFT

Just as the scope and delivery mechanisms for information are expanding on a yearly, monthly, or even daily basis, so are the possible iterations of "the information professional." The "library" or the "archive" is ceasing to be seen as a warehouse, but rather is evolving into a set of services, services designed for and by information professionals who simultaneously are reinventing themselves. These librarians and archivists are responding to the changing demographics and needs of their users, 21st century learners. These information generalists and specialists recognize the unique nature of every customer and are responding to the need for customization.

With information at the foundation of so many of today's activities, as a field we need to support the growing professional diversity, while still maintaining the professional identity. If we do not, we will likely find that commitment to our shared professional values is at risk. Where other than under this umbrella of information professions do we find such deep dedication to privacy, openness, commitment to the underserved, and long-term stewardship of the cultural record?

In designing their learning opportunities we need to model the same practice. The craft of connecting people to each other and ideas continues to be needed and of great value. Provided with the right preparation and approach, information professionals should be one of our most valuable resources in paving the way to success in the mid-21st century, just as they did in the 19th and the 20th.

Disclaimer: The views expressed are those of the author and do not necessarily reflect the official position or policies of the Institute of Museum and Library Services.

The "Open Movement" in Research Scholarship—What is it and What Does it Mean?

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I am not going to speak about information technology (IT) today—others will. That is not to say that it is not a key driver of the change in the information environment, a change that will demand that we adapt curricula to meet new educational needs. Instead I want to focus on an important socio-cultural "force" that I believe will, as much as technology, create a transformation in scholarly communications and will have ramifications throughout information organizations, particularly those closely allied to teaching, research and discovery. This force is open access (OA). I believe to ignore OA is to ignore an extremely important and well established movement that is disruptive for much of what information professionals do today as well as what iSchools do to educate for this work. But how do we think about OA and the long-term impact that it might have? My, perhaps, glib answer is that we use scenario thinking. This is relatively easy to do since scenario methodology is designed precisely to target dates as far in the future as 2050—nearly four decades from now. In simplest terms, we think about a future based on the premise that all of the problems that seem so large today will be solved. That is not to say that there will be no new problems. So, we can frame 2050 by enunciating conditions that will be totally different from those that exist today.

Like others, I am focused on the context within which I work—the academy. This is a quintessentially information-driven enterprise, if there ever was one, for all its core activities—research, teaching, learning, and knowledge creation. Most important, the academy is dependent on a system of scholarly communication that has evolved by accretion since the last quarter of the nineteenth century. I am positing, first, that this system—built on old budget models and print technologies—is broken and that it will be replaced by a completely different system four decades from now—one that springs out of the current OA movement. Furthermore, because the current structure of scholarly communication has so palpably defined what libraries are, it follows that libraries and—more to the point today—education for librarianship and other information professions will be unrecognizable. In this paper, I have attempted to outline evidence for the forces at work that are indicators of the increasing momentum of OA and why it will likely become the ascendant characteristic of scholarly communication. It is already having an impact. Thousands of OA journals and the OA textbook movement are evidence.

The full potential for using networked technology and computational power to accelerate scholarship depends on unfettered access to publications and the underlying data. The increasing awareness of the

importance of data has caught the eye of commercial interests as well as scholars.[10] Open access is emerging but access, in turn, depends upon the clearly stated rights to both use and re-use. Advocacy for OA is expected from the Association of Research Libraries (ARL), but the clarion call came not from libraries but from the scientific community beginning with Harold Varmus at National Institutes of Health (NIH) and the first Berlin Conference in 2003. Through SPARC, ARL has worked hard to support OA with many other academic library partners.

The full realization of this sort of vision will be dependent on the extent to which the academy embraces open access to create new knowledge, to build on earlier findings, and to translate research for educational and commercial use. Making the case for public access to tax-funded research is a principled stand. There are equally strong cases to be made, however, for the both the economic benefits and the acceleration of research scholarship that results from such access.

The lobbying for the recently proposed legislation like the *Research Works Act* that was aimed at rolling back the NIH posting requirement and preventing other agencies from similar mandates has been based on protection and/or creation of jobs by commercial advocates. That is something that motivates politicians, even when the case is flimsy or merely a bald assertion by special interests. So what is to be said in favor of the economic impact of OA? There is already a strong argument to be made that public access to high-end research results enables a broad array of businesses and industries to nourish their own R&D and to develop new products, thereby, creating jobs. There is a substantial body of research demonstrating that making publicly funded research available to all those who can use it just makes sense from an economic development standpoint. Early studies during the 1990s provided tangible evidence for the economic benefits to product innovation and revenue gains due to public access. Recent confirmation for these studies is to be found in the work of John Houghton, commissioned by SPARC and focused on the *Federal Research Public Access Act* (*FRPAA*):

Preliminary modeling suggests that over a transitional period of thirty years from implementation, the potential incremental benefits of the proposed *FRPAA* archiving mandate might be worth around eight times the costs. Perhaps two-thirds of these benefits would accrue within the U.S., with the remainder spilling over to other countries. Hence, the U.S. national benefits arising from the proposed *FRPAA* archiving mandate might be of the order of five times the costs.

Exploring sensitivities in the model we find that the benefits exceed the costs over a wide range of values. Indeed, it is difficult to imagine any plausible values for the input data and model parameters that would lead to a fundamentally different answer.[11]

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[10] Ariana Eunjung Cha, "'Big data' from social media, elsewhere online redefines trend-watching" *Washington Post* (June 6, 2012) http://www.washingtonpost.com/business/economy/big-data-from-social-media-elsewhere-online-take-trend-watching-to-new-level/2012/06/06/gJQArWWpJV_story.html (accessed June 8, 2012).

[11] John Houghton, Bruce Rasmussen, and Peter Sheehan, "Economic and Social Returns on Investment in Open Archiving Publicly Funded Research Outputs, Report to SPARC" (Melbourne: Centre for Strategic Economic Studies,

This is but one of many such studies that make the compelling case for OA policies for all government-funded research—some by Houghton but supported by others.[12] Those who most strongly question these studies are also the sponsors of efforts to eliminate OA policies because it is in their interest to do so. But we should not settle for the economic argument alone when there is an equally powerful case to be made for the advancement of human knowledge that is perhaps the most important value of the academy. Let me give you the OA talking points developed by ARL:

- Open access to research articles is a critical driver of scientific innovation and productivity. It
    - Increases citations and follow-on research
    - Promotes diversity in follow-on research
    - Increases the pursuit of new research pathways
    - Encourages faster application of research
- Faster access lets scientists incorporate new findings into their research rapidly.
- Open Access to these articles allows scientists to use new tools (like machine reading, computational tools) to get to and read more information faster.
- Open Access enables machines as a new category of reader.
- Open Access encourages contributions by "unforeseen participants" expanding the potential for new, innovative, interdisciplinary discoveries.

Again, we find a body of research literature that proves the productivity gains for scientific research.[13] But the most compelling case is that made by the scholars who directly participate in the benefits of openness and can speak to the real-life impact it has. The Berlin9 Conference, "The Impact of Open Access in Research and Scholarship," held November 2011, in Washington, D.C., (http://www.berlin9.org) brought together an international audience and research scholars who express, in no uncertain terms, how indispensable OA is to the accomplishment of their work and the future of their disciplines, from the humanities to the hard sciences. Their emphasis is not on advocacy; for them, OA is a fact of everyday professional life. It is integral to the way they think about their work—from initial research and experimentation to collaboration and final publication of the research results.

Victoria University, 2010), http://www.arl.org/sparc/publications/papers/vuFRPAA/index.shtml (accessed March 1, 2012).

[12] Among the best synopses of research supporting the extraordinary positive impact of OA on economic growth and scientific knowledge is to be found in the Harvard response from Provost Alan M. Garber to the OSTP RFI on open access, http://www.whitehouse.gov/administration/eop/ostp/library/publicaccess - main-content (accessed March 5, 2012).

[13] See for example, Karim R. Lakhani et al., "The Value of Openness in Scientific Problem Solving," *Harvard Business School Working Paper* (2007), http://www.hbs.edu/research/pdf/07-050.pdf (accessed March 1, 2012).

Do not tell them that their works published by large commercial firms need the protection of federal legislation from open posting and should forever be behind a pay wall that prevents large scale access. For them, the principle of "openness" is essential and inviolate. One gets the feeling when listening to these scholars that the attempts, however real, to reverse the trend toward OA will inevitably fail.

Even in the commercial STM camp, we begin to see the first glimmers of recognition that the future is with open access. For instance, at the 2011 STM meeting in Frankfort, Steven Hall (managing director, Institute of Physics Publishing in London) posed a critical issue to his audience: "There is unease and even strong resistance in the publishing community to the imposition of mandates by funding agencies which force researchers to use a particular model of dissemination and restrict their choice of publication. So how should publishers respond to the growing demands for open access: by engaging or opposing?" He described the reaction of publishers to OA as going through something like the five stages of grief—denial, anger, bargaining, depression, and finally acceptance. He observed that OA will not be the only business model, but it will play a very large role. He laid out a set of "principles of constructive engagement," arguing strongly for gold over green OA. To his great credit, he urged that when OA gold publication fees are taken, publishers must avoid the cynical intention to not take them into account in pricing. His conclusion was that the size of the profits may well decline.[14] The willingness of a commercial STM publisher to suggest taking an economic haircut is a sign of a pretty profound shift in thinking.

Research institutions already have vigorously initiated one important part of the path forward that emphasizes a key value of sharing—that is open access strategies. OA is really being led by our universities. What is the evidence?

- Worldwide, over 300 research and higher education institutions have a variety of mandates, both institutional and sub-institutional. In the United States and Canada, 49 colleges and universities have one or more OA mandates, and 31 of these are members of ARL.[15]

- These mandates are supported by the recent founding of the Coalition of Open Access Policy Institutions. It will "collaborate and share implementation strategies and advocate on a national level."[16] This is not a large proportion of institutions, and it is important that such OA policies become characteristic. For those who have not, it is time to engage faculties in a discussion about a deposit mandate on your campuses.

- The academy must strongly support passage of the *Federal Research Public Access Act*—almost half of AAU institutions and numerous others already have endorsed the *FRPAA*,

[14] Steven Hall, "Open Access: Engage or Oppose?" (presentation, International Association of Scientific, Technical & Medical Publishers Frankfort Conference, Frankfort, Germany, October 11, 2011), http://www.stm-assoc.org/events/stm-frankfurt-conference-2011/?presentations (accessed March 1, 2012).
[15] ROARMAP: Registry of Open Access Repositories Mandatory Archiving Policies, http://roarmap.eprints.org/ (accessed March 1, 2012).
[16] Rebecca Smith, "KU establishes first coalition of institutions practicing open access," *KU News* (August 3, 2011) http://www.news.ku.edu/2011/august/3/openaccess.shtml (accessed April 11, 2012).

which will extend the NIH posting policy to other federal agencies and has the potential to enable the maximum downstream use of the investment in research. At the beginning of February, the *FRPAA* legislation was simultaneously re-introduced in both houses of Congress—in today's political climate that is an extraordinary example of bicameral bipartisanship. The White House is considering an executive order to accomplish the same thing. However, continued support for the passage of *FRPAA* is essential because of its permanence.

- There are today over 1,700 OA repositories on campuses worldwide that provide the infrastructure investment that allows widespread posting of research results. Supporting them is vital.

The OA movement is but 10 years old, yet it has gained enormous momentum within the academy. It has grow to include a broader vision of what it means to be "open," embracing not just the end products of research—those things that used to appear in print articles and books—but the full life cycle of research from data to publication. The federal agency mandates for data curation plans in research proposals is indicative of the emerging sense that data must be preserved for future re-use and data-mining. Moreover, data are not, I repeat **not**, copyrightable and so do not create the immense roadblock to broad use and re-use that is posed by copyrighted materials.

Some investment risk management researchers now flatly assert that the large STM publishers have an unsustainable business model and are in great jeopardy from OA.[17] I have tried to describe the emerging trends that I believe make it reasonable to believe that, in no more than 30 years, something fundamentally different will replace them and dramatically alter the other elements of the scholarly communication landscape. This leads to three closing questions. What will a librarian, archivist, or any information professional do in a world in which the resources that used to march across the shelves of libraries and archives are freely accessible on the Internet? What will a library or an archive become in such an environment? And, what will the iSchool curriculum to educate for this work look like?

[17] Claudio Aspesi, "Reed Elsevier: The Other 99% Wins One - Elsevier Withdraws Support for the RWA," Bernstein Research, Sanford C. Bernstein & Co., LLC, February 28, 2012; Jared Woodward, "RUK, the Maturing Threat of Open Access," *The Street: Options/Futures*, (May 30, 2012) http://www.thestreet.com/story/11560589/1/ruk-the-maturing-threat-of-open-access.html?cm_ven=GOOGLEN (accessed June 1, 2012).

Workforce Trends, Issues and Values

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Some Initial Thoughts

This paper is a reflection based on my 16 years of experience as a librarian (primarily in health sciences libraries) as well as over two decades as a library and information science faculty member and administrator at the University of Toronto and the University of North Carolina at Chapel Hill. I have tried to pull out some lessons from these experiences that may be relevant to our discussions at IP2050. The past and the present can teach us a lot about change and point us in useful directions for the future.

Trends Based on Professional Experience

My own career as a health sciences librarian was marked by many change in information and library science practice. Starting in the 1960's, the health field was one of the first to develop a large scale bibliographic database (MEDLINE). By 2000, the original bibliographic database with abstracts had morphed into full text (PubMed/MEDLINE) and health sciences library collections became increasingly available in electronic form. As a result, health sciences libraries were early adopters of the digital library concept. Many are now on their way to becoming completely digital.

There were also many changes in the nature of health library services. At McMaster University Medical Center Library where I worked for 12 years, we developed a clinical librarian program with librarians participating as members of the patient care team to provide information services for both providers and consumers of health care. Librarians were getting out of the library and providing information services at the point of care. We also expanded our services beyond physicians to all health professionals as well as to patients and families and caregivers. These activities also led to a partnership with our local public library. Since that time we have seen the development of what has become known as consumer health information services. Consumers are now the largest group of users of the National Library of Medicine databases and health information is one of the most frequent topics searched on the web. These specific examples are playing out in many settings. There are more and more specialized services being offered in the user's electronic workspace, expansion of services to more diverse groups, and the development of new areas of information practice.

Returning once more to the health information services example, problem-based medical curricula have provided greater instructional opportunities for librarians. While intermediary searching has declined in favor or large scale end user access, the expertise of library and information professionals in database selection and search methods continues to be an important part of providing instruction and support for online access. At McMaster, the health librarians participated in a series of tutorials on "Critical Appraisal of the Literature" organized by the Department of Clinical Epidemiology and Biostatistics. These tutorials became the basis for what evolved into "evidence-based medicine". The concept of

evidence-based practice has since spread to all of the health professions and beyond. Here we can see an example of the expanding educational and instructional role of library and information professionals and the increasing centrality of information or evidence as a basis for decision making in organizations.

My involvement in these activities also stimulated my interest in doing research. After all, shouldn't librarians be evidence-based in their practice too? This led to a randomized controlled trial of the clinical librarian program (Marshall & Neufeld, 1981) as well as a study on the value and impact of the hospital librarian that was among the first to link the information services of librarians to patient care outcomes (Marshall, 1992). This is just one of many examples of how library and information professionals are moving into research roles and how research is being used to both measure value and continually improve information services.

My point in reviewing some of this historical background is to illustrate that some of the trends that we see today, namely digital libraries, broadening the audience for library and information services, outreach and partnerships, increasing involvement in instruction, and evidence-based practice have been percolating for some time in the world of library and information practice. While this example comes from the health sciences, I have observed similar trends occurring in other fields. I expect that all of these trends will continue to develop and provide opportunities for information professionals in the future. As educators we need to follow these practice trends and make sure that they are represented in our curriculum. We also need to build our contacts with practitioners so that we can involve them in both teaching, field experience and research activities. Community-based collaborative research (Israel, 2005), which has been used extensively in the health field, offers a framework for practitioner/researcher partnerships that can help to make our research more relevant and useful to information and library science practitioners.

Value and Impact Issues

For many years libraries and other cultural institutions were supported on the basis that they were a necessary part of every community. As resources have continued to shrink, all publicly-funded institutions, including cultural and educational institutions, are being challenged to demonstrate their value to their own users and to the broader communities that they serve. This has major implications for the education of information professionals as well as for practitioners.

We graduates need to develop robust methodologies and systems to provide evaluate our products and services, not only to demonstrate value but also to improve performance. A good example of such a system if the LibQual+ program developed by the Association of Research Libraries (ARL) and the resources for outcomes-based evaluation provided by Institute of Museum and Library Services (IMLS). The program evaluation model recommended by IMLS provides a framework for measuring impacts in the short term, mid-term and long term.

I am currently leading a large scale study funded by the National Library of Medicine to measure the "Value of Library and Information Services in Patient Care" (Dunn et al., 2009, Marshall et al, forthcoming). The new study, which replicates the 1992 outcomes study that I mentioned earlier,

involves 56 library sites serving 118 hospitals in the U.S. and Canada. The physicians, resident and nurses in the participating institutions were asked to recall an incident in the last three months where they had searched for information related to patient care using library resources and services. The health professionals were asked to respond to a web-based survey based on this incident. Over 16,000 critical incidents were gathered and changes as a result of using the information were reported in: advice given to patients, diagnosis, choice of drugs and other treatments,and choice of tests. Perhaps even more important, a number of serious adverse events were avoided.

The lessons that I have learned from my research are many. First, I have learned how important it is for practitioners and researchers to work together to design meaningful research that is actionable and which addresses the most critical challenges facing the profession. The community-based collaborative research approach mentioned earlier (Israel, 2005) can be used to accomplish this goal. In the future, we also need to develop more large scale, replicable studies that will provide opportunities for practitioners to participate in and benefit from research efforts in the field. Such studies will also provide opportunities for doctoral students to do secondary analysis of existing datasets, an approach that is common in sociology and many other social sciences.

I would like to see research, evaluation and evidence-based practice fully integrated into information and library science degree programs so the graduates are at ease with not only using research evidence but also with conducting their own studies when necessary. I would also like to see faculty engage as fully as possible with the practitioner community in teaching, research and service. In other words, I would like our future to emphasize linking research to practice.

Workforce Tracking Issues

Since 2005, I have led a series of research projects funded by the Institute of Museum and Library Services (IMLS) entitled Workforce Issues in Library and Information Science (WILIS). The WILIS1 project was an in-depth career study of graduates of library and information science master's programs in North Carolina from 1964 to 2007.

A follow up project known as WILIS2 adapted the recent graduates' portion of the WILIS1 web-based survey so that it could be used by other information and library science programs across North America to track their alumni and evaluate the effectiveness of their degree programs. Some 39 programs participated in the WILIS2 alumni tracking study (Marshall et al, 2010). We are currently working on WILIS3 which will archive all the WILIS data for future use and provide a guide for information and library science researchers who want to make their research data more widely available

My increased contact with IMLS during this period has made me realize what an important role this federal institute plays in supporting and developing the information and library science workforce and in shaping policies that guide the activities of cultural institutions of all types. The WILIS projects have also increased my awareness of our need for ongoing data collection about our workforce, particularly as it morphs and changes in response to the changing landscape of information work. Unlike other professions, most notably the health sciences, information and library science is not a licensed

profession. As a result, we have never been required by licensing bodies to track our workforce in a systematic way. The extent to which individual programs are able to track their alumni varies greatly, even though evaluating the impact of the degree on graduates is included in the American Library Association standards for accreditation.

In a survey of deans, directors and chairs of LIS programs we found that few programs have the resources to track the careers of their alumni on a regular basis even though they agree that it would contribute to strategic planning. IMLS has identified the LIS workforce as a priority issue for research funding and the Laura Bush Librarians for the 21st Century project has done much to provide scholarships and other forms of support for students, in particular minority students. IMLS also requires that all its funded projects address the issue of diversity. As the baby boomers retire, we will have to turn our attention even more to both recruitment and retention so that we can attract the best and the brightest into the field and keep them there once they have graduated. Those who are interested in exploring workforce issues further will find additional papers on WILIS and other studies in the Fall 2009 and Fall 2010 issues of the journal Library Trends.

The Role of Professional Associations

Again drawing on my own experience, I have also been active in professional associations such as the Medical Library Association and the Special Libraries Association, helping to develop competency statements as well as educational and research policies. The latter experience has made me realize what an important role the professional associations play in supporting the lifelong learning of information professionals.

I was attending the Medical Library Association annual meeting in Seattle as I was finishing off this paper and I was struck be the vibrancy of the attendees' discussions and the sense of urgency they had about the need to change and move ahead into the digital future. At association meetings one can also see very clearly the aging of the workforce and the reduced number of younger practitioners who are ready to take on what lies ahead.

One potent example of the major changes that are happening to health sciences libraries related to the move to electronic health records (EHR). As one young librarian told me, this will be another game changer for hospital libraries. Information resources can be built into these systems for both health care providers and consumers. So what will the role of the librarian be? The National Library of Medicine reported on new standards that are being developed for these embedded EHR information systems and the need for librarians who can act as trusted experts and evaluators of the choices available to health care institutions. So one door closes and another opens. Other kinds of game changing scenarios will likely unfold in all branches of the profession as we move forward.

The Importance of Professional Values

One of the most important roles of professional associations is to continue to build and sustain the set of values that have characterized the field of librarianship since it was established. Librarians see themselves as having an important social mission to preserve recorded knowledge and to provide access

to information for all. Dedication to this mission gives their work personal and social meaning and has led the profession to have one of the highest job satisfaction rates if any field.

An appreciation of professional values and ethics is something that educators should support and transfer over to new entrants to the expanding field of library and information science. The values and ethics that drive our field are what set us apart and make us so important in a world where information is increasingly being seen as a commodity. Courses in ethics are becoming more common in information and library science programs and student chapters of professional associations are alive and well in many programs. I hope that we will continue to emphasize the integration of values and ethics into our curricula in the future.

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IPWordles

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For me, it's all about the overlap – those characteristics of different information professions that remain consistently prominent whichever particular profession you are considering. The differences are important, too, and account for the fact that there are many titles and educational programs, but my primary interest lies in underscoring the similarities and through this bringing the information professions into partnership.

What commonalities should we look for? Were these professions with rich underlying theory, we might look there, and I hope that someday we will be able to do this. We might also, someday, look for shared beliefs and strategies. But a practical approach, especially for those who work to educate information professionals, is to look for shared skills or competencies. This is an approach that has been proposed by the ASIS&T Information Professionals task force, but largely remains to be done. This paper is an exploratory look at a set of information professions, using word clouds, and my hope is that it will lead to some creative sparks and further work on shared skills.

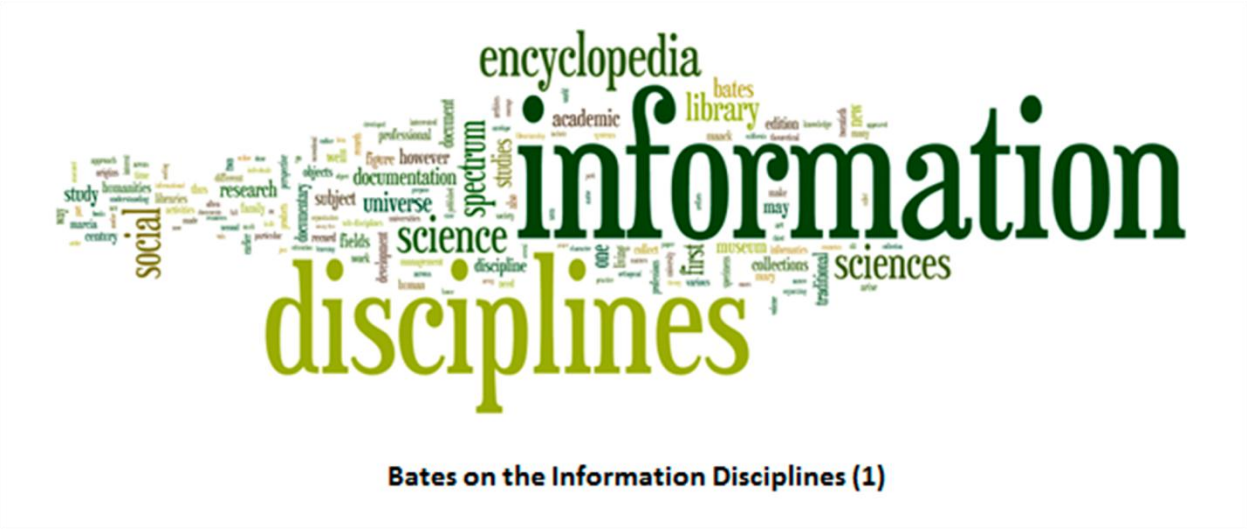
My methods were to identify information professions of interest, find authoritative statements of educational goals, and to create word clouds from them. A word cloud is a visual representation for text data, typically used to visualize free form text. I used wordle.net to create my word clouds. The documents I identified covered a wide range of dates, from the ASIS&T Educational Guidelines of 2001 to a recent job description for a user experience librarian. When I could not identify an authoritative statement, I used job descriptions. There is some, but not much, variation that would seem to be attributable to the time or the source of publication.

My choice of information professions was idiosyncratic. In addition to ones that are general, and others that group around librarianship, I included several from the health sciences, where I practice. Finally, I included some information professions with titles of recent origin, including user experience director and data scientist. It is my hope that you, the reader, will wonder about how other information professions would be represented, and will create your own word clouds.

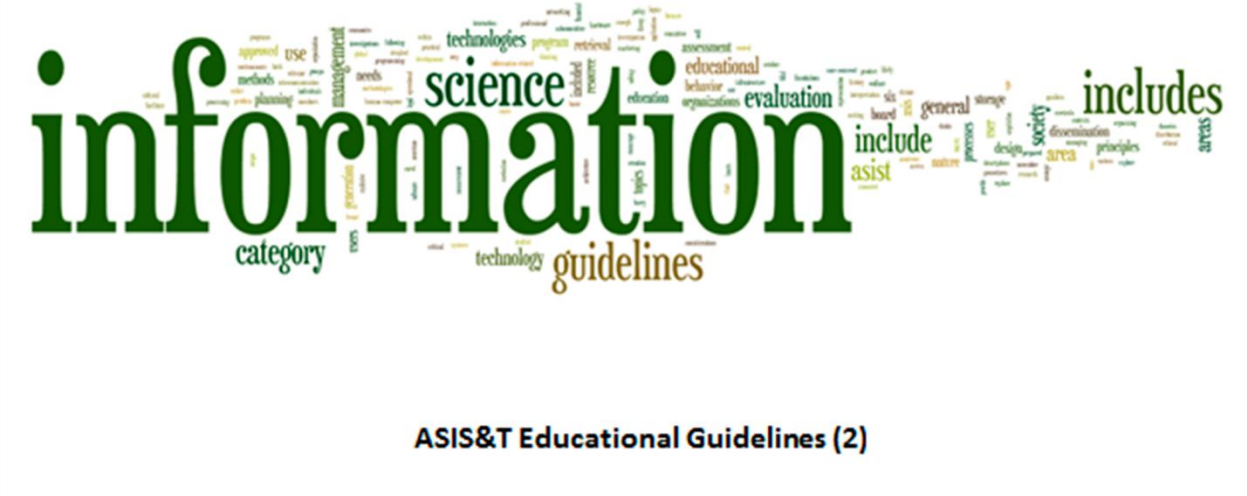
Reviewing the word clouds, I looked for the most prominent words. I also looked for occurrences of:

- Data, information, knowledge - the essentials
- Resources, systems/technology, users, services - the components
- Creating, organizing, providing, managing, analyzing - verbs
- Organization, society - context

It is my hope that as you look at these IP word clouds that you will see other patterns, and that they will collectively inspire us on to further investigation of the commonalties and differences among the information professions.

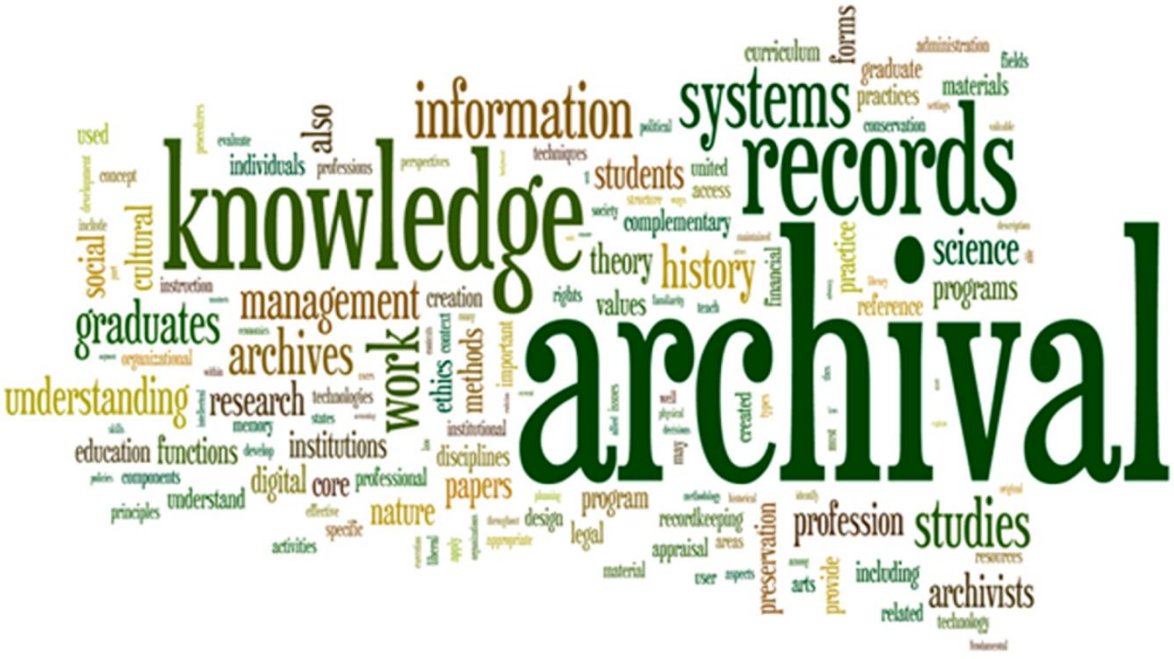


Bates on the Information Disciplines (1)



ASIS&T Educational Guidelines (2)

ALA Core Competencies (3)



Society of American Archivists (4)

Special Collection Professionals, ACRL (5)

Special Libraries Association (6)

Medical Library Association (7)

Health Information Management (8)

Clinical Informatics (9)

Data Sciences (10)

User Experience Librarian (11)

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The Future of Libraries and Archives

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Four presentations introduced the discussion about the future of Libraries and Archives: *A Core for Flexibility* by Mary L. Chute; *The "Open Movement" in Research and Scholarship – What is it and What Does it Mean?* by Charles B. Lowry; *Workforce Trends, Issues and Values* by Joanne Marshall; and *IP Wordles*, a text analysis of information professional position announcements, by Nancy Roderer. These presentations captured, reported, and reflected on important trends in the changing landscape of information service organizations that will have long-lasting effects on the core nature of library and archival service organizations. As it surveyed the rich territory information professionals must be prepared to explore, the Future of Library and Archival Organizations discussion, moderated by Sarah Michalak, converged on three themes: (1) the roles and nature of professional values in the field; (2) economic models and scholarly communications; and (3) relationships between library and archival organizations and the range of higher educational units offering programs leading to professional careers in library and information sciences.

Defining the information professions: Values and Practice

While IP2050 might be characterized as a consensus congress, a wide-ranging discussion suggested that individuals and organizations in the field identify with a more diverse spectrum of values and interests than those that have formed our core identity in the past. Furthermore, attempts to draw on a distinctive set of shared values central to the identity of the information professions may be problematic in light of the diversity of the field. Within that discussion some participants cautioned against turning to values to define the information professions based on observations of significant changes in the core values of other professional fields such as medicine and religion in recent decades. Changing and divergent values do not provide a secure grounding for a broadly acceptable definition.

As societies increasingly reinterpret the nature of important problems in informational terms, a broader landscape emerges at the intersection of information, society, and technology. The landscape will be broadened as increasing demand from a variety of public and private organizations for information professionals expands employment horizons and entrepreneurial opportunities. At the same time this broadened landscape will increase the potential for conflicting goals and values and intensify competition for resources and authority.

The relationship between the social mission of libraries, most vividly expressed by the institution of the public library, and the core values of workers in some sectors of the information professions will continue to diverge. While some organizations and individuals will continue to strive to fulfill the social mission traditionally associated with public libraries, others will identify with alternative visions. The

extent to which the social mission is still definitive or pervasive within the field (or even should be) is in debate. What can be agreed is that information professionals acting in different capacities and organizations do adhere to one overarching code: to connect people and information in meaningful ways that enrich lives and satisfy both everyday needs as well as higher level needs such as intellectual curiosity.

As one participant mentioned, the importance of values in the information fields is made explicit at organizational and institutional levels through devices such as values, vision, and mission statements and in documented goals and objectives. In academic and public library and archival organizations, core services of librarianship, including bringing content and users together; and organizing, providing access to, and stewarding information resources are still very relevant, and will guide the activities of these organizations as we step towards 2050. Future information professionals will go beyond collecting to ensuring the fullest utilization of information resources, balancing "high tech and high touch" using multiple skill sets just as they do today. Physical and organizational forms of libraries and archives will continue to evolve, producing novel variants, but librarians and information professionals of the future will draw from contemporary goals and values interpreted through the lens of local contexts, themselves shaped by the interplay of individual, social, and institutional actions. Accordingly, the essence of contemporary goals and values revolving around organization of information, universal access, collaboration, intellectual freedom and diversity of thought, self-directed learning, creativity, stewardship and preservation of knowledge, and responsiveness to user needs will be evident in everyday work practices of the future.

Economic models and scholarly communications

A second thread in the discussion of the future of libraries and archives focused on libraries, though there are important implications for other information organizations, including archives. Participants agreed that the future viability of libraries hinges on recognition of the economic values of information services in specific social contexts. In the academic realm, this was discussed in terms of the economics of scholarly communications. While Lowry (this volume) notes that the economics of scholarly communications is neither a new concern nor one that originated in the information professions, ongoing changes in scholarly communication systems indicate research libraries may be very different in the future. Development of new economic models for scholarly information and pervasive implementation of open access (OA) models will radically change the nature of everyday operations of academic and research libraries. Previously, libraries adjusted to a shift from ownership of physical copies to access to content on a fee basis. If use of open access models continues to grow, we should expect to see a concomitant shift in the use of library resources to accommodate broader support for open access content development, management, and curation. Ultimately, these content resources must be supported. Such support will require the development of new relationships, skills, and practices; as well as viable financial models for OA. To date, no single OA model has become pervasive, but some approaches show great promise (e.g., Harnad et al., 2008, on gold and green OA). Work by the research library community in cooperation with the Association of American Universities (AAU) presidents and provosts to develop models for access to and preservation of digital format scholarly

monographs is another example of ongoing developments that will contribute to the establishment of a more sustainable research information environment.

Discussants noted that uneven relationships between and among for-profit and not-for-profit sectors[18] and complex networks of interest have complicated the development of OA models. Commercial vendors' pricing strategies, while enriching some members of the industry, have severely constrained library budgets. On the other hand, a number of powerful private stakeholders have essentially forced the creation of a set of several OA models.

Focus on big questions has the potential to enable information science researchers and practitioners to make substantial contributions of practical import to large sectors of society. The questions of how traditional expert content producers, including news, publishing, and other media organizations will survive; and how changes in the systems through which content is produced will impact scholarly and other communication systems remain. Solutions will require multidisciplinary teams that include experts from information science and communications, and also from economics and finance. Universities, acting within the interstices, will find opportunities to become the *honest brokers*[19] for deliberations in the realm of scholarly and other communications.

Educating future library and archive information professionals

The third discussion thread focused on the relationships between information and library science education and practice in the information field. Discussion focused on the contributions of educators and researchers to the development of models of library and archival organizations. These models must be relevant, responsive, and beneficial to future communities of information users; they must also prepare future information professionals for their work.

We recently witnessed a period in which the correspondence between library and information science/studies programs and library organizations was approximately one-to-one: It was expected that most if not all graduates from American Library Association (ALA) accredited programs would find employment within academic, school, public, and specialized library organizations, and, to a lesser extent, archives. Similarly, it was expected that the majority of professional staff employed in these organizations would hold degrees from ALA accredited programs. Increasingly, however, students graduating from these programs are finding opportunities outside of the traditional library and archives sector. Employers in the private sector use different titles for employees with the same skills as employees found in traditional occupations. These titles emphasize job skills (information - related) as opposed to job place (e.g., library). As the number of alternative employment opportunities increases, there is a tendency to reinterpret what it means to be a librarian, or to create or import alternative titles

[18] Though broadly, organizations may be characterized as for-profit or not-for-profit, a number of participants noted that in practice, especially in the United States, the abundance of organizations that stress the importance of public-private cooperation blurs this distinction. The current orientation suggests that the growth of organizations with hybrid allegiances will continue.

[19] Literal translation of a term originated by Otto von Bismarck (*ehrlicher makler)*: a mediator (Oxford English Dictionary).

that align with understandings prevalent in the marketplace and by those we believe will benefit from our expertise. The language we use is important to our sense of identity, the establishment and reinforcement of community boundaries, and to explaining our relevance and abilities to those outside our communities of practice.

A shifting of emphasis towards provision of a broader background in information science coursework both in more traditional library and information science schools and iSchools has accompanied use of a new terminology. Other disciplines too have shifted emphasis, educating increasing numbers of students to work in what we broadly conceptualize as the information professions. The more society views experiences in the world via an informational lens, the more the information territories become coveted and contested spaces. Communities traditionally inhabiting these spaces will see a period of flux.

Though a state of flux threatens stability, it also offers possibility. Both risk and opportunity abound. Challenges to offer the right blend of traditional and innovative education will be met by structural modifications and new interdisciplinary alignments: new ways of teaching and new combinations of subject matter will emerge to meet these challenges. The rich environment provided in the context of iSchools and information and library science/studies programs at research universities provide tremendous opportunities for developing information services and systems relevant to libraries, archives, and other information organizations of the future.

We are well-positioned to confront the challenges and contribute to solutions to large and important questions that have wide-ranging implications for the future information environment, reflexive engagement with the role and nature of values underlying the information professions, the development of viable economic models for scholarly communications, and the re-envisioning of education and training models that will provide emerging professionals with the skills and understandings needed to bringing together information and people in the diverse contexts of 2050. While it is a challenge to envision the precise nature of the elements of library and archival organizations of the future, *futurizing* contributes to their creation, as well as the creation of a vision for the future of our field.

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Part Three

Information Industry Trends

Reflections on the State of Specialized Libraries: Five Global Trends all Knowledge Professionals Should Understand

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That we are living in an age of information and knowledge explosion is an accepted cliché. Formal and informal data, information and knowledge are available to individuals and organizations in both structured and unstructured formats leading to information overload, concerns about data accessibility, discussions of the role of metadata, content farms, return on investment in both the creation and consumption of information and the future of the information professions and those who provide services to them.

Social media has worked to make every information consumer believe they are search experts, to create new models of communication bypassing traditional sources, directly impact the business structure of information companies and lead to the rapid decrease in the number of libraries, information and business centers and the role of information professionals in corporate, news and related settings.

In this position paper I'd like to suggest there are five global trends causing, affecting and driving these dramatic changes.

Globalization

We live in a shrinking world. Thomas Friedman, the *New York Times* columnist and author of *The World is Flat: A Brief History of the 21st Century,* believes we are now working on an unprecedented level playing field, that political, technical and economic factors have lowered geographic borders and we live in a world where events in places such Egypt, Greece, Portugal, Singapore, India, China, Brazil affect our domestic economies. Open sourcing, blogging, offshoring, outsourcing, supply chain and informing are all driven or are products of globalization.

Among the results of this trend are the interconnected personal networks and sites which permit nearly instant sharing of news and content everywhere in the world. Digital world of mouth changes the model of recommendation, referral and review which have traditionally relied on more formal and more refereed and authoritative processes.

Distressed Markets

Events occurring in the US employment sector affect stock markets globally. The collapse of economies in parts of the European Union affect business success thousands of miles away in Japan. The collapse of the global housing bubble in 2007, issues of bank solvency and the West and elsewhere, global stock market declines, and nagging unemployment and underemployment issues are but a few of the trends affecting the information sector. The increased stress on business conditions has resulted in the acceleration of library and information center closings, outsourcing of information work and the rise in

low-cost competition in the news and business information sectors. The pressure to demonstrate return on investment in information commodities has never been higher and the free and low-cost competition to significant traditional information sources has never been more intense.

Disintermediation

The elimination of intermediaries in the supply chain also referred to as in "cutting out the middlemen" is the classic market definition of disintermediation. Also thought of as the "do it yourself" movement or the rise of the individual, this trend is driven by the uses and practices of the millennial generation. In the consumer world disintermediation, coupled with disruptive technologies, as driven use the use of the internet for self-service in nearly every field of endeavor. Banking, shopping, searching and research, reading and referral are but a few of the areas of communication affected by this trend. It has also affected to role of librarians and other information professionals in both positive and not so positive ways.

Disruptive Technologies or Disruptive Innovation

Clayton Christiansen, the Kim B. Clark Professor of Business Administration at the Harvard Business School, writing his series of books and articles on innovation, including *The Innovator's Dilemma*, *The Innovator's Solution*, *The Innovator's Prescription* and most recently, *The Innovators DNA,* was among the first to study innovation and commercial enterprises. His use of the idea of disruptive innovation set the stage for intense discussions regarding the positive changes new and interruptive technology can bring to commerce as well as social institutions, healthcare, education and others.

Competition

All four of the factors already noted are contributors to the increase in completion in the commercial sector as well as nearly every other area of global endeavor. Competition in the business sector, particularly in the business of information, is moving in a disruptive way toward merger or acquisition of companies, including traditional competitors, to the increased pressure to provide stockholder revenue, to the rise of startup companies in niche or low-cost markets. Competition for funds in the library and information sectors has seen the merger as well as closing of information centers and libraries. Competition funding in the academic sector and rise of distance education models, free models and other innovations are changing the way students approach and consume education. Competition is both a disruption and innovation driver. While the results are not always clear, the process of competition will provide new and innovative answers and increased choices.

If information educators and information professionals have an increased understanding of these global trends we can begin to work towards better formulating professional programs to equip our graduates and faculty to prepare them for the information challenges of the future. It is impossible to imagine fully the world these professionals will inhabit in 2050, and nearly as impossible to look toward a much shorter future. But in understanding these factors we can provide some continuing skills and understanding in the ways humans and organizations identify, acquire, organize, describe and

disseminate intellectual capital. These are constant and continuing requirements for the success of the enterprise.

From Knowledge Navigator and Watson to Star Trek: The Role of the Information Professional

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We have been given a formidable challenge. We have been asked to look to the future we want to see, not necessarily predicting what might happen. At the same time and at the end of the day, we have been asked how to prepare students to invent the future. And to bring it all home, we have been asked to help identify a set of key challenges and recommendations for courses, activities and experiences to meet those challenges. As we go along, perhaps some of the questions are as important as any single answers.

My context in this is the information industry, but a very specialized marketplace in this industry. My company does information management and information technology support services for federal agencies. We focus on scientific and technical information management. The direct relevance is we regularly engage practicum students and hire graduates from schools of library and information sciences. But we also hire computer scientists, and subject matter experts. And ideally we look for combinations of the three. So, let's begin. We're talking about 2050, so let's imagine:

In looking at the future we want to see, it might be good to start with some scenario review. In 1989 we had the "Knowledge Navigator", (www.youtube.com/watch?v=HGYFEI6uLy0) the scenario of the information future at that time. The Navigator had an Avatar who helped the hero navigate through information as well as personal schedules and life. Not too unlike our iPhones today with all our applications and it even included a voice response not unlike a good Siri. And we all shook our heads and saw all of the obstacles to that future. Remember there was no Internet, no World Wide Web and no Google.

Today we have Watson. An information machine that answers questions better than smart human beings. Again we see the constraints and challenges to expanding the scope of knowledge. But is this just the universe of knowledge or is it the kind of knowledge?

And then we have Star Trek where the computer is the fount of knowledge and can answer any question. But we see that as rather far out. Looking at how past futures have come into reality, it's not so far-fetched to think that 2050 might see more of "Computer" than Watson.

So the first question might be whether *Star Trek* is so bad? Other than the earth destroyed and wars continuing, is the information future where we want to go? The second is whether it is inevitable? And if we go to the future where all the information seeker has to do is ask a "machine", then what is the role of the information professional?

Or here is another vision of the information future: The print world talks of "food for thought." In the networked world users will be the prey and information the predator (Paul Peters, 1993). That's a pretty aggressive Computer! But we're on our way with recommendation systems that are pervading more and more of our information seeking functions.

However far we get by 2050, it is clear that we will be a paperless (not me but the next generation), wireless, and mobile society. We will expect and get our information anytime and anywhere. It will not be the "document" that contains the information but the information itself.

Clearly libraries as we thought of them in the past are out – in fact they are already far in the process of transformation. Are librarians, who are now more broadly associated or interchanged with Information Professionals including information scientists, archivists, records managers, and some computer scientists, also out? A segment of librarians have not been traditional for a long time. When everything started having a fully digital life cycle, librarians have continued to carry on basic technical services functions, including collection, technical processing and knowledge organization, and information dissemination and retrieval. On the user services side there continues to be the function of education, training, reference and even circulation (think e-books and user controls). But the technologies and the means by which these functions are carried out have changed radically. This has meant adding new skill sets, mainly technology driven, to the mix. Even in the most traditional of reference functions, social media has transformed the way this can be done.

Technologies have been disruptive and it is critical for information professionals to stay up on changes in technologies. Figure 1 shows the rapid rate of change in technologies and each of us can overlay our views on how these have changed the roles of information professionals.

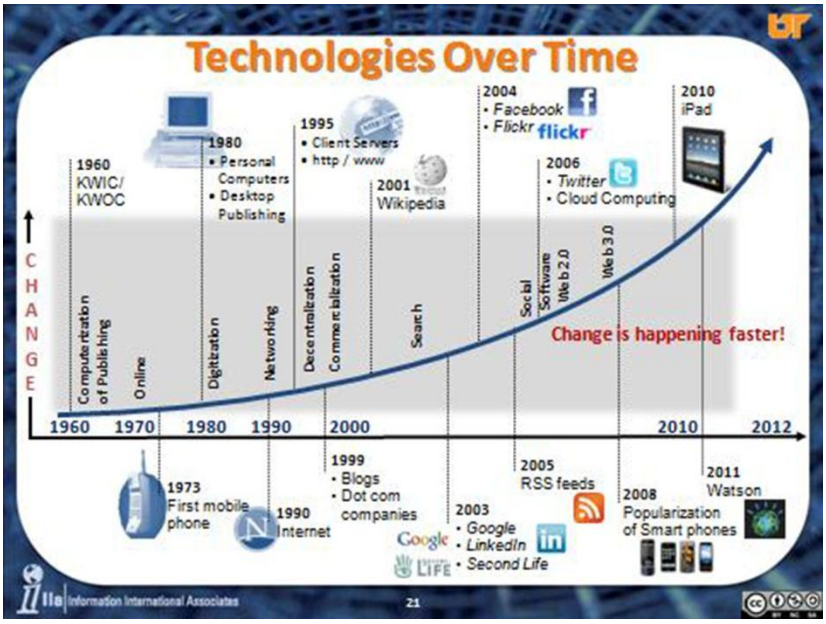

Figure 1

We may not be the developers of these technologies, although our knowledge organization expertise has been sought after by the "big ones" after they realized that the machine needs to better understand the structure of knowledge to be better guided to the human interface.

So what are the key challenges? Clearly there are many, but I will highlight four. The higher information literacy and expectations of the users that have been enabled by such disruptive technologies. First, search engines like Google and now social media like Facebook, have changed the playing field. Not in 38 years but for the next 10 years we're going to have to rethink children's "reading rooms" because those age groups are digital natives and baby boomer's "reading rooms" because we are the digital immigrants. They will be in power in 2050, but we are in power now. The information professional will need to rethink providing services to accommodate a rapidly changing user profile.

Another major challenge is information overload. We hear daily about the data deluge and the amount of information that is more than we can absorb. But even this is not a new phenomenon. What is new is the degree and kind. And some of the solutions like data visualization, data analytics, and data mining are based in technologies. Just as the mechanical machine enabled the industrial revolution and extended human physical power, the computer has forced the information revolution and will extend our mind power. So information professionals will need to have the skills to address this information overload for the next generation -- until "Computer" really holds the day.

The third challenge is the total globalization of knowledge and the dramatic changes it brings. Particularly here in the United States we are facing a brave new world. For my generation, English has always been the language of science and the language of commerce. This wasn't always true and when one looks at world demographics, we can wonder what it will be like in 2050. We have economic competition and national security concerns. We have cyber warfare both in the boardroom and in the military. We have cross-cultural and multi-lingual challenges to deal with today. Think of the Wal-Mart cashiers and note that even in the US, even in the small towns in Tennessee, we must choose between English and Spanish. In scientific information, the demographics of authorship are dramatically changing. Clearly, the US information professional will face some unique challenges as we engineer our information systems of the future.

The final challenge deals with the broader cultural changes taking place in the social cyber world; with a key emphasis on intellectual property and personal privacy. What will the future property regimes look like and how will the work that the information professional will do be impacted by these changes? We already see evidence that the digital generation has a very different sense of intellectual property and sharing of information. There is an orientation toward openness and borderlessness. But we also see a tightening of international patent and copyright interests to protect what the current generation has invested in. How will all of this factor into the role of each information professional as s/he enters the world of work -- and into the information systems that will be built?

So what are recommendations for courses, activities and experiences to prepare students to meet workforce challenges? Clearly the more technology and tools we understand, the better. But specific

tools will be constantly changing. So it is also important to teach insight and understanding of them in the context of the information life cycle and the kinds of needs served by these various functions as mentioned previously. Opening up interfaces with mathematical and computer science tools, including simulation and modeling, will allow the information professional to participate in the building of Watsons and will add a depth to the information professional's understanding.

It is also important to maintain perspective on different user communities. Traditional courses in sciences, social sciences and humanities will have an important place to understand the special nature of different user groups. But the boundaries among disciplines are breaking down in our flat and fluid information world. In each disciplinary class or perhaps as a follow-on it is important to teach information needs in interdisciplinary problem solving of macro problems of the day like global change, deficit reduction as well as thinking about micro problems like competitive business intelligence for a specific company.

Cross-cultural exposure and perspectives are also important to include in the curriculum, both within individual courses and in other ways. Perhaps some element in the curriculum that exposes the students to thinking about the future just as we will be discussing at IP2050 will help prepare them for the rapidly changing world they will be entering. The one constant is that the rate of change is increasing. Giving some perspective on the history of change can be enlightening.

In addition to course content, it is also clear that a lot of the training of today's S/I school graduates is being done virtually. From almost all virtual to only some on-line courses, the media is increasingly part of the message. It is a transition for digital immigrants, but probably more normal for the next generation. Thinkers about the future of the University are dealing with such problems at the higher levels and perhaps information professionals should be leading the way in this kind of thinking since information is the currency of the learning process.

And finally, as part of all programs for those information professionals who are looking at a terminal masters level professional degree to enter the workforce, it is important to gain work experience. Student practicums and internships (paid or unpaid) as well as bringing real problem solving into the classroom are good tools to improve a resume in principle and the graduates abilities in fact. Most schools have such programs, and this will be increasingly important in the future. This has been impacted by the job market competition where graduates must find ways to differentiate themselves. Perhaps by 2050, the training and hands-on doing will be even more integrated. One should also add a cross-cultural experience to real world experiences. This can be done by studying abroad or organized tours as part of a classroom experience. Perhaps we should think of cross-cultural as not only international but also exposure to work communities. In the case of the world for which we hire, one should have tours of scientific and/or intelligence environments. A lot of this is being done, so the recommendation is to support and enrich these directions.

In reviewing the courses and programs of a few schools in preparation for IP 2050, we see that change has been taking place. There are elements that address most of the challenges that have been

presented. It is most difficult to begin with 2050 and bring it home with current program development. But getting the discussion going is a great start.

Turning Adversity into Opportunity—Entrepreneurship and the Information Professional

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Huffington Post, 2010: Four young blog editors and I were sitting around after work talking about the new iPad that some of us had previewed and the fact that it would have an enormous impact on the newspaper industry. I naively included Huffington in that category and said I was looking forward to reading my papers over breakfast on an iPad much as I had always done. A comment from one of the editors knocked me for a loop. "There is one problem with that," she said. "There is no longer any news in the newspaper."

Fast forward eighteen months. I am in bed reading the New Yorker before going to sleep, a habit of mine that is over 40 years old. Now I read it on my iPad. A voice emerges from the pages. I gasp and so does my unsuspecting wife. "What's that?" she asks. "It's the poet reading her poem," I replied. We huddle together looking at the screen and realize something big has just happened even if we don't fully understand its implications.

Three months later I am sitting in my living room again reading the New Yorker on my iPad while listening to music on my stereo which is also now wirelessly iPad controlled. I come across a review of an album I can't wait to hear. Click, I go to iTunes. Click, click, click, I buy and download the album. Click, click, I begin listening to the album and click I go back to reading the New Yorker right where I left off. I paused for a moment and said, "Thank you Steve Jobs."

-- Buck Goldstein

The information reset

Nothing about these three events is particularly unique and by themselves they are merely isolated experiences. Multiplied across millions of consumers they suggest fundamental changes are taking place in the nature of what those in the business have referred to as "content" ever since Bill Gates' famous essay, *Content is King*.[20]

Even before the iPad, content providers have been bypassing traditional media and creating new channels for delivering, sharing, and accessing information. Readers no longer get their news from newspapers. Changes in readership and declines in classified advertising are ripping apart one of society's most venerable institutions. Similar changes are rippling through the film, radio, and book industries. For instance, predictions made decades ago that most of the world's books would someday be digitized have come true and the very meaning of the word 'book' will never be the same. All of this

[20] Gates, Bill, Content is King, 1996. Retrieved on 4/16/2012 from the Wayback Machine

is being driven by swift technological change and the optimistic sense that there is still enormous value in content that is yet to be unlocked.

Content, context, and convergence

The iPad and other consumer devices serve as the 'last mile' for providers of content-in-context. Today, we don't 'go' to get information, information flows to us, when and where we need it. What once was science fiction – ordering music on iTunes from within an album review in the digital *New Yorker* – has now become routine. This is all possible due to the convergence of rich digital content, ubiquitous wireless consumer electronic devices, a robust e-commerce infrastructure, and socially augmented applications. The commercial impact of all of this is only beginning to be understood. What content will consumers pay for and what will inevitably be free? How will publishers of reviews be compensated for 'click-through' sales? What models are needed to make curation and aggregation of social media economically viable?

The information profession can view this uncertainty as a threat or an opportunity. Content creators and intermediaries who are afraid to take risks and unable to take advantage of new technologies will be superseded; a reality that gives urgency to the need to come to grips with what has been called "the new normal." We believe library and information science (LIS) graduates can play central roles in commercial and non-commercial opportunities in this new environment. They can bring competencies in the organization and curation of information, user-oriented service development, and information technology skills to these enterprises. Yet these strengths alone are not enough. We believe information professionals must also function effectively at the intersection of innovation and execution which, in our view, requires entrepreneurial thinking.

What is entrepreneurial thinking?

In the words of Peter Drucker: "Entrepreneurs innovate." They connect the dots in ways that are often obvious after the fact and they relentlessly execute their ideas even with inadequate resources and no guarantee of success.

We return to Apple and the creation of the iPod for an example. In the late 1990s, digital music was played on 'clunky,' hard to use MP3 players, piracy was at its height, and the music industry was in total disarray. At this time, Apple Computer was struggling as its personal computing market share had dropped precipitously. Out of desperation, the Apple board invited company founder Steve Jobs to return. Jobs inherited a company low on cash and short of good ideas.

The chaos in the music industry looked like a nightmare; but to Jobs it looked like an opportunity. He was convinced that consumers would pay for a music service, if it was inexpensive and easy to use. And so Jobs created a small group within Apple to work on the iPod and the iTunes store. Ultimately Jobs and Apple turned the industry on its head by selling an inexpensive music experience to encourage purchase of the iPod. This was the first product of a line of lifestyle appliances that revolutionized Apple. Jobs and his colleagues never looked back and Apple is now the world's largest corporation.

Entrepreneurs solve problems

If viewed as an entrepreneurial activity, creating information systems and services is never *just* about information or computing. Information systems are built to meet users' needs and to solve real-world problems. Yet, IT skills are not enough. Information entrepreneurs need to master the skills of problem solving and creative thinking typically viewed as the province of the liberal arts.

The American Association of Colleges and Universities (AAC&U) identified *problem solving* and *creative thinking* as two essential learning outcomes of a liberal education in the 21st century. Students who master *problem solving* can define a problem, identify and evaluate multiple approaches to solving it, execute an approach that will likely bring success, and then evaluate the outcome. *Creative thinkers* synthesize knowledge and diverse ideas to create wholly new solutions to problems. They are comfortable with ambiguity and contradictions, and do not avoid taking risks.[21]

LIS is a translational discipline that can provide students with ideal settings and opportunities for honing these skills. The work of a translational discipline "straddles the border between academia and the real world,"[22] 'translating' research into solutions to important problems. A prime example is engineering in which faculty and students apply research findings and techniques to solve real-world problems. LIS programs too have a responsibility to bring 'information expertise' to bear on problems in the 'real-world.'

Information entrepreneurs cannot solve problems they know nothing about. They must engage and collaborate with experts in other academic disciplines, external partners, and clients to discover the information problems most in need of solutions. LIS programs have a long history of preparing their graduates for roles in the information professions resulting in a practical, outward focus to their curricula and research agendas. This is a true strength of the information fields. However, more intensive collaboration is needed to provide students with the opportunities to develop the problem solving and creative thinking skills needed in the "new normal."

Recommendation: Initiate projects and partnerships

For years, LIS programs have partnered with internal and external organizations to provide students with 'on-the-job' training and opportunities for group projects. These are important relationships which in many cases result in first jobs for our graduates.

We recommend going a step further by seeking out entrepreneurial opportunities for our students through relationships with university-led or regional incubators. The Syracuse Student Sandbox for startup companies[23] and the UNC Social Innovation Incubator[24] are just two examples of university-

[21] AAC&U (2010). VALUE rubrics for problem solving http://www.aacu.org/value/rubrics/pdf/problemsolving.pdf and creative thinking http://www.aacu.org/value/rubrics/pdf/creativethinking.pdf

[22] Thorp, Holden and Buck Goldstein. *Engines of innovation: the entrepreneurial university in the twenty-first century*. Chapel Hill, NC: University of North Carolina Press, 2010, p. 40.

[23] Syracuse Student Sandbox, http://www.syracusestudentsandbox.com/

[24] UNC Social Innovation Incubator, http://campus-y.unc.edu/about/social-innovation-incubator

sponsored incubators. Students working in an incubator are surrounded by peers with similar motivations where they learn the entrepreneurial skills of teamwork, risk assessment, and creative problem solving. Another possibility is encouraging internships for students with incubators or startup companies themselves. In these environments, students will work with entrepreneurs learning to apply what they've learned in the classroom toward commercial or non-commercial ventures.

Commercial partnerships can serve as catalysts as well. Faculty and students working alongside commercial partners exposes the community to new ideas and to problems that need to be solved.

Finally, internships and partnerships should not be reserved for the annual report. Internship sponsors, departmental partners, and entrepreneurs should be invited to the school as public speakers and to serve on panels exposing the entire community to new ideas.

Entrepreneurs are impact-oriented

Entrepreneurs have a vision for what the future might be and act to create that future. In so doing, they have an impact on the world. To find his or her way, the information entrepreneur must possess the critical abilities of assessing, measuring, and communicating impact associated with a venture. Who will the venture help? How big is the market? Entrepreneurs must be able to communicate the potential impact (and risk) of a project to stakeholders or investors at its inception to gain acceptance and then again at closure to assess project success.

Since the late 1970s, the user-oriented research paradigm in information science has yielded a rich literature focused on the value and impact of information. Value and impact may be quantified in financial terms, but more often are measured in terms of user success or user outcomes. In either case, information entrepreneurs will seek out or build models for measuring and communicating impact.

Recommendations: Add entrepreneurial competencies to the curriculum

LIS programs should provide students with exposure to and experience with methods for assessing, measuring, and communicating the value and impact of information resources and services. These skills are essential for entrepreneurship, but they are also becoming essential skills in all enterprises. Stakeholders in private and public organizations increasingly demand evidence that products support the financial bottom-line and services make a difference in people's lives. Graduates who can develop methods for answering these questions will be in demand in the workforce.

Information professionals should also have a fundamental understanding of accounting and finance. LIS students intending to work in the non-commercial sector are not exempt. Currently, some programs offer management courses that cover budgeting basics and occasionally students can take a full course on finance for non-profits as an elective. We recommend programs offer a short-course on financial literacy for the information entrepreneur.

Recommendation: Encourage entrepreneurs-in-residence

We realize that these changes will not happen by themselves. While numerous faculty members in the translational disciplines are entrepreneurs in their own right, an entrepreneur in residence can be a catalyst for change as well.

An entrepreneur possesses the skills of calculating risks, assessing impact, and acquiring funding. These skills can complement those of fellow faculty innovators in the LIS program, turning a good idea into a going concern. Perhaps as exciting are the opportunities for students who apply to an LIS program because they have innovative ideas they want to test and financial goals of their own. Interacting with faculty mentors and entrepreneurs-in-residence can provide a student with a solid background in the discipline and the entrepreneurial skills needed to build a venture. The trick is finding entrepreneurs who can meet the academy at least half way. To the extent that an entrepreneurial practitioner understands and appreciates the role of the academy and faculty members appreciate the perspective an outsider brings to the conversation, there is opportunity for real innovation in the LIS curriculum.

Entrepreneurial thinking can transform the profession

"Innovative opportunities do not come with the tempest but with the rustling of the breeze"[25]

– Peter Drucker

Conclusion

Entrepreneurs are attracted to rapid change like moths are attracted to light. Such change, which is often viewed with alarm by big institutions, is the greatest source of entrepreneurial opportunity. Although there can be reasonable disagreement on the direction of change in the information world and whether or not the change is positive, there can be little doubt that the information profession must change with it. Such change will be more than an academic exercise. It will take place at the intersection of innovation and execution, a space where entrepreneurial thinking is required. Academic institutions that successfully negotiate the challenges created by the rapid change in the information industry will be the ones that embrace and even welcome rapid change and the entrepreneurial opportunity such change offers.

[25] Drucker, Peter. *Innovation and Entrepreneurship.* New York: Harper & Row, 1985.

Masters of Librarian Science

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On the afternoon of Wednesday, November 7, 2011, National Public Radio's *All Things Considered* ran a story about the CIA's use of social media in the fight against terrorism (Siegel, 2011). The story was reported by Kimberly Dozier, the intelligence correspondent for the Associated Press. At one point in the story, after Ms. Dozier had described the scope of the CIA's efforts, Robert Siegel asks how many "minds" are looking at all these mountains of data. Dozier responds "We're talking about several hundred staffers. You've got people who are experts at finding information. And many of them have a master's of librarian science."

I cringed when I heard Dozier's mistake about the name of the degree that most of us have. But it also got me thinking about the future of our profession and how that future might be affected by individuals whose degree was a master's of librarian science instead of a master's of library science. What would our profession look like and how would it be valued if it were defined by the skills we possessed instead of the place where we work? Would those professionals be better suited to an environment that is likely to be even more fluid and driven by rapid innovation than the one we know today? In order to define this refined vision of our professional future, I have interviewed several librarians and information professionals who embody this new take on our discipline (personal communication, 2012).

While the title of this paper might incline you to think that I am only writing about librarians and librarianship, I want to be clear that my focus is about defining the professionals we need to be active and vital participants in the broadly defined information industries as those industries exist today and will exist in the future.

Finding a Place

In 1982, Peggy Hull was in another of a series of temporary positions. This time she was working as a temporary cataloger at the Burroughs-Welcome corporate library, at the time the largest pharmaceutical company in Research Triangle Park. As the end of her temporary assignment approached, Peggy began looking for other employment opportunities. The head of the BW library had been getting calls asking for advice from a researcher at a new pharmaceutical firm in the Triangle—Glaxo. She suggested that Peggy give them a call.

When Peggy called, the Glaxo researcher told her that they were not hiring a librarian but Peggy got him to agree to talk about a temporary, part-time position. When she finally met her contact, she found that the "company" was in rented space and in their only conference room she found a stack of journals on a folding table and a few books in a bookcase. She was hired for six months to organize these collections.

In 1982, Glaxo consisted of about 25 employees, mostly pharmacists, regulatory affairs staff and clinical researchers. They were working to get several drugs that were established in the UK and European markets approved for the US market as well as getting one brand new drug approved by the FDA. Peggy's first tasks included developing a routing system for the journals, establishing a rough order for the books and going to local medical libraries to photocopy the articles they needed. She found her new users to be extraordinarily grateful for the work she did for them. She quickly determined that Glaxo's employees could benefit from literature search services, so she took a Dialog class and began searching Medline and other medical databases (on a dialup line with thermal paper rolls). In these pre-Internet days, learning how to search Medline involved attending a 5-day course in Bethesda, which Peggy did. She also continued photocopying articles in the evenings—providing her clients with a complete search and delivery service.

When Glaxo's new drug was approved and hit the market—Zantac wildly exceeded expectations and Peggy's contributions to that effort did not go un-noticed. As a result of Peggy's decision to focus her early energy on solving problems in creative ways and create a "just in time" library experience instead of a "just in case" facility, when she left Glaxo in 1996, its library had a staff of 21 that included 10-12 library professionals, including some who held advanced degrees in chemistry and biology. This facility was delivering tailored scientific, news, and business information on a daily basis electronically to the whole global company.

Producing Products

In 1999, Peter McCracken was working in the libraries of East Carolina University and then the University of Washington. He was experiencing a growing frustration over the difficulty of identifying and accessing the journals contained in the databases to which the libraries subscribed. When he started talking with his brothers about this issue, his youngest brother said, "If you can explain the problem to me in a way that I can understand, then I can build a solution." Peter's other brother chimed in "If Mike can build it, I can sell it."

Peter managed to describe the problem in a way that Mike could understand it and these three brothers and a growing team of friends and colleagues set to work on what would become Serials Solutions. Cornerstones of the company's success included a commitment to accurate data, an unyielding focus on what works best for the customer (the library), not limiting their technical approach to the state of library automation at the time, keeping services simple, and being careful about what they would build and what they would not.

While Serials Solutions is the company that Peter is most recognized for, it is not his only entrepreneurial effort. Building on a long-time passion, he has created ShipIndex.org. ShipIndex.org is a company that focuses on aggregating and providing access to information about maritime vessels. The work that resulted in ShipIndex grew out of an internship at the Maine Maritime Museum in 1994 and coursework at UNC's School of Information and Library Science. And what is the key to the success of this new venture? According to Peter all he needs to do is change the way that societies view maritime

history. Peter feels that we need to see that "this history matters; that ships, which have transported people, goods, ideas, and more for the entire span of human history, is one of the most important areas that we should study."

But Peter doesn't just use his research and entrepreneurial skills to create information companies and commercial products. He has also used those skills to start a small nonprofit online community calendar to help make the 1600 residents of his village aware of all that is going on in their community.

Building a System and a Community

In 1998 and with less than one week on the job, David Singleton, Georgia's new Resource Sharing Librarian, was asked by the Vice Chancellor for the Department of Technical and Adult Education to write a white paper on the feasibility of a shared automation system for Georgia's public libraries. The reason for this request was that the Governor's office was kicking around the idea of a state-wide library card. While David knew that a paper-based system of cards for every library would work, he believed that a shared automation system would be an essential part of making a state-wide library card a reality.

At the same time, while the entire country was steeling itself to deal with Y2K, David and his colleagues had to deal with the fact that not all of Georgia's public libraries had internet access, and many were still using dial-up. In public library systems across the state, access to the state's 3 year old state-wide collection of databases (GALILEO) could only be obtained from a handful of work-stations in each facility. In essence there was no statewide network. David, who became Acting State Librarian soon after the development of his white paper, began working with the legislature and Georgia's public library systems to build a statewide telecommunications network.

The shared automation system solution was PINES. Conceptualized as a Y2K project, PINES went live in December, 1999 as a shared automation system that was supported by SIRSI. 98 Georgia public libraries rang in the 2000 New Year as PINES members. PINES membership eventually grew to 275 libraries, a union database of 6,000,000 books, and almost 2 million users.

One of the primary goals of PINES was to increase access to all of the state's public library resources. Was this a success? In FY07 the system handled 540,000 inter-library loans as compared to only 6,000 traditional loans between public library systems in 1999.

As PINES approached the end of its initial 5-year vendor contract, David Singleton, Julie Walker and other Georgia librarians started taking stock of what they had achieved and began to dream about what else they could accomplish. This group conducted a systematic and thorough survey of the existing library automation marketplace and found only a handful of systems that could handle PINES' requirements.

At the same time, David and Julie began asking a very significant question: Is the software driving the policy/procedure, or is the policy/procedure driving the software? They concluded it was the former and

decided that in Georgia that had to change. They began a series of focus groups with both library staff and users. The groups were basically brainstorming sessions where participants were asked to imagine an automated system that could work magic. These groups described a system that would eventually become Evergreen, an open source system built by the Georgia Public Library Service with the public libraries of Georgia being involved throughout the development process. Today Evergreen is in use in over 1,000 libraries world-wide.

And when asked what they did right, David and Julie answer, "We listened, and designed the system based on input from library staff and patrons. This created a sense of ownership and pride in the system as it developed." David, Julie and the public librarians of Georgia wanted to create the right system for Georgia, but, in doing so, they also created a system that had the potential for changing how libraries thought about open source in libraries.

Recognizing Patterns

In 1999, Ms. Ashton (not her real name) became the first librarian at a research institute focused on aging at a major Southern research university. Like Peggy, when she walked in the door she found an unorganized stack of books, journals, and articles. Her first task was to develop a basic library for the members of the Institute and, more broadly, for researchers outside the Institute who were interested in the Institute's topic. She also had to operate in the context that her library was part of a much larger university library system. So as she built the Institute's library she focused not only on what needed to be housed at the Institute but what could be accessed from the larger context of the University's collections and resources.

Like David and Julie, Ashton also found herself creating systems and tools that increased access to the materials that her colleagues needed. Also like the Georgia team, she listened to and involved her colleagues in her work. For example, she paid attention to the requests that she was receiving. While she responded to individual requests for information and service, she listened for whether or not these requests were unique. When she found that a question or need recurred, she developed a resource to address the challenge in a more efficient manner. For example, she was often asked questions about whether a particular journal was available in the Institute's library or on-campus. To address this recurring need, she built a database of journal information related to the interests of the Institute's staff. Another example was how she responded to requests for a list of researchers who were working on campus in the area of aging. This was surprisingly challenging, given that the field is spread out over various disciplines and subject areas, so the faculty focused on aging were located in departments as varied and as far flung as social work, business, and information science. The result was that they often didn't know each other. In response, she created a directory/database of faculty and researchers, including their research interests as well as their positions and connections throughout the university. She turned this directory into an online database so that anyone could use it to search for other faculty members with similar interests. This meant that a researcher could discover someone from a completely different department who shared either their research interests or could support the work of the Institute. It also helped create a system for that supported interaction among this diverse group of

researchers. This became a popular resource and was valuable when it came time to develop collaborative projects and research proposals across disciplines.

Since the Institute's staff was small, Ms. Ashton was able to develop direct and personal relationships with her users. This gave her colleagues a chance to learn more about her and the skills that she possessed. As a result, as the needs of the Institute changed, her role also changed. For example, she became responsible for managing the Institute's web-site. What started as a few web-pages developed into a 1500-page site that not only provided information about the Institute but pushed the Institute's information, publications, and research out to a wider audience. In addition to the website, she also became responsible for managing the Institute's publications and defined its social media strategy. Like Peggy, who attended a DIALOG class to learn on-line searching, Ashton pursued an aggressive self-directed learning program to develop the competencies that she needed in order to meet the needs of her employer.

When she left the Institute a few months ago to take a position in the private sector, she not only left behind a solid, functioning special library. She left behind a group of individuals who had a new awareness of what a librarian could do for them. She left behind an organization that was better positioned to leverage its information assets to achieve its mission.

A COMMON CORE

All of these individuals share several traits that are not only important today but will become increasingly important to the information professions of 2050.

Entrepreneurial stance

All of these individuals identified a problem and focused on creating solutions to it instead of just accepting the status quo. They set about creating new products, new systems, and new services that overcame these problems and improved the efficiency, effectiveness and/or the quality of life for their communities.

In their book *Engines of Innovation*, Thorp and Goldstein (2010) define an entrepreneur as someone who increases the use of underutilized resources. The essential nature of libraries has historically been as institutions that collect resources and information, but the purpose of this entrepreneurial approach to gathering is not just to collect, but to increase access and use.

At Glaxo, when Peggy begins offering on-line searching, she is seeking to maximize the efficiency and effectiveness of Glaxo's most precious resource—its staff.

At the University of Washington, Peter wants to generate use of the library's electronic journals. He wants not only to help scholars and students find the information they need, but to increase the library's return on its investment in these materials.

In Georgia, David and Julie identify needs in their state that no existing system can meet. They decide along with the Georgia public library community to build a system to answer those needs. The result is

not only in a system that meets the needs of its users but a community that understands, respects and cooperates with each other.

For each of these information professionals, problems are not just something to be endured -- they are something to be overcome. The solutions they create result in higher utilization of some asset their institutions or communities already hold.

Customer/Community focus

Each of these individuals was committed to a specific user group or community and committed themselves to helping these communities achieve their goals through more effective use of information resources and services. In some cases they created the resources and systems needed by their communities to achieve these goals. In all cases, they were pro-active and anticipatory in identifying community needs and crafting responses to them.

For Peggy, the community was her colleagues at Glaxo, but she just doesn't wait for them to bring requests for articles to her. As Peggy sat in that conference room "arranging" Glaxo's handful of journals, she listened for the questions and challenges that were being discussed. She would then conduct literature searches to find articles that might help move Glaxo's research and regulatory agendas forward, drop print-outs of these search results by her colleague's offices and ask if they wanted her to obtain the articles for them. In many cases, they requested copies.

For Peter, the community was initially the students and faculty at the University of Washington, but his solution solved problems not only for that institution but for research institutions world-wide. The same can be said for David and Julie in Georgia. A local solution has global impact. In 2011, Equinox, a company that supports Evergreen implementation signed 21 contracts representing 117 libraries and 415 facilities (Breeding, 2012).

In the case of Evergreen, however, the efforts of these two Georgia librarians not only resulted in a resource that their constituency could use. PINES and Evergreen both resulted in a healthier, more resilient community. In essence, the product of PINES and Evergreen was not just the system—it was the community itself.

Information in Context

In every case, this group of professionals has a correct orientation towards information. Information is an asset that is meant to be used—not just collected or preserved. They were passionate in their belief that the availability of recorded knowledge and story improves the quality of life of their constituencies.

While she was hired to arrange a collection of journals, Peggy went on to create both a document delivery service and an online search service for her employer. From the outset, she focused on identifying and delivering the information needed by her "market" in the most efficient and effective way possible.

In the case of Peter McCracken, his entrepreneurial orientation became a commitment to convince the world of the value of maritime information.

For David and Julie, their orientation is not about guarding their state's public library resources -- it is about creating both systems and a culture that is committed to maximizing the sharing of those resources.

For Ashton, finding ways to share information with diverse audiences was the key to helping a specialized group of individuals become better connected and have better tools for collaboration.

Technology as a means to an end

Each of these individuals took advantage of emerging technologies to create their products and services, but in all cases technology was not an end in itself. The technology that was most effective in achieving their goals was applied to the community challenges that each of them identified. The goal was using technology to address user needs.

On-line database searching was not something that was available at Glaxo when Peggy showed up. She introduced it not because it was the new, new thing. She took her DIALOG course to be able to ensure that her scientists had the latest, most accurate information available and that they obtained this with the least amount of time and energy on their part.

Peter says that one of the keys to Serials Solutions' success was that it was not limited to current library technology. He was able to draw on some of the cutting edge technology that was being used and created by the dotcoms that his brothers and their friends were working for. Again, it wasn't just access to cutting edge technology—it was using this technology to solve the information challenges faced by Peter's users.

At the research Institute, Ms. Ashton explores strategies for maximizing the impact of the Institute's web-site not only to share information about the Institute but to give its findings a wider audience. She also begins developing a social media strategy for use within the Institute as these technologies become available. Again, her goal was not to create a Facebook page, but to determine whether this social communications technology can help her achieve the mission and goals of her employer.

Collaboration

There is an image of the lone entrepreneur, the inventor in the attic or garage who invents in isolation. Each of the individuals featured in this paper realized that an essential key to success was finding the right team to implement their ideas.

The two outstanding examples of this are Serials Solutions and PINES/Evergreen. Without Peter's brothers and their friends it is an open question whether or not Serials Solutions would have ever seen the light of day. As has already been discussed, from its outset PINES/Evergreen was a collaborative effort between the Georgia State Library and the state's public libraries. But collaboration also occurred

between its funding sources, the team of developers who worked on the code, and that community of libraries as well.

Ongoing, Self-Directed Learning and The Spirit of Inquiry

Any entrepreneurial effort is at its heart a self-directed learning activity. As Peggy, Peter, Julie, David, and Ms. Ashton moved from having the idea of building a library service for Glaxo, creating Serials Solutions, developing PINES/Evergreen, or defining a social media strategy for the research Institute to their realization, I suspect that each of them could make a long list of the things they learned along the way. Undoubtedly, some of these would be things they set out to learn, but I suspect that many of what they would now view as the key takeaways from their efforts were complete and total surprises.

Another essential ingredient to the success of these efforts is that they were driven by individuals who embody the spirit of inquiry. They were genuinely curious about the problems and challenges facing their constituencies and were motivated to actively seek solutions to these problems.

Implications for Librarian Education

During the 1970s and early 80s, Lester Asheim, a Kenan professor at what was then the UNC School of Library Science, taught a course entitled "Agencies of Mass Communication." One of the texts in that class was Marshall McLuhan's *Understanding Media* (1994). A central tenet of that text was that a new medium does not extinguish an older medium, it transforms it. The same can be said for our profession. The need for professionals to staff the libraries that are housed in universities, corporations and communities will continue. However, the information ecology and industry of today and tomorrow is also transforming the roles that our profession can play—and indeed must play—if it is to occupy a place of significance in the lives of our communities, businesses and institutions of learning.

These new professionals will also require professional schools that identify, recruit, educate, and sustain them throughout their careers.

Identifying the Entrepreneurial Spirit

As part of their student recruitment and admissions efforts, professional schools need to seek out and identify candidates who not only meet rigorous academic standards but who have those traits that are found in budding entrepreneurs. Whether or not this can become part of the admissions process, these schools should provide opportunities for students to assess their predisposition for start-up activities and whether or not these are positions and activities that would be satisfying to them.

Peter McCracken credits a marketing course taught by Dr. Evelyn Daniel as being instrumental in helping him think about the opportunities that became Serials Solutions and ShipIndex.

Both David Singleton and Julie Walker "ran" stores growing up. David would "borrow" candy and snacks from his father's grocery store and sell them to his cousins. Julie ran an impromptu lemonade stand in the parking lot outside her family's restaurant. I doubt that either of these stories surfaced as part of

their admissions process or even during their time at UNC but both indicate an entrepreneurial stance that would become cornerstones of their professional careers.

Another example of how students with the skills needed for the information professions in 2050 could slip through a professional education program un-noticed occurred during a recent visit to UNC's School of Information and Library Sciences. I was a guest speaker at the School's Popular Materials class. Before I began my presentation, I wanted to gauge the needs and interests of the students in the class. During this "needs assessment," one student said that she very much admired NoveList but that she wanted me to know that she was going to "take" my business. This is exactly the drive and determination that the information professions need not only in the future but now. Did the faculty at UNC know that they had yet another budding young entrepreneur in their student body? I suspect not.

If we are going to ensure that the information professions continue to be active and vital participants in the imagination economy, we cannot afford for students like the one mentioned above to pass through our programs un-noticed and un-developed.

Exploring Technology

An early version of ShipIndex was a series of web-pages that Peter hosted on the internet. These were the first pages on maritime history to be posted on the web. Peter learned how to develop these pages as part of his coursework at SILS.

Professional schools must continue to provide experiences for students not only to develop their technical skills but to become adept at assessing these technologies and their potential for improving a community's information infrastructure and systems.

I'm not advocating that our schools graduate web designers or developers, but graduates need to be fluent not only in current technologies but emerging ones as well. They should be skilled at technology assessment, especially in how it contributes to solving information challenges.

In essence, we need a process for educating emerging information professionals about technology similar to the approaches discussed by John Richardson, Jr.,(1992) in his article on the teaching of reference. Through an analysis of reference textbooks, Richardson concludes that over time, three different approaches to teaching reference have been in vogue. The first one, the structuralist focused on teaching the formats of reference sources. The second, the procedural emphasized the analysis and classification of the reference question and then mapping the question to the best resource for addressing it. The third approach, which Richardson calls the "psychologisticalist," focuses on understanding the interpersonal interactions between librarians and users that result in successful reference service. Richardson concludes his article by arguing that only when all three are blended into developing reference professionals "will the field have reference librarians trained, educated and capable of rendering high quality reference service."

Similarly, only when we have in place programs that help students understand various information technologies, how these technologies map to solutions for the problems facing user communities and the interactions necessary get these technologies adopted and used will we have the information professionals needed for 2050.

Information Needs Assessment

Our profession has a long-standing tradition of evaluating information resources. We know how to compare and contrast various encyclopedias, databases, and web-sites. How good are we at evaluating a community's or an organization's information needs? How good are we at being able to create and prescribe information solutions that help communities achieve their goals?

Ashton recalls several courses at SILS (Human Information Interactions and Information Systems Analysis and Design) that helped shape her ability to analyze user needs and develop information systems in response.

The profession of the future will need individuals who are equipped to fulfill this role for the communities they serve.

Collaboration

The April 30, 2012 issue of *The New Yorker* contained an interesting article on Stanford University (Auletta, 2010). One of the many interesting topics covered in the article was Stanford's Institute of Design, an interdisciplinary program that brings students and faculty from a variety of disciplines together to work on a project or problem. This format is something that should be explored as a vehicle for developing the entrepreneurial skill, information needs assessment techniques, and technology awareness of tomorrow's information professionals.

Such a program would provide an environment in which future librarians would learn how to articulate a problem so that engineers could craft a solution and marketers could promote it.

Leveraging the Present into the Future

In 2050, the information professions will have to be more entrepreneurial, community-focused, and collaborative. They will be involved in the creation of new systems, new content and new products for accessing and using information. The result will be a new definition for these professions and for librarians.

As David Singleton notes, quoting John Schaar in a talk where David is celebrating the tenth anniversary of PINES, "The future is not the result of choices among alternative paths offered by the present, but a place that is created -- created first in mind and will, created next in activity. The future is not some place we are going to, but one we are creating. The paths to it are not found but made, and the activity of making them changes both the maker and the destination."

The information professionals of today will be involved in shaping that not too distant future of 2050. If they are like the professionals that are described in this paper, then they will shape not only the future and themselves, but our profession and the world it occupies as well.

A glimpse of the context in which these future professionals will operate is available to us today. In "The Great Tech War of 2012," Farhad Manjoo (2011) says that the four companies that have come to define the information and entertainment landscape of 2012 are going to war and the outcome of that war is likely to determine the shape of the future imagination economy. The companies featured in Manjoo's article are Amazon, Apple, Google and Facebook. While Manjoo paints a detail-rich landscape in which powerful, talented and well-resourced Goliaths are at each other's throats, even he could not imagine some of the twists and turns that have occurred since the publication of his article. For example, Facebook has gone public. Apple and the Big Six publishers have been sued by the US Justice Department and the EU (Auletta, 2012). Microsoft, not be outdone in the tablet market, has "partnered" with Barnes & Noble to continue development of the Nook, a chief rival of Amazon's Kindle and Apple's iPad according to Auletta. Apple is also responding by creating a mini iPad designed to compete against Amazon's Kindle and Google's new Nexus 7 tablet (Martin, 2012).

If the information professions and the world which these professions envision are not to be collateral damage in this conflict; we will need to focus on three key things.

First of all, we must carefully and clearly define the nature of our work and how that work adds value to the communities we serve.

Secondly, we need to understand the nature of the people we need to do this work and how we equip and support them in adding value to their communities.

Finally, we need to understand the nature of the education ecology needed to educate and prepare all of us for what in 2050 will surely be not the information industry but the imagination economy..

Today, the *American Heritage Dictionary* (2006) defines librarian as "a person who is a specialist in library work."

In 2050, if we succeed at the three tasks mentioned above, whether we consult the *American Heritage Dictionary* (edition to be determined), the *OED* or the 2050 equivalent of *dictionary.com*, the working definition of information professionals will be "A professional who leverages a community's information assets to achieve community goals."

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Information Professionals 2050 - Industry panel

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This panel brought together Anne Caputo, Bonnie Carroll, Duncan Smith, and Buck Goldstein as representatives of the information industry. They shared their perspectives on the challenges facing the information industry, described the attributes and skills information professionals will need to succeed in this sector, and provided recommendations for recruiting and preparing iSchool graduates.

Challenges

Anne and Bonnie identified several disruptive forces including globalization, distressed markets, and innovations in information technology which impact the industry and its professionals. Information firms increasingly operate in a global market, meaning that events occurring worldwide can have an impact on these firms. These are also times of distressed markets in which economies can collapse and businesses merge or fail. This leads to competition between business units in firms and information services units often lose in these struggles. This is also a time of increased complexity and competition for the information sector as firms must do business in multiple languages and amidst multiple interpretations of intellectual property law. Innovations in information technology have been both a blessing and a curse as IT innovations have simultaneously increased user expectations and disrupted the information life-cycle. Many information tasks formerly handled by people have been automated leading to disintermediation, which in many cases is beneficial to end-users but displaces information professionals. Bonnie discussed this in depth in her talk on Tuesday at the conference.

These forces have had adverse effects on information services units and information professionals. With access to a global workforce, information work is also subject to outsourcing and offshoring. Information life-cycle tasks that were performed by information professionals a decade or more ago have been outsourced or automated as associated skillsets have been commoditized. We briefly discussed the plight of information units within corporations that have increasingly been eliminated or merged into other divisions. Anne noted that many information professionals have found roles embedded within other business units.

While end-users have benefitted from disintermediation, this also comes at the cost of information overload as we move from a world of information scarcity to one of information abundance. The panelists suggested that the iSchools have an opportunity to develop expertise and analytic tools to help our customers cope with and overcome overload. We also briefly discussed the trend in information literacy away from teaching search and emphasizing the evaluation of information. Gary Marchionini suggested that it is not just about information gathering and retrieval, but managing our own digital assets and our identities. Derek suggested that educating our communities about these topics is an opportunity for the iSchools and information professionals alike.

Another challenge is that communicating the value of information services to industry and our communities as a whole has proven to be very difficult or of low priority. There was speculation, but no agreement that the ability to demonstrate the value of information services in corporate contexts would have forestalled the closing of special libraries. Yet symposium participants widely agreed that skills in articulating and demonstrating the value of information services will be increasingly important for information professionals.

Needed Attributes & Recommendations

In this time of change, disintermediation, and outsourcing, participants agreed that successful information professionals will need to be adaptable, continuously updating their skillsets and redefining their roles. The symposium participants identified several skills necessary for succeeding in this environment including technology skills, knowledge of intellectual property and copyright, as well as domain-specific knowledge and skills. The participants largely agreed with Bonnie, who stated that knowledge of specific information technologies would be less important than understanding how IT can contribute to specific customer or organizational goals. Duncan added that technology is a means to an end. The symposium participants did agree that some iSchools and iSchool programs are more IT-focused than others.

Panelists discussed the importance of mastering specific computer programming languages. Symposium participants agreed that exposure to computer programming is helpful, but that this is not a core skill expected of all graduates. Gary suggested our goal should be to ensure that our graduates have knowledge of and are comfortable with the 'primitives of computation' that are a standard part of being literate in today's world. Gary noted that computer science skills may help get the first job, but information skills help get the promotion. Symposium participants agreed with Duncan, who added that skills of technology assessment are also critically important in understanding the scope of a problem and recommending solutions.

Both Anne and Duncan mentioned examples of information professionals serving their clients or communities in embedded roles where they work within business units or in government offices. Bonnie noted that information professionals serving in embedded roles will need to acquire domain-specific knowledge in addition to information skills. Buck argued that this trend suggests the importance of a problem-oriented outlook for our graduates, instead of a discipline-specific outlook. Participants in the symposium did not go into a lot of detail on the topic of analytics, except to say that it was important and is being addressed to some degree in the iSchools through specific courses or certifications. Additional time would have allowed for a discussion of the appropriate role of the iSchool in helping our graduates develop analytics expertise and for preparing managers with the skill-sets necessary to use analytics to support data-informed decision making.

These panelists all expect information professionals to master a suite of 'soft skills' including collaboration and creative problem solving. Duncan Smith stressed the importance of information professionals taking an entrepreneurial stance. This stance encompasses a set of customer-oriented

habits and skills ranging from engaging with customers, identifying problems, and then collaborating within and across institutions to craft and implement solutions. Duncan also made the point that successful information professionals will find ways to use information to solve problems in the context of specific communities. This requires skills of listening and a "commitment to a spirit of curiosity." Answering the question: "how does our profession add value to our communities?" may provide guidance for how we educate information professionals. He added that one of our biggest problems is the lack of imagination in solving envisioning our role and proposing solutions to problems. Barbara Wildemuth and Liz Liddy noted their iSchools recruit students with a history of demonstrating creative problem-solving and risk taking. Sarah Michalak and Susan Nutter noted that they explicitly seek out individuals with creative problem-solving skills during the hiring process.

Buck elaborated on this point by suggesting that the iSchools seek out the most important conversations, find big problems that span disciplines and communities, and then work to solve them. Buck made the point that the information professions were tangentially involved in the two most important conversations to occur in our field in the last 20 years: search and design. The challenge now is to be ready to be a part of the most important conversations for the next 20 years. He argues that research universities have the capacity and responsibility to be leaders in those conversations. There are very few research institutions that can be trusted as honest brokers like universities.

Once the iSchools figure out what conversations we need to be a part of, Buck recommended creating problem-based teams. Doing so will require 'opening the tent' by openly collaborating with partners across disciplines as well as with industry and customers or end-users. It will also require creating a university culture that supports 'problem-based' teams which draw expertise from throughout the academy. Buck cited the problem of turning content into commerce described in his paper. This is a problem the iSchools can address in partnership with Journalism, the Law school, the University Press, and Economics as well as content creators and consumers.

Problem-based projects can also provide students with opportunities to apply what they learn in the classroom to real-world issues. Each of our panelists suggested that coursework be complemented with work experience in the field. Duncan called this 'pushing education to the point of practice.' Panelists and participants agreed student experiences in field or work experiences allow them to develop and apply creative thinking and problem-solving skills that are so important in the workforce.

Symposium participants briefly discussed issues of life-long learning and credentialing. Anne, Bonnie, and Duncan raised the point that information professionals need to continuously update their skillsets through lifelong learning. There was general agreement with these points, but the symposium participants did not make firm recommendations regarding the best ways for iSchools to attend to the life-long learning needs of information professionals.

Gary asked about the value of providing credentialing for the information professions. Symposium participants were split on this topic. Most argued against credentialing for the profession as a whole but some saw the value of certification or credentialing for specific areas of expertise. Charles Lowry

suggested there may be value, for instance, in providing a credential or certification in specialties in demand in the workforce such as data curation. Bonnie and Anne noted that employers in industry expect continuous updating of certifications in specific areas such as project management and suggested there would be merit for the iSchools to do so as well. Laura Sheble noted that students are attracted to programs due to their specializations and Nancy Roderer added that certifications or credentials are important to students because they provide a mark of achievement. Barbara Wildemuth suggested that such a mark of specialization could be advantageous in a job-search and that offering such certifications could be a way for iSchools to participate in continuing education for information professionals.

PART FOUR

Information Trends

The Library Information Landscape approaching the year 2050

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I'm fortunate to have been able to build my career as a technology professional in the library community, riding successive waves of major changes in computing. My earliest experiences with mainframe-based systems were followed by involvement with microcomputers, and then to client/server systems able put powerful desktop computers to work in conjunction with servers available at very moderate costs. In recent years, cloud computing has taken a strong hold and I'm tracking the beginning of a new phase of Web-based library platforms designed to be deployed through software-as-a-service. I've been especially fortunate to have had generous opportunities to share my expertise and perspectives with the broader profession through professional and academic publications, conference presentations, and through the Web and social media.

I entered the profession through a non-traditional route, working my way up the technology track in an academic library without formal education through a graduate program in library and information science. An aptitude for technology, ability to learn through practical experience, and attentiveness to the broader realm of libraries and information technology helped fill that gap. My graduate degrees in the liberal arts broadened my perspective, improved my communication skills, and honed analytical abilities. Over the years, I've had the chance to work with hardware from the mainframe to the desktop, network gear of all sorts, and to figure things how computing works up the stack through the firmware, operating systems, and applications, with quite a bit of software development experience along the way. All this was done in library setting, where no matter what the task at hand, my main perspective was oriented to how it would help support the specific needs of the organization. My consulting and speaking activities have expanded the scope of my experience and I have had the good fortune to work with libraries of almost all sizes and types in many regions around the globe.

I can attribute, at least in part, the opportunities open to me, were due to the traditional nature of the professional educational programs of the time. The disconnect in the 1980's between the curriculum of the LIS programs and the technology used in the trenches in libraries meant that there was not an abundance of systems librarians with up-to-date technology skills emerging from these graduate programs, opening a gap that allowed self-taught professionals such as myself or librarians from other specialties—especially technical services—to become technology leaders. Today as all areas of librarianship are deeply intertwined with technology, it's essential that these programs instill new information professionals with the ability to master the technologies of today, but more importantly to adapt to those that will cycle in and out through the decades of their career.

In this position paper, I will consider some of the trends that I see in place today in the realm of library technology as indicators of what we might expect in the coming decades. It is naturally impossible to

make any kind of reliable prediction as far forward as 2050. Many disruptions are likely to occur to shape the future quite differently. The exercise of pressing current trends past the horizon of predictable trajectories can be helpful in positing a range of possibilities for which the new generation of information professionals need to be prepared. Given the trends underway and their possible outcomes, the perspectives, knowledge, and skills that information professionals will need to be successful in their careers may differ significantly from what applies today.

How will IT trends play out for our Global Society?

I'm hopeful that much of the unevenness of access to technology that we see today will moderate over time. While those with more financial resources will always likely have earlier and more plentiful access to new technologies, there will come a time when some level of communications and computational devices will be affordable and available to the vast majority of the population in all regions of the globe. How long will it be until smart phones and their corresponding data plans will be just as widely deployed as land line telephones or cell phones? It may be overly optimistic to imagine that in the distant future a world with a rapidly expanding population will be able to provide sustenance and shelter for all, much less basic technology, but there is hope that many of the digital divides in place today will steadily erode over the coming decades. A well-connected global society will amplify opportunities for educational institutions to have global reach beyond the traditional residential and distance programs.

Dominant high-tech will companies provide an important context for future information professionals. Today technology companies such as Google, Apple and Facebook stand as the established corporate giants. I would anticipate that in the coming decades that at least some of the favored tech companies known today will have fallen from grace and that new ones will have ascended that were able to better exploit the cycles in society and technology that came after the phases of Web search, social networking, and consumer-ized technology that fueled the success of today's giants. I expect the future to be far more deeply connected even than what we experience today. Connectivity and mobile devices may ultimately be the free loss leaders that bring mass society into this new media for commerce. Will the time come when social networks prosper not just on their entertainment value, but also become part of the fabric that supports official civil discourse and daily commerce?

If society is saved from a digital dark age, where some catastrophic event turns back—or even turns off for a while—progress made in technology, we can expect electronic information will pervade almost all aspects of human life. Will commercial interests find ways to restrict and monetize information, or will current ideals of open access pervade? How the freedom or restriction of information play out in our future society will have broad implications for the educational institutions. Whether the tide turns toward open access to information or toward the reinforcement of proprietary commercialized models for access to scholarly research will make an enormous difference in the role of libraries of that era. I'm again optimistic that the current momentum of open access publishing will continue to build, allowing libraries to focus more on building services based on widely available scholarly content rather than exhausting their resources on procuring it.

Changes in Technology

If trends stay on course, cloud computing will be fully realized, allowing libraries and their parent institutions to reallocate resources sunk into managing commodity infrastructure and to focus more on value added activities higher on the technology stack closer to their constituents: students, faculty, and staff. Reliance on IT infrastructure outsourced to third parties will come at a cost, hopefully less overall than current expenditures, but will allow organizations to focus more on their areas of core expertise and strategic interest. We can anticipate that many of the problems that currently impede adoption of cloud computing will be solved in the coming years, such as those involving privacy regulations such as HIPPA and FERPA, as well as general concerns to rigorously protect the privacy of library patrons.

Today, cloud computing in libraries has been more talk than substance. Much of what is touted today under the banner of cloud computing can really be considered legacy applications that live in the vendor's data center instead of the customer's. This arrangement offers marginal improvement in efficiency, but does not radically transform the way that the technology supports the organization. True multi-tenant software as a service is needed to realize the potential of cloud computing. Not only does this truer model enable a more scalable and efficient use of computing resources, but it opens up opportunities for vast communities to share information assets in ways that radically diminish the burden of information management. Especially in the library domain, the current models of automation bake in massive redundancy of efforts. In order for libraries to serve their own communities well, it's important for us to massively aggregate the efforts we apply to describing and managing collections and to the fullest extent possible to consolidate the collections themselves. Shared content resources will form increasingly strategic components of future library automation technologies.

Future information professionals will need to understand computing through an entirely virtualized form. Those that have been around for a while think of software running on servers that we see and touch. We've built systems from scratch—or at least from basic components, where we cobbled together motherboards, memory SIMS, drives, video and network cards, installed the operating system and finally were able to load software that does something useful. Now, it's much faster, cheaper, and easier to sign on to Amazon Web Services, spin up a machine instance, and have significant computing power at your disposal in just a few minutes. Even as the core infrastructure of the library shifts toward large-scale business systems, there will continue to be need for smaller hand-crafted applications that address specific niches or features not addressed. Skills to work with virtual servers, design systems and interfaces, to create niche applications will complement the ability to manage large-scale industrialized business systems.

Changes in higher education

It's hard to imagine that higher education will hold onto its current shape in future decades. Universities currently face economic pressures that will surely result in major structural change. The cost of tuition and other factors will challenge the viability of the traditional residential undergraduate program. If the current form of universities is to survive mostly intact, they will do so by finding new efficiencies, with technology and information management playing a key role.

Events taking place in recent months and years stand to reshape the future of education, research, and scholarly publishing. Many institutions, such as Harvard University, MIT, and others, have taken bold steps to open their intellectual outputs to the widest audiences, with great potential to break the stranglehold that commercial publishers have exerted. Can we imagine that the default level of access to research and teaching will be something more like Creative Commons 0 public domain license? Will the products of teaching also see similar distribution? Will other institutions follow the model of the MIT Open Courseware initiative? To what extent will primary research data be exposed through open licenses?

Consistent with its policies toward open access to its productive outputs, the Harvard University Library released 12 million MARC records representing the collections of its 73 libraries under CC0. This release of a substantial body of metadata had an immediate effect, with its incorporation into EBSCO Discovery Service, the Community Catalog of Ex Libris Alma, and into LibraryThing within days. The library community has been had a pent-up demand for sources of large bodies of bibliographic data in the public domain. The definitive body of bibliographic metadata, OCLC's WorldCat, has been subject to that organization's Rights and Responsibilities statements which have had the effect of mostly walling those records off within WorldCat itself and within the systems of its members. OCLC's position regarding the sharing and reuse of WorldCat has been steadily evolving toward more openness. But with standing precedents such as Harvard's public release of their records, many of which are downstream from WorldCat, I see the floodgates now open so that bibliographic data will be readily available to any project and that future business models will depend on services performed based on such metadata and not on the existence of the metadata itself. I see access to bibliographic metadata a small fraction of the broader information landscape, but it does serve as an indicator of the transformations can be accomplished once bodies of content break free from barriers of constraint.

Information professionals of the future will hopefully be advocates that effect changes toward more open access to information. Toward this end, they will necessarily be savvy in the legal, organizational, and commercial angles that comprise the information landscape. It will not be enough, for example, to simply hold philosophical views that information should be open, but to also participate in the business ecologies that depend on information to design solutions that maximize the openness of content while still enabling business models to sustain the organizations on which we depend for important services. The ability to construct sustainable processes that support the information environment will be paramount, even in the scenarios where open access prevails over proprietary restrictions.

Transformations in the Library Technology Landscape

Today libraries are in the beginning of a ten-year cycle that will see the maturation and deployment of a new generation of library services platforms. These products, such as Ex Libris Alma, Serials Solutions Intota, OCLC's WorldShare Platform, Innovative Interfaces Sierra, and the community source Kuali OLE project are well positioned to replace the current crop of legacy systems that automate most libraries that serve higher education. These new library services platforms, each in their own way, help libraries break away from the print-dominated models of management, discovery and access to library

collections to a more unified approach that recognizes the dominant role of electronic resources, digital collections, and diminishing reliance on print materials. While just coming on the scene, they enter many years late given how long ago library collections reached critical tipping points in the transition from print to electronic. Given progress to date and the typical rate of change in libraries, it seems that these new systems will see a surge of acceptance in the next two or three years, followed by a more gradual phase of transition for the following four to five years.

These new systems bring capabilities important to academic and research libraries, including the ability to leverage cloud computing infrastructure, to take advantage of highly shared metadata and content stores among very broad communities of educational institutions, to manage complex collections of print, digital, and electronic materials, to deal with both owned and licensed content, to better integrate with the enterprise infrastructure of the broader institutions through Web services and APIs, and to present modern user interfaces.

The advance from the traditional integrated library systems in widespread use today to the new generation of library services platforms makes a much needed step in helping academic libraries meet their immediate needs. Yet, it also represents only a small step toward supporting the role of libraries in a more distant time frame. These platforms consolidate the fractured nature of how libraries manage and provide access to their collections, but still in a library-centric way that must eventually evolve into an approach focused on the broader information management needs of the institution.

I expect to see increased consolidation of the business and information management infrastructure of educational institutions. Large organizations require enterprise resource planning (ERP) systems that deliver comprehensive management of their resources in a way that supports strategic and operational decisions. Examples of these ERP systems include those provided by PeopleSoft or SAP and community source projects such as the Kuali Financial System. The automation infrastructure for a library can be considered, at least to an extent, as an ERP system that drives the operation of the library. One of the huge challenges today involves improving the interoperability between the business and accounting components of the library management system with that of the institutional ERP.

Current integrated library systems generally deal with institutional ERP systems through inefficient batch processes. The new generation of systems aims for more dynamic interoperability through APIs, which should result in significant improvements in efficiency. Even this approach fails to unify the library with the strategic infrastructure of its parent institutions. I would anticipate a further level of consolidation, where the library operates more as a node of the institutional ERP. The Kuali OLE project follows this approach, using the Kuali Financial System as its foundation for acquisitions and other business functions. Similar opportunities for deeper integration or synergies exist between the institutions' learning management systems and the library's services platforms. The delivery of library content to students and instructors through learning management systems such as Blackboard or Sakai will rise to strategic importance and demand more efficient interoperability that currently exists, even in the next generation of products. I would anticipate additional examples of alignment or consolidation

between information technology infrastructure for the institution and that for the library. Information technology infrastructure deployed specifically for libraries may eventually be displaced by institutional infrastructure that subsumes information assets and business processes formerly considered as within a separate library domain.

In the same way that libraries today have quite a difficult time operating a dozen different applications to manage their infrastructure, in the next round the consolidation will take place at the institutional level where information technology systems deployed for specific operational units will be subsumed into a cohesive and comprehensive institutional environment. This may not be achieved through the creation of monolithic systems of epic scope, but through domain-specific components that use service-oriented architecture to achieve strategic interoperability.

Part of the efficient information technology management that will help ensure the survival of higher educational institutions will involve the library moving away from its current technical isolationist stance toward one fully integrated into the enterprise. The idea of the library managing one set of resources apart from other information assets of the institution will diminish in favor of a more comprehensive and unified information architecture. Today we think of only certain areas of information as within the library's domain, including its established collection and the metadata that describes it, digital collections it may have created, and the body of content it licenses on behalf of the institution.

If this trajectory of library information systems evolving toward a more enterprise flavor takes place, it will have other interesting implications. Going forward, the pragmatic differences between open source and proprietary software will evaporate. As systems become more complex and deployed through multi-tenant software as a service, the concept of having local programmers work with the internal workings of these systems to make modifications will become increasingly less applicable. Rather, these systems will be created out of low-level services and will expose these services through APIs, which will become the basis of local customizations, extensibility, and interoperability. The role of library technical personnel will rise up the stack away from working with low-level hardware, operating systems, or applications software development toward adding value to these core business systems through creation of higher-level, customer-facing services. It is not within the library's core expertise to manage servers, data centers, enforce network security, or engineer business software. Rather, the role of the library technologist of the future may focus more on designing or developing value-added services based on existing platforms.

In this future of deep integration or consolidation between the information systems of libraries with that of the parent institution will impose the need for future information professionals to have broader views of information architecture. Today information professionals in libraries work to consolidate the silos of content. In the next round of activity, the challenge will be to ensure that the library itself does not operate as a silo within the institution.

New Generations of Library Discovery

I can recall the distribution of information from the days we received the Wilson databases on magnetic tape to load into our mainframe-based NOTIS system using the MDAS (Multiple Database Access System) and the CD-ROM discs that we mounted on multi-drive network towers and jukeboxes that came before the current era of electronic resources available through the Web. From my earliest days in library computing, I've worked with the problem of bringing many different types of library content together in a consolidated interface. That work continues today through my involvement with index-based discovery systems, including studies of the products and technologies and through the Open Discovery Initiative. One of the key challenges of the future will involve closing the gaps in the library resources not covered in these discovery environment, expanding the depth of indexing from mostly metadata to mostly full-text, and improving the state of the art of relevancy and other search and retrieval technologies used in these products to more effectively deliver access to library managed materials.

While library discovery services will inevitably become comprehensive relative to the body of content of interest to academic institutions, its less clear that they will ever become the central tool that students or faculty rely upon for their academic research. Will they become powerful enough and be positioned in ways that they become the starting point for research? That isn't the case today. Or will the power of these tools be realized as their capabilities are embedded in other tools closer to the daily lives of the students, faculty and staff? Information professionals of the future will face challenges of finding ever new ways to bring traditional library services into the appropriate information infrastructures and architectures.

Cutting across all of the threads that I've explored, the qualities most needed by future information professionals would include adaptability and continual curiosity and exploration. Little of the specific information learned at the beginning of a career will apply towards its end. Any given technology has a short shelf life, and the expiration dates are shorter with every turn of the technology cycle. It's the general aptitudes, attitudes, and learning techniques that seem more likely to persist over the long haul. Sometimes changes in technologies or organizational context require evolutionary adaptation, other times it requires a major overhaul of career path. Any program that aims to train information professionals must not only equip them with the specific knowledge and practical skills relevant in the short term but to also instill the insight to anticipate the implications of the technology cycles and societal changes that will transpire across multiple decades.

Libraries and the informational future: some notes

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Note: portions of this submission, especially section 2.4 are based on an unpublished paper written with Brian Lavoie.

1. Scope

First, 2050 is very far away. Here are two quotes about change which frame my decision to take a modest view of developments within the next 5 to 10 years.

> How did you go bankrupt?
> Two ways. Gradually, then suddenly.
> — Ernest Hemingway, The Sun Also Rises

> We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.
> - Amara's Law.

Second, while some of my remarks are reasonably general, they are influenced by a library perspective.

And third, a note about technology and networking: we often tend to talk about the impact of networking or technology on features of the environment, rather than on the environment as a whole. The most interesting questions about impact though are often systemic, about how the environment as a whole may change as the interactions between the parts change. For example, changes in research and learning behaviors and expectations are more important for the academic library than any library technology changes per se. Similarly, how networking reshapes library organization, collaboration, and scope will have more impact in the medium term than any particular local technology adoption.

My plan of action is to discuss four very general themes and then to make some general observations about library change and LIS (Library and Information Science) education in this context. The themes are:

1. An informational future: a processing perspective
   We are moving from a relatively static 'document' based world to a more dynamic informational one.
2. From transaction costs to the network level: an organizational perspective
   The reduction of transaction costs in a network environment has meant that whole industries have been reshaped. Libraries will be no exception.
3. The power of pull: a social perspective
   The library has to actively position itself to engage with research, learning and civic engagement.

4. The importance of focus: a strategic perspective.
   This is essential as libraries position themselves as important partners within their home institutions. They cannot continue to spend a lot of time on activities that replicate what is being done elsewhere and do not create real value for their institutions. Strategy is about making choices that increase impact. It is about moving resources to where there is most benefit, and finding the right level in the network at which things should be done.

My overarching theme is that we need to prepare for systemic changes by better understanding how organizations are being reshaped by networks. I rely on several non-LIS sources in this context, notably on Manuel Castells and John Hagel.

2. Some themes

2.1 An informational future: a processing perspective

I liked Manuel Castells' use of the word "informational" a few years ago,[26] and although it is always ultimately counterproductive to try to use words in a reserved way, I am going to use 'informational' here in the sense that Castells proposes.

Castells uses 'informationalization' and 'informational' on the model of 'industrialization' and 'industrial'. Informational activities are activities where productivity is maximized through the use of knowledge, gathered and diffused through information technologies. 'Informationalisation' is visible at all levels: doors open automatically, money is disappearing; the flow of materials is monitored by tracking systems; domestic and office environments are becoming more 'intelligent'; distribution chains, the disposition of goods around retail floors, investment decisions, these and others are increasingly driven by behavioral data. Flows of people and materials follow the flows of data. Data is gathered, analyzed and shared to support decisions. An increasingly rich apparatus of instruments collects data about our environment. Pandora does our listening for us.

In our own context we can see this in multiple ways. We are moving from a relatively static 'document' based world to a more dynamic informational one. Consider some examples …

- A **computational** approach is becoming more routine. We will programmatically promote metadata from resources, as the volume of resources to be managed makes it difficult for manual processes alone to cope. We will mine text and data for meaning. In Franco Moretti's term, 'distant reading' will complement close reading, as we look for patterns.[27] And given the focus on this meeting on education, it is appropriate to mention here Hal Varian's now famous remark: "So what's getting ubiquitous and cheap? Data. And what is complementary to data?

[26] Castells, Manuel. *The Rise of the Network Society*. Malden, MA: Wiley-Blackwell, 2010. passim

[27] Moretti, Franco. *Graphs, Maps, Trees: Abstract Models for a Literary History*. London: Verso, 2005. Print.

Analysis. So my recommendation is to take lots of courses about how to manipulate and analyze data: databases, machine learning, econometrics, statistics, visualization, and so on."[28]

- Resources are **social** objects that become nodes in a network environment. Think of 'bibliographic' services: Amazon, Goodreads, LibraryThing, Worldcat, Mendeley. They each provide functional value: they get a job done; however they also provide network or social value as people make conversation and connections around resources of interest or importance to them. This in turn enhances the value of those services. Similarly think of a reading list or a bibliography or a resource guide: they frame resources in the context of particular research or pedagogical interests. We need better ways of creating social value in library services.
- **Analytics** is now a major activity, as transaction or 'intentional' data is aggregated and mined for insight. We have become used to recommendations based on buying or navigation patterns. As more material is digital, as more business processes are automated, and as more activities shed usage data, organizations are manipulating larger amounts of relatively unstructured data and extracting value from it. Within the library field, patterns of download, holdings or resolution are being mined to improve services.
- From **Strings to things.**[29] Google/Yahoo/Bing/Yandex are promoting schema.org as a pragmatic way to add semantic markup to web pages. Effectively, it signals an interest by the big search engines in more structured data. The Google acquisition of Freebase a while ago and its recent announcement of the 'knowledge graph' is another. This marks a general interest in being able to answer questions more effectively, by being able to make assertions about the identity of 'things' and their relationships. Things like people, places, concepts, and so on. We are seeing a growing interest in more semantic approaches involving entity recognition, ontologies, clustering of like items, and so on. This general interest poses questions about the future of authority control and subject analysis: there is at once an opportunity as important intellectual work has been done by libraries and a challenge as ways must be found of mobilizing that work in this new environment.

The recent focus on big data in interesting here, as it seems to bring together two important issues. The first is data, and it is now common to talk about volume, variety and velocity as characteristics of **big** data. Here is an example of Library of Congress big data:[30]

- 5 million newspaper pages, images with OCR, available via API, used in NSF digging into data project for data mining, combined with other collections used in new visualizations, and in an image analysis project.

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[28] "Hal Varian Answers Your Questions." *Freakonomics*. 02/25/2008. (accessed 07 Aug. 2012) <http://www.freakonomics.com/2008/02/25/hal-varian-answers-your-questions/>..

[29] This is a nice phrase of Google's.

[30] Library of Congress details from a personal communication on FaceBook from Leslie Johnston, LoC, quoted in "Big data .. big trend " *Lorcan Dempsey's Weblog*. Feb 4 2012. (accessed on 07 Aug. 2012) <http://orweblog.oclc.org/archives/002196.html>.

- 5 billion files of all types in a single institutional web archive - researchers do not search for and view individual archived sites, they analyze sites over time, and characterize entire corpora, such as campaign web sites over 10 years.
- Extreme example: over 50 billion tweets: many research requests received to do linguistic analysis, graph analysis, track geographic spread of news stories, etc.
- Collection of 100s of thousands of electronic journal articles, which require article-level discovery: they don't all come with metadata and no one can afford to create it manually.

The second, though is the emergence of better infrastructure. The availability of the Hadoop family of technologies and cheap commodity hardware has made processing of large amounts of data more accessible. Cloud options are also emerging, from Amazon, Microsoft and others. Uptake has been rapid. So, while Hadoop and related technologies have emerged in the context of the Big Data requirements of webscale companies, they are becoming more widely deployed across a wider range of applications.

These make it possible to make data work harder, to perform predictive analytics, and this will change our expectations of what we can and should be doing.

2.2 From transaction costs to the network level: an organizational perspective

Transaction costs (sometimes 'interaction costs') have emerged as an interesting way of thinking about some dynamics in a network environment. Transaction costs are the costs involved in arranging for someone to do something for you rather than doing it yourself. Firms come into existence, Coase famously argued, because it is more efficient to coordinate the various component activities of production under a single organizational structure – a firm – rather than transact for each activity individually in the market.[31] Such activities might include acquisition of raw materials, processing, marketing, human resource management, accounting services, and more.

The reduction of transaction costs in a network environment has meant that whole industries have been reshaped. On the infrastructure and operations side, organizations have externalized requirements like payroll, computing infrastructure, manufacturing, and so on. Companies like Cisco or Apple externalize much of the actual manufacturing of their products. Newspapers externalize printing and in many cases non-local news gathering. And on the consumer side, change has been rapid and far-reaching. Think of what has happened to music and books, for example. Think of the travel industry. As the need for physical distribution of expertise and materials diminishes, so there is a trend to achieve economies of scale and greater impact by moving to the network level. Amazon, Expedia, Etsy, Wikipedia, Google Scholar, Pinterest, Flickr and many other have emerged as important concentrators of internet use.

Think about academic libraries for a minute.

[31] Coase, R.H. (1937) "The Nature of the Firm" *Economica*. 4:386-405.

The use and creation of information resources is integral to the work of university members – students and faculty. In a print era, this meant acquiring, reading and annotating books, journals, reports and other materials. For some it also meant writing books, articles and so on. Since World War II, with the expansion of the scholarly publishing system, until recently, libraries, publishers, authors, and various other agents, have operated in a reasonably well understood value chain. It was convenient for the university to internalize a collection of locally assembled materials, to organize it, and to interpret it for its users. The alternative, where everybody was individually responsible for all of their information needs would be inefficient and expensive: the aggregate transaction costs would be very high. This has led to the model of the library which has dominated university perceptions until recently: that of a building which houses collections and of an organization vertically integrated around the management of those collections. Each library deploys collections, and the systems and staff required to acquire, process, organize and provide access to those collections locally. Preservation is a benign artifact of the print publishing model as materials are redundantly available across the library system.

As the network lowers transaction or interaction costs we see change. On the infrastructure and operations side, historically there have been several waves of externalization and consolidation, either to collaborative infrastructure or to third parties. These include the development of shared cataloging and resource sharing networks and the move to a licensing model for the journal literature and more recently for books. More recently again, there has been a move to shared discovery environments, library management environments and other services sourced with cloud-based providers. We are at a stage where libraries are increasingly looking to collaborative solutions. Think of Hathi Trust. A few years ago, it is likely that libraries would individually build infrastructure to manage digitized books and store them locally. It is now accepted that this is better handled in a consolidated way, gaining from economies of scale, but also from being able to put a unified resource on the network.

What does this mean for directions in library management environments? Libraries will increasingly collaborate around infrastructure (see for example the growing interest in cloud-based shared management systems), collections (see for example the growing interest in shared print management arrangements) or expertise, or externalize these functions to third parties. The reduced transaction costs of collaboration and externalization make this consolidation inevitable. I provide some examples below.

On the consumer side, the change has been much more sudden and more far-reaching. Whereas information creation and use may have been organized around the library, it is now coming to be organized around network level services which support local workflows. For researchers, learners and citizens the transaction costs of creating and using information resources have declined considerably. This creates issues for the library, as its historic rationale is questioned and as it needs to position itself to add value in this environment.

Think of arXiv, SSRN, repec; Google Scholar, Google Books, Amazon; Mendeley, Citavi, ResearchGate; Goodreads, LibraryThing; Twitter, Facebook. These network level services are important components of workflow and information use for researchers and learners.

So, again, what does this mean for directions in discovery environments or workflow support?

- **Unified search**: libraries have focused on reducing the fragmentation of their search environments and making them more interesting.
- **Discovery happens elsewhere**: libraries are thinking about connecting their location services to those discovery services. So, they configure resolvers in Mendeley, Google Scholar or PubMed Central. They put links in Wikipedia. They develop widgets, bookmarklets, and toolbars. They want to disclose their resources to other discovery environments.
- **Outside in vs inside out**: libraries continue to buy and license materials (outside in) and make them accessible. However it becomes increasingly important to think about how the institutions unique resources (special collections, images, preprints, learning materials) are discoverable elsewhere (inside out). This drives an interest in SEO, in metadata syndication, and in other ways of managing resources to be discovered.

These directions make strategic choice crucial, and I return to that below.

2.3 The power of pull: a social perspective

Google and Bing have each been working to include more social features in their search results. Specifically they are interested in leveraging the 'graph' of your personal connections to improve the results they provide as well as the overall experience. Google has been more deeply integrating Google Plus, and Bing has an arrangement with Facebook. This is a very visible sign of the way in which those connections have become more important. I spoke about social objects above. It is clear that people are important entry points[32] to information spaces.

John Hagel and colleagues provide some interesting context here. [33]

> […] As we discussed in earlier chapters, in a world of accelerating change, the most valuable knowledge is highly distributed and may be embedded in the heads of people who are not well known and who are difficult to identify. [...]
>
> It's not so much about finding which information is most valuable, as many of those who fret about information overload would have it. Improving return on attention is more about finding and connecting with people who have the knowledge you need, particularly the tacit knowledge about how to do new things. The danger is that we all get so busy assimilating explicit knowledge that we have no time to connect with people and build the relationships through

[32] This is a nice phrase I heard from Dan Chudnov.

[33] Hagel, John, John S. Brown, and Lang Davison. *The Power of Pull: How Small Moves, Smartly Made, Can Set Big Things in Motion*. New York: Basic Books, 2010.

> which tacit knowledge flows. We get so busy reading about steampunk, or brewing, or building networks, that we don't actually find and connect with and learn from the people who are doing it. It's not so much information that we need as knowledge. And knowledge means people.
>
> These people and the knowledge flows they generate can then become effective filters for information more broadly. By harnessing social media such as blogs, social-network platforms, and wikis, we can begin to rely on these mechanisms to expose ourselves to information that has been curated and passed on by these people. Since we deeply understand their contexts and passions, we can begin to determine when their recommendations are most reliable and increase our return on attention for both the tacit knowledge they offer and the information they recommend to us. Our personal social and professional networks will be far more effective in filtering relevant knowledge and information than any broader social-technology tools we might access.

The authors provide a broad framework for thinking about current changes and how people and firms should position themselves to operate effectively. A major part of this is a shift from managing 'knowledge stocks' to being able to participate in 'knowledge flows'.

The authors talk of three 'primary levels' of pull. First there is *access*, the ability to find people and resources when they are needed. The second is the ability to *attract* valuable and relevant people and resources to you. Social networking, conferences, location in relevant geographic spikes (Nashville for country music) are important here, as is the ability to be open to and develop relationships through serendipitous encounter. The third is the ability to *achieve* more by learning more effectively and translating that learning into improved performance. Interestingly, the authors discuss 'creation spaces' which support this third level. Examples include the social interaction on World of Warcraft and the SAP Developer Network which provide support for shared attention to problems.

I want to take two things from this discussion. The first is to think about the three levels in relation to library expertise and resources (if libraries want to be seen as experts, then their expertise must be seen).

1. **Access:** Is library expertise visible when people are searching for things? Can a library user discover a personal contact easily? Are there photographs on the website? The University of Michigan has a nice feature where it returns relevant subject librarians in top level searches. And what of resources? Are there blogs about special collections or distinctive services or expertise? I have already discussed how libraries need to make links back to library resources from where their users carry out their discovery process.
2. **Attract:** How should librarians position themselves so as to seem natural partners or collaborators? Curriculum support, grant support, data curation: the variety of ways in which to engage is growing, and libraries need to make sure that they are visible and active within appropriate organizational networks.

3. **Achieve:** As 'creation spaces' emerge how should librarians interact with them? One thing that comes to mind here is the role of emerging social networks for researchers, and whether library interaction and support is helpful or what form it might take.

The second is that I was struck by the extent to which success is seen by the authors to be bound up with network participation - networks of people and resources facilitated by digital networks. The future, they seem to suggest, favors - in Dave White's phrase - the network residents.[34]

In summary, the library has to actively position itself to be in the flow of research, learning and civic engagement.

2.4 The need to focus: a strategic perspective

As libraries reconfigure how will they make choices about focus? John Hagel and Marc Singer[35] provide a simple framework which may be useful. They argue that historically firms have had three business foci, which because of high interaction or transaction costs were all internalized.

- **Engagement:**[36] attracting new customers and building long-term relationships with them. This requires economics of scope.
- **Product Innovation:** developing new products and services, and bringing them to market. This requires agility.
- **Infrastructure :** building and maintaining the "back-office" facilities and capacities that support day-to-day operations. This requires economies of scale.

However, they argue that as interaction costs fall in a network environment, firms tend to specialise in one or two of these. Think of the examples above. Cisco and Apple focus on innovation and engagement. They have outsourced infrastructure. Newspapers focus on engagement. They have outsourced infrastructure. Organizations rely on UPS for supply chain management, on ADP for payroll, and so on.

Is this relevant to libraries? I believe it is. For libraries, the main focus may be engagement around services that support the workflow and learning lives of users. This does not mean that infrastructure is not important or essential.[37] Rather, the library or university may look at alternative ways of sourcing more infrastructure, moving it to collaborative or third party sources.

Against this background, here are some examples of 5-10 year trends clustered under five elements of the library: collections, systems, space, services and expertise. I have discussed how aspects of

[34] David S. White and Alison Le Cornu. Visitors and Residents: A new typology for online engagement *First Monday*, Volume 16, Number 9 - 5 September 2011 http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/viewArticle/3171/3049

[35] Hagel, J. ., & Singer, M. (January 01, 1999). Unbundling the corporation. *Harvard Business Review, 77,* 2.)

[36] They actually talk about a customer relationship business, but we use engagement here as this fits the library environment better.

[37] This section compresses a complex argument. For some libraries, those in research institutions with a mission to preserve the scholarly record for example, an investment in infrastructure remains important.

collection management are being externalized to collaborative environments or to third-party providers. This happened some time ago with licensed materials. There is now broad interest in managing down print collections and working through the policy and service implications of consolidating print storage across groups of institutions. This is because those collections are releasing progressively less value on site, but also because of the opportunity cost represented by the use of valuable space. Hathi Trust has emerged as a collaborative response to the management of digitized materials. This too represents a reduction of local infrastructure investment. Libraries are also recognizing that the complexity, fragmentation and weight of locally deployed **systems** is burdensome and a drain on resources. This strengthens interest in moving to collaborative shared environments, or straight to third-party providers. In some cases scale advantages can be realized in terms of improved analytics, economies, and performance. In all cases, there is some rebalancing and a trend to externalization.

In a major trend, **space** is being reconfigured around broader education and research needs, and less around the management of print collections. In effect, space is shifting from infrastructure to engagement, as it supports social interaction around learning and research, access to specialist equipment, expertise or communication facilities, exhibitions, and so on. The "**service** turn"[38] will become more pronounced, as libraries look at creating distinctive local services which meet particular needs. As changes in information use continue and the library is defined less by access to collections, or by the distinctiveness of its collections, focus shifts to information management and use in research and learning, and greater engagement with students and faculty. This is accompanied by the recognition that library **expertise** must be more visible, and that new forms of expertise might be internalized, such as copyright or pedagogical expertise. In each case, libraries are creating increased value across a broader range of research and learning activities.

This is essential as libraries position themselves as important partners within their institutions. They cannot continue to spend a lot of time on activities that replicate what is being done elsewhere and do not create real value for their institutions. Strategy is about making choices that increase impact. It is about moving resources to where there is most benefit, and finding the right level at which things should be done.

Trends in Collections

Accelerated transition from print to digital, from bought to licensed for 'outside-in' materials.

Major reduction of local print collections and move of print collection management into shared supra-institutional collaborative/third party structures (gradually then suddenly?).

Progressive externalization of selection/acquisition processes: e.g., consortial purchasing arrangements, user-driven selection.

[38] This is a phrase of Scott Walter's. See Walter, S. (2011) "'Distinctive Signifiers of Excellence': Library Services and the Future of the Academic Library" *College & Research Libraries* 72:1. Available at: http://crl.acrl.org/content/72/1/6.full.pdf+html

For many institutions a stronger focus on managing institutional resources: digitized special collections, institutional research and learning materials.

Greater engagement with scholarly and learning process, with a focus on increasing support for life-cycle of information production and use.

Progressive move to shared supra-institutional collaborative/third party structures for preservation.

Trends in Space

Reduction of the physical footprint of print collections.

Externalization of collection storage and related services.

Re-purposing of library space for interaction between people, and between people and specialist services, rather than for interaction between people and collections.

Internalization of user-focused shared service spaces, such as "learning commons" services, access to specialist staff and equipment, exhibitions.

Trends in Systems

Shift from internalized institutional-scale systems to externalized shared systems.

General divestiture of infrastructure management as a "core business" of the library.

Growth in importance of systems for engagement – pooled analytics data, app and integration work.

Trends in Services

Shift in focus from supporting collections to supporting users.

"Distinctive" services emerging as new indicator of impact and value.

More emphasis on supporting the process of scholarly activity, rather than just the products.

Growing importance of effective data-mining/analytics strategies to refine and improve services.

Trends in Expertise

Library expertise is a key element of the library value.

Renewed focus on embedding library expertise more deeply in research and learning processes.

Growing need within the university for expertise on creating, managing, and preserving digital resources.

The meaning of library expertise will diversify in the context of user engagement and changing research and learning practices.

Increased integration of other professional skills: marketing, pedagogy, technology, legal, …

3. Switches: Some library implications

So, against this environmental background, here are some ways in which library choices are changing as we move into an informational/network environment.

Abundance

Previously resources were scarce and attention was abundant. Now, attention is scarce and resources are abundant.

The library is now a part only of the information universe. Many of its approaches were developed to manage when resources were scarce.

Workflow

Previously researchers/learners would build their workflow around the library. Now, the library must build its services around the user workflow.

The library has to think about how to get into those flows.

Consumer

Previously, work or educational technology was more advanced than consumer technology. Now, expectations are set by consumer experiences which are often richer than work/the library/the school/etc. offers.

Systems and services are continually in need of change.

Enterprise

Castells again:[39]

> In a dynamic, evolutionary perspective there is a fundamental difference between two types of organizations: organizations for which the reproduction of their system of means becomes their main organizational goal; and organizations in which goals, and the change of goals, shape and

[39] Castells, Manuel. *The Rise of the Network Society*. Malden, MA: Wiley-Blackwell, 2010.

> endlessly reshape the structure of means. I call the first type of organizations bureaucracies; the second type, enterprises.

Stability and a shared understanding of function favored bureaucracy. An enterprise mentality is required to navigate change, as library means must be reshaped to meet changing goals.[40]

Pull

If libraries was to be seen as expert, then that expertise must be seen.

Engagement, feedback, marketing, assessment all become important.

Data

We are used to thinking of data in reservoirs to be managed.

We now have to design, manipulate, visualize rivers of data.

Collections

Libraries acquired and managed relatively static collections.

Increasingly, they are looking at engaging with the creation, management and disclosure of institutional materials, with data curation, with scholarly publishing, with institutional reputation management.

Institutions

We are used to stable institutions.

We are now going through a period where publishing, education, and civic institutions are being transformed.

And much more …

4. Some thoughts about education: an interest in interstices

What does this mean for the education of those working in libraries?

While there is a small and specific professional core, much of LIS education looks at the intersection of particular LIS domain concerns and other domain concerns. Think of management for example, or computer science. Against that background here are some areas where those intersections might be updated, reconfigured or added.

And again, note that my focus is libraries, while acknowledging that LIS schools increasingly have broader purposes. I have also focused on academic libraries, although I hope these comments may be seen to be applicable in other contexts also. Finally, I have kept the treatment reasonably informal in keeping with the clearly preliminary nature of the thoughts presented.

[40] See "The enterprising librarian". *Lorcan Dempsey's Weblog*. June 30, 2012. < http://orweblog.oclc.org/archives/002201.html> (Accessed 07 Aug. 2012)

4.1 An informational future: a processing perspective

I think it is important that people have done some programming, so that they have a native sense of issues. I was interested to see the 'programming is the new Latin' argument.[41]

Library managers have to be more confident with technical staff, and more secure managing organizations that depend on system choices.

It is also very important to understand that data and systems have to be designed, not just adopted and used.

Here is Hal Varian again: "So what's getting ubiquitous and cheap? Data. And what is complementary to data? Analysis. So my recommendation is to take lots of courses about how to manipulate and analyze data: databases, machine learning, econometrics, statistics, visualization, and so on."

Other areas: digital forensics, ontologies/domain modeling, information architecture, UI/UX, Text mining, data curation, machine learning, ……

One role that the LIS school (or the I-School) may be well positioned to play is in interdisciplinary brokerage around informational issues. Data science, digital humanities, bio-informatics, publishing and scholarly communication: these and other areas are of interest may lend themselves to some cooperative attention.

4.2 From transaction costs to the network level: an organizational perspective

Libraries are organizations which operate in political funding environments. They are operating in a time of change which brings into play different skills and perspectives.

It is important to understand something of the dynamics of organizations, of the economics of information, maybe of institutional economics/industrial organization and law.

Librarians need to understand how education, local government, and publishing are not unchanging monoliths, but are being reshaped by economic and networking pressures.

They also need to understand how managing information, discovery and disclosure, has shifted.

4.3 The power of pull: a social perspective

Libraries and librarians have to position themselves. It is important to understand something about marketing and assessment. It is important to understand about the structure of disciplines, the behavioral norms of scholarship, the changing nature of publishing. It is increasingly important to understand the dynamics of social and research networks, and about writing/communicating on the web.

[41] Rory Cellan-Jones. "Coding – the new Latin". BBC-News-Technology. 28 November 2011. <. http://www.bbc.co.uk/news/technology-15916677> (Accessed 07 Aug. 2012)

It is important to talk the language of the libraries' home institution, to be able to talk about library values but also to be able to communicate library value in the context of institutional or scholarly or public values.[42] Librarians have to be able to tell good stories.

4.5 The need to focus: a strategic perspective

Libraries represent resources to be managed, and strategic choices need to be made about how best to create value for the home institution and their users.

Negotiation, business planning, and budgeting are important, but so is change management, organizational learning and development, cultural transformation, project management, teaming. Working with staff to evolve roles is crucial. Libraries need to be more enterprising than bureaucratic.

Marketing and assessment, evaluation, research and testing become more important as services need to evolve.

Above all it is important to understand that ends need to structure means, because, as the poet said, it must change. The library, after all, is a growing organism.[43]

[42] In the symposium presentation which accompanied this I quoted one of my favorite expressions of library value. This is from Fintan O'Toole, Irish author and journalist: "The library should not provide an argument for a particular case, but demonstrate that there is always another case to be made. The notion that the library is a place that has no agenda other than allowing people to invent their own agendas is what makes it an indispensable resource for a democracy." This is in an essay in the collection: McDermott, Norma, and Muriel McCarthy. *The University of the People: Celebrating Ireland's Public Libraries*. Dublin: Chomhairle Leabharlanna, 2003. This does not seem to be available on the web but a longer quote is at: "Public libraries in Dublin". *Lorcan Dempsey's Weblog*. 7 April 2005. <http://orweblog.oclc.org/archives/000624.html>

[43] With nods to Wallace Stevens and SR Ranganathan.

Big Data, the Crowd, and Me

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Like many of you, I've been swept up by the romance of Big Data. But instead of stepping back and taking the long view, in this account I plan to get enmired in the details and tell you a story about my own Big Data dalliance. Furthermore, in an effort to explore some fresh territory, I'm not going to take a curatorial perspective (see, for example, Borgman, Wallis, and Mayernik, 2010, or Tibbo et al., 2009), nor address the challenges of data storage and processing (e.g. Yu et al., 2008) or data sharing (e.g. Reichman, Jones, and Schildhauer, 2011). Instead, I'm going to look outside of the pool of light, in among the digital dust bunnies, to see if I can tell a slightly different, more personal story about *what someone like me* (a qualitative researcher) might need to know to be part of a Big Data effort (bearing in mind boyd and Crawford's (2011) thoughtful scholarly reflections on the implications of manipulation and analysis of Big Data)[44]

Big Data is surely the Gold Rush of the Information Age. Researchers across many disciplines have been seduced: currently, mining a carefully-wrought chunk of the Twitter feed can mean a high-visibility (and relatively straightforward) publication in CS or Information Science; an n-gram analysis of Google Books can form the spine of a Digital Humanities study. Every researcher I've talked to who does one of these analyses realizes its limitations, but like me, they have been seduced by Big Data's availability and held in its thrall.[45]

Big Data, Schmig Data

According to *New York Times* technology journalist Steve Lohr, "Big data refers to the rising flood of digital data from many sources, including the Web, biological and industrial sensors, video, e-mail and social network communications." (Lohr, 2012) It's a broad definition to be sure: there are no particular limits as to size, media type, genre, source, or the degree of curatorial attention they receive. It seems that almost anything that's hard to handle in conventional ways (by, say, pulling semi-structured bits into a spreadsheet and going to town with plots and pivot tables) counts as Big Data. Indeed that's the principle distinguishing factor if you consult Wikipedia, which itself counts as Big Data. It seems that all we know about Big Data is that it's too big to look at closely.

So people do sensible things to give themselves a handle on what they have: they use simple visualization tools (how does this look as a scatterplot? How does some aspect of it change over time? How does it look superimposed on a map using lat/lon pairs?); they talk to people *about* the data rather

[44]. My account is more personal, and as such, more anecdotal. I'll tie the two together where it makes sense.
[45] Like the California Gold Rush of the late 1840s and early 1850s—or the California real estate gold rush of the 1970s—the allure of Big Data is considerable and it doesn't take much to get started. "However," as one Wikipedia author admonishes, "many returned home [from the Gold Rush] with little more than they had started with." This is not true, of course, of California real estate

than looking indiscriminately at the data itself; they look at the data's metadata, hoping the description of data (possibly from its source) will tell them what's inside; or perhaps they break off tractable chunks of the data, sampled randomly or deliberately culled, and hope they are not missing data that represents an inconvenient truth.

Big Data, the Crowd, and Me

Like many of my peers, I've been working on an analysis of portions of the Twitter feed. In particular, my colleagues and I are wondering how people identify tweets that are interesting enough to take notice (and perhaps to favorite or save) or important enough to retweet or attend to for more than a fraction of a second. It's seemingly so simple. Millions of people read—skim, interpret, glance at, retweet, respond to—billions of tweets every day.[46] They don't have a real information need (they aren't searching for the diagnosis of disease symptoms or for a book about Alfred Hitchcock's phobias); perhaps they're just looking for social interaction at the digital water cooler or a serendipitous new bit of knowledge or celebrity gossip (Java et al., 2007). And they know what they're looking for when they see it.

Of course, what makes a tweet interesting is a question that is so laughably vague and subjective that you'd think I'd know better.[47] But the subjectivity of the question hasn't stopped any of us from taking a running leap into the haystack of tweets (see, for example, Alonso et al., 2010; Andre et al., 2012; Duan et al., 2010). And the vagueness of the question is part of what makes it intriguing. No information need has been identified. There is no seeking context. Just millions of readers and writers creating and consuming billions of tweets. It's just one of many modern information phenomena that have upended the assumptions we've brought to the table.

To do this research, I'm collaborating with an AI researcher (a peer of mine at Microsoft Research, Silicon Valley) and a colleague in the Social Search portion of Microsoft's Bing product group, a senior technical lead who knows his way around crowdsourcing at scale. What do I bring to the problem? In moments of insecurity, I'd say 'not much', but my story has to do with how my experience doing qualitative field research fits into the group, and more generally, what we needed to do and to know to approach this specific instance of Big Data.

Our general method—as preparation to training classifiers that would eventually be used to identify interesting tweets—went something like this:

(1) *Sample the Twitter data*. This meant grabbing a relatively small chunk of the public English-language Twitter feed. This limited sample is used two ways: first it is winnowed further into a set of tweets that's tractable on a scale suitable for human computation. These are the tweets to be judged by

[46] According to the official Twitter blog, as of March 2012, 140 million active users produce about 340 million tweets per day. We can assume there are many more readers than writers, that people have multiple accounts, and that people who use Twitter are not people at large.

[47] After all, most well-regarded papers marry solvable problems with social good.

an internal crowdsourcing workforce, one that specializes in relevance judgment, to form a labeled training set. The remaining large sample can then act as a test set for the trained classifiers.

(2) *Label the tweets*. This involves picking an existing labeling scheme or designing a new one, and developing a way to present the tweet to a worker and collect the label and any other information deemed necessary to assess the label's potential veracity (for example, the worker's level of Twitter experience). This crowdsourced work is monitored, keeping an eye out for fraud and assessing what seems to be steady progress toward completion (Alonso, 2012). If the human computation task isn't moving along, it must be debugged and redesigned.

(3) *Analyze the data*. This means a couple of things: First, ensure data quality by looking at the labels the workers produce. Then decide how many workers need to evaluate each tweet, and what constitutes sufficient consensus (i.e. do 2 out of 3 judges need to agree? 3 out of 5? 4 out of 5? 4 out of 7? As the numbers go up, so does the cost). This initial analysis will determine whether the task was interpreted correctly and that the work is meaningful in addition to being high-quality (in other words, even if the work was done correctly, the results may not be helpful). Statistics may then help identify patterns in the data.

(4) *Add a secondary data source*. Bring a secondary data source into the picture to help interpret the first one. In this case, we had access to query data, since one of us is associated with Bing.[48] This supports the interestingness model we will use to train classifiers.

(5) *Reflect on the results*. In other words, evaluate up the results in a way that is convincing to the research community. We can anticipate criticisms because, after all, it would've been more straightforward if there had been a clear-cut information need (e.g. emergency workers who need to locate hurricane victims (Hughes and Palen, 2009); London residents who wanted know about the truth of rumors about the unrest (Lewis, 2011); or perhaps a DJ who wants to spin records suitable to match the apparent moods of millions (Poeblete et al., 2011)). As always, reading related work is nerve-wracking after you've finished an initial round of data gathering and analysis—projects inevitably shift subtly as you're working, and a project whose closest relative was far away when you started might be too close for comfort later on. Big Data has the potential to fuel new kinds of science (e.g. the emerging field of Climate Science[49]). It also has the possibility of telling us what we already know.

[48] As boyd and Crawford (2011) point out, this association is significant, and can be an element of what distinguishes who is on each side of the digital divide.

[49] In 2010, at the American Geophysical Union's Fall Meeting, I noticed that an entire half-aisle of the poster session (perhaps 20-30 posters) was devoted to Climate Science. Of course, the program says there were 11,517 posters in all, but at least there were a few of them.

Putting together this list was straightforward. Accomplishing the 5 items on it wasn't. I'll pull back the curtain and narrate my side of the story.[50]

I came to the problem skeptical. In the abstract, I believed that Twitter users could tell you which tweets they found interesting or important in their own feeds. But I wasn't sure that they could articulate the criteria they used; nor was I certain that they could label tweets that weren't in their own feed. Would they be able to pick out tweets of general interest? Would they have noticed Keith Urbahn's tweet[51] as it scrolled by if they weren't interested in global events?

Thus before we started, we asked the crowd what they looked for as they read their Twitter feed. This seemed to me like asking for trouble; I'd say we should ask a specific question like, "What's the last tweet you retweeted or favorited?" But the answers they gave us seemed reasonable. They didn't seem to be purely aspirational; nor were they telling us what we apparently wanted to hear. They admitted to being on the lookout for celebrity gossip, for humor and inspiration, for photos, for tidbits to which they could attach their own names and turn into memes.

Step 1 was another story. The first sample file, just a few days' worth of tweets, was far too large to open in a text editor and too unwieldy to use the Unix-derived strategy of looking at the first lines of the file. It was even difficult to move the flat fine around. Finally we broke off a much smaller chunk *of the sample* so I could take a look at it. Although I'm sure most of the people doing these analyses operate on faith when they start, I can't bear to begin without rolling around in the data.

What can I say about the public English-language Twitter feed? The many papers I'd read over the past few years did not prepare me for what I saw. Nor did my own Twitter feed or the feeds of the people I follow. Not even my occasional searches of the public feed helped me get my head around what I saw when I scanned through the random tweets.

On the upside, the tweets reminded me of the importance of considering how one recruits participants, that the people we know and encounter in our own everyday lives— our samples of convenience — might be very different than most real users.

That the tweets were so incoherent and dopey[52] was both disheartening and exhilarating, even though this was exactly the problem we were anticipating. I've watched colleagues work with scientific datasets, with telemetry, with sensor data. I've interviewed CIA image analysts as they pursued open-ended

[50] The reader should be cautioned that my side of the story may bear little resemblance to the version(s) told by my two colleagues, even though we've worked together closely for the last six months. To our credit, no-one has blamed anyone for anything.

[51] If you don't recognize his name, you will after I tell you that he's the much retweeted guy who is responsible for, "So I'm told by a reputable person they have killed Osama Bin Laden. Hot damn."

[52] There's no other way to say this. What are we to make of @OscvrBoy's tweet "thirsty bitches are so annoying bruh. "?

search tasks, looking through endless imagery to discover something new in the landscape.[53] I've interviewed a researcher to learn how he programmatically sifted through search indices for spam (as we watched text stream by on the screen, he cautioned me that some of it might be 'adult content'[54]). In fact, I've always loved to watch search voyeurs, those displays like the one in Google's main lobby that shows peoples' aggregated queries whiz by.[55]

But the Twitter feed's sheer banality and size overwhelmed me. What if we gave workers 10,000 ordinary tweets, and not a single one was interesting or important? Yet, if we screened the tweets to start with, wouldn't we be doing exactly what we were trying to avoid (filtering a dataset so we could find exactly what we were looking for)? And certainly, if you filter Big Data (like many current research projects do), you'd want to keep very close track of the relationship between what you have and what you're leaving behind.

Once I had a conversation with a TSA screener as my carry-on luggage crept forward on the conveyer belt through the x-ray tunnel. He was watching a window washer clean fingerprints (gross, greasy, kids' fingerprints) off of a restaurant window; the window was facing onto the concourse where he stood all day. "Looks like fun," he said to me with a sigh. Looks like fun? Cleaning fingerprints off the window? But relative to looking at the ghostly outlines of stuff inside bags, it probably *was* fun. "They have magazines just for window washers," I told him. "One of them is called *American Window Cleaner*." He looked decidedly jealous.

How would he ever notice anything interesting (interesting in a gun or bomb way) in that steady stream of shoes, keys, cell phones, laptops, carry-on luggage, and Ziploc baggies full of toiletries?

But that's Big Data for you.

And that brings me to the second step in our method, crowdsourcing the tweets to obtain what my colleagues were calling a "gold set," a set of tweets labeled through expertise and consensus.

In practice, we discovered that the greatest flaw in the labeling task was the task itself: it was boring; it was fatiguing; and it was frustrating. At first I thought it would be relatively fun and easy. But take a look at three tweets our judges assessed as interesting. In fact, all 5 of them agreed *these tweets are interesting*:

- ***Recent Advances in Ultrasound Diagnosis: 3rd: International Symposium Proceedings (International congress series): http://t.co/9Bqd266l***
- ***Stoned officer calls 911 thinking he's dead... http://t.co/OUBvsEMw***

[53] The Cuban Missile Crisis began with just such a revelation—something new was being built. President Kennedy, upon seeing the imagery did not know what he was looking at (perhaps a football field, he speculated), but an image analyst knew what he was seeing.
[54] I've always thought 'adult' was an odd euphemism for porn.
[55] I suspect they filter this display; the query feed always looks remarkably G-rated and upbeat.

- ***This is NUTS! Been using this app for Twitter, getting 100s of followers a day! Check it out: http://t.co/QjDsUw6a***

Do these tweets stand out from the others? The judges say they're interesting. Are they perhaps spam? Interesting spam? It's hard to tell. We might say the first one looks legitimate, but the link leads the reader to a volume for sale in Amazon; the symposium proceedings are from a medical meeting that occurred in 1981. The volume looks distinctly unpromising. Yet five judges agreed that this is EXACTLY what we're looking for. Probably the judges are just worn down. After all, at least the words in the tweet are spelled correctly, and the partnership between Amazon and Twitter (the program that is the source of this tweet) is legitimate by some measure. In fact, a surprisingly large number of tweets that the judges labeled for us were exactly of this form, items in Amazon, everything from plastic screws to laptop batteries to bumpers for a 1980s-era Dodge.[56]

The second tweet in the list refers to a goofy animated video made from a recording of a 911 call in 2007. It weighs in on YouTube at under a million views. Does this count as viral? Perhaps. Does it count as humor? At least to its intended audience it does. Is it timely? Probably not, but it's supposed to be funny, not breaking news. Four out of five judges thought it was interesting. According to our survey, Twitter readers are indeed reading their feed with an eye toward being entertained.

The cynical among us might recognize the third tweet as spam; a promise to automatically increase one's followers usually falls under that category. Yet the majority of judges (three out of five) thought it was interesting. And here's what puzzled me the most: Items in Amazon are one thing, but out-and-out spam is another. Should I pretend that this is a good label? This tweet-label pair will become part of what my collaborators are calling the "Gold Set."

And with this, I lost some of my confidence in the crowd's wisdom. Even in aggregate, the crowd seemed misguided, like it was just milling around. "Aw, I haven't seen anything interesting in a while. This one's gotta be interesting," they seemed to be saying.

Although my machine learning collaborator seemed untroubled by the apparent non-wisdom of the crowd, I began to feel some angst. I started to pick apart the judges (was Worker 7475 working a bit too quickly? Did Worker 11101 assign his labels in a pattern?), the judgments (could the judges really pick out an incipient meme?), and the information we were giving them (the endless feed of meaningless tweets). Different elements of the labeling could easily be going haywire:

The judges. Were they working too fast? Perhaps they were missing key semantic aspects of the tweet and being fooled by its form. What kind of speed bumps would keep them from working so quickly?

Or perhaps the judges were becoming fatigued. Maybe they needed to judge more interesting tweets. One surely couldn't look at 10,000 boring and poorly written tweets without losing one's mind.

[56] Here's another one: ***Sony Vaio AR Series Laptop Battery (Replacement): 6-Cell Sony Vaio AR Series 11.1V 4800mAh LiIon Laptop Battery.... http://t.co/RM2fWgae***. Interesting, right?

And there was nothing to say that every judge was familiar with Twitter. What if they weren't? A #FF (follow Friday) wasn't recognized for what it was (a standard Twitter convention), and this made me suspicious that we were relying on an expertise—the ability to quickly scan a Twitter feed—that was not uniformly held by our crowd workforce.

The tweets. Were we giving the judges sufficient exogenous information to judge the tweets? We know that a tweet will be judged differently if it flies from Kim Kardashian's keyboard than if it's from a profile called ***@Ishy_Wishy99***. In the first labeling task, we presented the tweets as they appear in most Twitter clients (a profile picture and name, plus the tweet itself). Perhaps it would help to give the judges the number of followers in addition to a profile name and photo. After all, these weren't the people they normally followed.

And what about all that spam? We know that between 1 and 14% of tweets are spam.[57] Would the judges know it when they saw it? Would it dishearten them the way it's disheartening me?

The labels. Maybe it was the labels. At times, we gave the judges multiple categories. Then we cut back to an interesting/not interesting judgment. More nuanced labels (without creating such fine categorical distinctions that the task would become unbearably cognitively taxing) might help. What if there was a *ProbablySpam* label? Would that help the judges to recognize spam?

The punchline is, in my efforts to fix the task, I not only spoiled the training data, I potentially alienated the crowd workforce and possibly ticked off my colleagues. I'm still not sure how to fix things, but I'm starting to know what I don't know.

First, I'll confess what I did. As a qualitative researcher I thought, let's find out something about the judges. I began asking the judges to tell us how often they used Twitter. Perhaps we could correlate work quality with Twitter familiarity. Then we upped the number of possible judges from fewer than ten to more than a hundred. Perhaps that would ameliorate the fatigue problem. We asked them to give us rationale for their labeling decisions. Perhaps asking the judges to reflect would improve the quality of their labels. We also expanded the label set—if we added a secondary interest category (*LimitedInterest*), it would allow judges to make a more nuanced distinction; and if we added a spam category (*ProbablySpam*), the judges would realize that some of what they were seeing was spam.

What a mess!

Suddenly the judgment task was cluttered with incomplete responses. Out of 534 responses, only 14 were reasonably complete.[58] This is something no-one says very often about human computation: the humans are, well, HUMAN, and you, the requestor, can violate their trust.[59] You can bore them. You can

[57] Depends on when you look and who you ask.
[58] We iterated five more times, and gradually got better response rates. We may have done irreparable damage to our reputation among the workers however.
[59] Far more emphasis is placed on the judges' competence and their ethics (are they willing to spam?).

irritate them. You can frustrate them by asking them to do something unpleasant or impossible. I'm afraid we may have done just that.

And before we did that, we did something else that both embarrasses and puzzles me. We filtered the data. I had thought, what if there were more interesting tweets for the judges to label? Some workers evaluated more than 6000 tweets and found fewer than 150 interesting ones. No wonder they were fatigued.

In the first assessment task, the judges seemed to like tweets with links in them. What if they were tagging a training set in which every tweet had a link? And perhaps we should discard the tweets coming from profiles with fewer than 250 followers. 250 was an arbitrary number; it wasn't informed by what I know now (in our datasets, spammers sometimes had over 10,000 followers). Furthermore research by Yardi, Romero, Schoenebeck, and boyd (2010) puts the number of followers that a spammer has at an average of 1230 (median 225), while a legitimate user has an average of 536 followers (median 111).[60] So the number of followers may be a rather poor indicator of the profile holder's intentions. Of course we should discard any tweet whose first character was "@", since it signified a conversation—these were by definition unimportant.[61]

And this is how the trouble started. What's more, I suspect this is relatively common practice when it comes to Big Data: it's like sculpting. You keep throwing away stuff that seems like it shouldn't be there, and when you're finished, you have just what you want. I see this when I read my peers' work. They've thrown away data that looks irrelevant (data without the right topical hashtags or data without the desired keywords or data outside the desired geographic region).

There's just so much data that we can all afford to throw quite a bit of it away. *We can throw away data until we find what we're looking for*.

At some point, my machine learning colleague began complaining about datasets we'd been referring to as D2 and D3. The correlations were terrible, he said. And the data was bizarre. All of the tweets had links, and the negative correlation he'd found between what he called "@ mentions" no longer held.

"Oh," I said. "I wonder why THAT happened."

A Research Background for Approaching Big Data

To me, this story illustrates so much about the coming Big Data work, and what a qualitative person needs to know to get along (and what a qualitative person can contribute, if she is careful and doesn't start throwing away data prematurely). As I said at the beginning, I'm not considering the curatorial skills that are mandatory, nor the basic data storage and processing that is necessary to deal with a to-scale dataset. In the first case, I'd hope I'd know the curatorial skills from other parts of my education; in the second case, I'd hope I'd be partnering with a computer scientist (one with data management skills,

[60] Albeit again, the universality of these numbers depends crucially on how they filtered the data.
[61] Unless, of course, you're listening in on a conversation between, say, Justin Bieber and Lady Gaga.

and one with machine learning chops) to fill in these gaps. What I will focus on instead are the Big Data boundary objects (Star, 2010).[62]

Human computation. At its best, human computation is compelling. Tasks that are ambiguous or difficult can be performed by people instead of computer programs. But programming a human system is nothing like programming a parallel computer. Computers don't get bored, frustrated, nor do they generate inconsistent results. Although much has been made about eliminating spam workers and bad results (Jakobsson, 2009), little emphasis has been put on the requestor, the nature of the tasks the requestor designs, and the quality of the tasks (with the notable exception of Alonso, 2012). Learning how to use human computation in its many variations (for example, to do OCR via CAPTCHAs (von Ahn, 2008) or to answer questions about social norms via scenarios (Marshall and Shipman, 2011)) seems important to dealing with the numerous tasks that are required to effectively use Big Data.

In twenty years, human computation will change. Perhaps the workers will organize, unionize: THE UNIVERSAL BROTHERHOOD OF RELEVANCE ASSESSORS 358. Or perhaps they'll be exploited to an even greater degree.[63] But the layer of communications infrastructure between requestor and workers will surely change. Already there are crowd aggregators like Crowdflower, and on the other side there are communications forums for the workers (c.f. turkernation.com and mturkforum). Furthermore, the relationship between requestor and worker has not escaped notice (Silberman, Irani, and Ross, 20102)

Statistics. Here I'm not talking about using Pearson Coefficients. I can look up the formulae or call the functions and plug in the numbers. A good statistics course can show you how to establish the significance of your results. Instead I'm talking about statistics as a meaningful translation between data writ small and data writ large. When there's a spike on a graph, a data scientist needs to be able to know how to ask questions of the data to see what the spike means and whether it represents a meaningful trend or an anomaly in the data.

As an overly simple example, in one dataset we were using, there were a surprising number of tweets that were 99 characters long. String matching showed that they were not identical. We could put the graph in the paper, and note the spike, or we could discover that the spike was the result of a ubiquitous piece of spam, "***GET MORE FOLLOWERS MY BEST FRIENDS? I WILL FOLLOW YOU BACK IF YOU FOLLOW ME - <shortened link>***" and realize that we have thousands of judgments of that one tweet (albeit with different link shortenings), published by an amazing variety of profiles, some with zero followers and computer-generated names **(*@fsdfsdf5y5y45h4***) and others with 13K followers and human-sounding

[62] I'm sure you are worried about my liberal interpretation of the term "boundary objects." I am too. You already know I'm a worrier. But this will not stop me from pressing forward. They're data boundary objects in the sense that these are the points at which data passes between people playing different roles who read the data differently.

[63] I had never really taken a Labor view of human computation. That is, not until a paper I'd written with a colleague was rejected because one reviewer was offended by how we were exploiting the workers. "You're not even paying them minimum wage," the review exhorted. Yet some early research shows that US Mechanical Turk crowd workers participate in these tasks not simply as information piecework, but rather because they find the work somehow entertaining, diverting, or motivating [].

names (***@alexjoshthomas***). Thousands of inadvertent judgments of the same tweet are oddly interesting. They can tell you that one judge in the crowd struggled with the tweet's validity (because he or she spent a great deal of time on the judgments of that tweet and sometimes labeled it *TRUE* and other times labeled it *FALSE*). By breaking off a very small chunk of data, we begin to straddle the qualitative and quantitative.

The ability to use statistics to straddle the quantitative and qualitative means that way we don't end up with meaningless laws that are neither laws of nature, nor laws of data, but rather accidents of human interaction with technology and statistics.

Data visualization and manipulation. Data visualization has been a topic hailed as promising for almost 20 years. Yet many of the most imaginative visualizations turned out to be unintelligible to the scientists, analysts, and others the visualizations were supposed to serve.[64] Yet Big Data is well served, especially by the simplest of presentations (time-based or place-based mappings). How do you know what you have? How do you know that the data is okay or that it's what you think it is? How do you discover anomalies in the data and figure out what caused them? Most importantly, how do you establish the relationship between your sample and the rest of the data?

One of the big changes from campaign based data gathering (where a scientist went to the data site and used instruments to collect data) and sensor-based data gathering (where the data is collected and accumulated remotely) is the loss of direct contact with the data, and hence an explanation for bad data values (e.g. bird poop on a sensor or a sensor that only works in partial sunlight).

Furthermore, most data visualization is not interactive in a useful way (i.e. although you can manipulate the presentation, you cannot change the underlying data—for example, to compare different algorithms for cleaning the data).[65] There remains a substantial research agenda, well beyond the beautiful information quilts and information geographies that cause us to ooh and aah and secretly scratch our heads.[66]

Identifying ancillary datasets. One pervasive aspect of Big Data is that no matter how big a dataset is, there are others, and often there's one (or more) that can be brought to bear on question we are asking (provided, of course, that differences in the context of production can be bridged (boyd and Crawford, 2011). Maybe it's someone else's snowfall records when you're looking at plant respiration and carbon

[64] I realize I'm talking about this topic without being specific. This is deliberate. Some visualizations, e.g. Wordle, are visually appealing, but ultimately a little silly. Others are straightforward, but possibly deceptive. Without deep knowledge about a topic, a corpus, and how to interpret the visualization, Big Data can be viewed deceptively. I also don't want to pick on visualizations that are beautiful, but ultimately unintelligible and meaningless.

[65] I once discarded the Amazon River from a world map databank (large for its time, small now). I surely would not have done so had I been working with a visual representation of the data while I was cleaning it (by algorithmically throwing away line segments with impossible offsets).

[66] We can go all of the way back to the NoteCards browser for examples of this. Users would compute the hypertext graph, print it, and hang it on their walls. When you asked them what it meant, they'd invariably say, "I don't know. But I like the way it looks. It's inspiring!" See, e.g., http://www8.informatik.uni-erlangen.de/IMMD8/Lectures/HYPERMEDIA/Vorlesung/Design/DD/map3/map3gif/notecards1.gif

production. Maybe it's Bing social queries when you're looking at a dataset of labeled tweets. The ability to identify ancillary datasets, to interpret them, know which ones to trust, to understand the ways in which they compromise privacy, and to form partnerships that will give you access to them may seem like an atheoretical skill, but it advances a research agenda in untold ways.

Privacy. When we analyze Big Data from social media—especially when we start to interlock one dataset with another—privacy questions come to the fore. What do we really need to know about privacy? The literature is extensive, so extensive that the last time I looked, I became overwhelmed and decided that anything I could possibly say about privacy (either from the perspective of personal practice, or from the perspective of the data itself) had been said already. And when I make my best effort to read the privacy theory papers, I am overwhelmed by the sophistication of their models. What could these numerous insights into practice or these formal models mean for the information professional or researcher who is anonymizing a dataset? Surely I have nothing to say here either. Would I even have known enough to run into Abdur Chowdhury's office shouting "DON'T DO IT!"[67]

Yet personally I feel so exposed on one hand (I'm constantly fearful Facebook is going to inform my whole social graph that I read Dlisted.com), and completely baffled by the bizarre twists of other peoples' understanding of privacy on the other. My collaborators and I have interviewed countless people with irrational privacy beliefs, e.g.:

- if you pay for a service, your data is more secure (from the study reported in Marshall and Tang, 2012);
- if someone puts a picture of your kids on the Internet, a child pornographer will do unspeakable things with it (from the study reported in Marshall, Bly, and Brun-Cottan, 2006); and
- a letter you read at a funeral is substantially more private than your finances (again, from the data we gathered for Marshall, Bly, and Brun-Cottan, 2006).

What's more, I have witnessed people inadvertently compromising their own fiercely guarded privacy by giving out the one small fact (e.g. a birthdate) necessary to weave together IMDb and blockshopper, which will yield far more personal information than one would ever tell one's friends (e.g. the details of a long-ago house purchase or personal tax liability). Just when I feel smug about my examples, I come across something like this (in among the Ricola lozenges and Zagat guides):

[67] It seems that *Business 2.0* included the release of AOL's search data on a list called "101 Dumbest Moments in Business." (see http://money.cnn.com/galleries/2007/biz2/0701/gallery.101dumbest_2007/57.html) Easy enough for them to say; I'm not so sure most of us would know better.

Figure 1. The password Pal: A blank book speaks volumes

Much to my surprise, writing down passwords on paper is an uncontroversial solution that is endorsed by a Windows security expert.[68]

Big Data reminds us that privacy problems are far from solved, and that there's an enormous gap between theory and practice.[69] Some of these problems are explored in boyd and Crawford's 2011 Big Data Provocations paper under the rubric of ethics.

Reading the world. If there's anything true of Big Data that isn't true of smaller, more tractable sources, is that you must be able to read the world—the data's world—to understand it (see. Let's go back to the tweet I cited earlier, an example of an entire mystifying genre of tweets:

- ***Recent Advances in Ultrasound Diagnosis: 3rd: International Symposium Proceedings (International congress series): http://t.co/9Bqd266l***

This tweet did not seem to bother anyone but me. The judges thought it might be interesting, and demonstrably labeled it and many of its fellow tweets—all pointing to items for sale in Amazon—as interesting:

- ***Sony Vaio AR Series Laptop Battery (Replacement): 6-Cell Sony Vaio AR Series 11.1V 4800mAh LiIon Laptop Battery.... http://t.co/RM2fWgae***
- ***6 Piece Stacking Rainbow Mug And Stand Set by Collections Etc: 6pc Rainbow Mug Set: Space-saving design! Set of ... http://t.co/qfhS1u10***
- ***Irish Hallowe'en, An: On the Emerald Isle, Halloweíen becomes even trickier, courtesy of three good-for-nothing ... http://t.co/Mwi0MWco***

[68] http://msinfluentials.com/blogs/jesper/archive/2008/02/04/write-down-your-passwords.aspx
[69] By practice, I don't just mean personal practice. I'm including database administrators, digital curators, researchers, and everyone else, probably even the people who have published the most about privacy.

- ***A/C UV Air Sanitizer 8,000 BTU: A/C UV Air Sanitizer w/Electronic Remote-8,000 BTU http://t.co/0aJfAJ0m***

In fact, a significant proportion of the tweets the judges labeled as interesting are exactly of this form. Is Twitter now a place to run classified ads? Are these squibs spam? Or are they just the result of millions of people acting in accordance with Amazon's Associates program, which gives its members the ability to "Share with Twitter" (aka *Social Advertising*)? I rummaged around my search results (query: *Amazon Twitter*) for quite some time before I found this entry on readwriteweb:

Last night, Amazon sent out emails to their Amazon Associates members touting the latest addition to the company's affiliate program: a new feature called "Share with Twitter." According to the email, participants can generate "tweetable" links to any Amazon product after first logging into their Associates account. ... After updating Twitter, any person who clicks through on the link and makes a purchase will earn the participant referral fees payable through the Associates program.[70]

Another blog post asked rhetorically if it was spam, hidden advertising, or both. It answered its own question: "It's product placement, Internet-style. Subliminal advertising is rampant on TV (Don Draper in his London Fog coat on *Mad Men*, anyone?), and now it's going to show up in Twitter streams." The blogger ended, however, by saying there's something deceptive about social advertising of this sort.

Without deep-ending on this one example, I'm just trying to say that to read Big Data, you have to read the Big World.[71]

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Information Professionals to Serve Academia

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Like the papers presented by the panel on the Information Industry, my focus too is on the needs of a specific sector. For academia, information professionals serve the research, instructional, and learning needs that present themselves at colleges and universities. The academic sector's needs for information support services are today changing no less than those of many other sectors and this change will accelerate. Information professionals must be prepared for new methods and practices of research, teaching, and learning, as their role in supporting them is changing significantly.

Academia

Compared with other sectors of the information environment that have seen profound change over the past 20 years, academia has remained relatively stable. Research funding bodies have maintained or even increased their support and student and family demand has allowed tuitions to continue to rise faster than inflation. The last several years of reduced public funding have been especially challenging, and seemingly in parallel a great deal of attention has been given to a variety of models that would deliver instruction outside of a traditional campus construct.

A variety of different types of organizations are continuing to develop such models, which have included everything from conveniently located commercial learning centers to a variety of types of online and distance learning. At selective universities, comparatively tentative courseware approaches seem to be giving way to certificate-awarding courses and programs. Will credits and even degrees follow?

It is too soon to know what ventures can emerge successfully from this period of innovation, rapid prototyping, and willingness to fail. Some observers see the same stable higher education system we have had for 100 years; others see an information industry blind to the disruptive forces that are massing at the gates. Looking forward to 2050, to the extent we can, suggests a need to engage structural unknowns of this type.

What types of information structures and roles would be needed by a disrupted higher education environment? How would reconfigurations in research and teaching roles and responsibilities, within and across educational institutions, affect the demand for and organization of information support services? Those interested in considering a career in academia may benefit from having a framework for considering the types of environmental change that may affect academia as they understand it today.

Research practices and support

These structural shifts driven by changing methods of organizing and delivering instruction may seem speculative, but the changes in research methods and practices are not. Among those trends that may prove to have greatest significant for information support providers include:

- Primary research materials are becoming increasingly readily available online in essentially all fields.
- Computational methods are blossoming in many fields, changing the very nature of the types of research questions that can be feasibly pursued in the course of one's career.
- Research practices are changing even more dramatically as new tools and processes make it possible for scholarship to be conducted with greater efficiency.

To understand the types of changes that are taking place, information professionals must be prepared to engage at the right level of community for the services required. In the case of academia, the key level of community around which research methods and practices are organized is at the discipline- or perhaps field-specific level.

For this reason, Ithaka S+R's Research Support Services for Scholars program area is organized around focused studies of individual academic disciplines, beginning with key fields such as history and chemistry. In these studies, we are taking a scholar-centric perspective. To do so, we recognize that we cannot simply ask scholars and students what they would like to have in terms of information services and support; but rather we must understand their actual practices and how these practices are changing. In engaging the disciplines' changing research methods and practices through these projects, my colleagues and I are analyzing the types of research support services that scholars individually and their fields collectively will benefit from having available to them.

With a list of research support services needs, these projects will ultimately position the community to consider the types of information services organizations that are best positioned organizationally and substantively to provide a given service. For example, any given service might be best provided by a library, or a scholarly society, or a research-computing center, or a publisher, or some combination of them. If our premise that discipline- and field-specific needs will drive distinctive services requirements is correct, then something other than centralized campus-level services development and delivery will be required. And, field-specific offerings may not always be constrained to a single university but may sometimes be provided across institutional boundaries.

A basic prerequisite is to identify services that offer value to researchers, and then to position existing service providers and new ones alike to put their resources towards these valued services to the greatest extent possible. How can information professionals be most effectively prepared to balance a scholar-centric perspective against an organizational approach in planning their work?

Attributes and Skills

In addition to some of the ideas mentioned above, some key attributes and skills that we may want to consider information professionals requiring today or going forward will mostly allow them to adapt given an environment of uncertainty:

- An understanding of how to incorporate diverse sources of *data* in appropriate ways into strategic and services planning and development, and where to gather such data when it does

not exist. Every information professional should be expected to have basic skills and positive instincts in these areas.

- An ability to consider the *organizational interests* of relevant entities in developing and planning strategies, programs, and services. Perhaps first among these is the information organization (the library) itself alongside its college/university setting, each of which has values, priorities, and real interests. Concern for the needs of the parent organization, in a period where some of them could face real trauma and others unimagined opportunities, is especially needed. Partners and vendors are often trusted too much or too little; how can information professionals develop the right level of scrutiny to inform appropriate degrees of trust and dependency?
- Information professionals should be comfortable *engaging* – deeply, regularly, and creatively – with the individual users and user communities that they support. Softer or perhaps even innate skills, such a confidence in building a relationship with a professor and curiosity in attending the annual meeting of the academic scholarly society, are perhaps always valuable. Harder skills, such as advanced training in the appropriate academic field, may also be beneficial.

Information Trends: Summary of the Symposium Discussion

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Introduction

The Information Trends panel members examined how emerging trends in information technology development may impact libraries and higher education. The panel included Lorcan Dempsey, Marshall Breeding, Cathy Marshall, and Roger Schonfeld. Each person examined our possible future by focusing on a particular set of trends. In aggregate, their observations provided a context for the full group's discussion of potential futures and what students in i-schools need to learn to contribute to the creation of that vision.

In his opening remarks, Lorcan Dempsey noted the evolution of libraries from document repositories to service and analysis organizations working in a very dynamic environment. He described this evolution as a shift from reservoirs holding information to rivers of information flows. As transaction costs have decreased in a networked environment incorporated consolidated services available on the internet, libraries will need to think in a different way about their strategic focus. In particular, they will need to find innovative ways to engage directly with faculty and students to meet their information needs. Users of information services will be selective in the disclosure of their personal information, while libraries will need to participate in collaborative sharing of their resources and services.

Marshall Breeding described the impact of increasingly shorter generations of technology change, so that we can expect two more generations before 2050. Of particular concern is the struggle between commercial scientific publishing and the open access (OA) movement. While there is a strong OA movement, commercial interests still seem to have control over most scholarly content. An additional trend of interest is consolidation of information resources and services. Such consolidation can improve collaboration between "cylinders of excellence", and libraries may be able to capitalize on this trend by more fully integrating the use of information resources within their parent organizations.

Cathy Marshall examined some of her own experiences with analyzing a very large collection of tweets (an example of "big data"). Her study used crowdsourcing to complete one of the steps in the analysis of the data, since it was impractical for a small team of researchers to complete that step. Described as human computation or re-mediation, this approach raises many concerns about the validity of the findings from analyses of very large data sets and the privacy of the knowledge workers participating in the project. Some of the roles that future information professionals are likely to play include the curation of large data sets, their annotation so that they can be more fully understood during sampling and analysis, using data visualization techniques to ensure the validity of the data set or a sample of it, identifying ancillary data sets that can be trusted, and protecting the privacy of any human subjects described in a very large data set.

Roger Schonfeld focused our attention more directly on academia, with special attention to trends in the processes of research and teaching. He described the evolution of user requests from a focus on access to documents, to a focus on analysis services. An implication is that research activities will be strongly tied to collections, both local and virtual, and campus libraries will need to more strongly support data analysis for local research initiatives. They might do this by providing a set of common services, or by providing highly differentiated services for particular groups of scholars. This is just one design issue that must be addressed within the context of a push toward seamlessness that may have driven users away from campus-based support organizations to external information providers.

Themes that Emerged During the Discussion

After these initial brief remarks, the panel joined in discussion of information trends with the other symposium participants. The discussion focused on a number of trends and themes, including current and future collections, selection of resources by information seekers, the management and support of information-related scholarly activities, data stewardship, the organizational and cultural context in which changes can be made. Each of these themes, and the discussion of them, is briefly summarized here.

Current and Future Collections

The current focus is on "outside-in" collections, in which materials created outside an institution are gathered and organized and made available to members of the institution through the library. While this role will likely continue, it will also be likely to change in three ways. First, it is likely that libraries will become responsible for the intellectual products of their institution – materials created by scholars at the institution. These might include both final products of scholarship and intermediate products, such as data sets, documentation of ongoing analyses, technical reports, etc. Some libraries are already involved in their institutional repositories; in the future, more libraries are likely to be even more actively involved in these efforts. Through these efforts, an ecology of repositories (i.e., collections) within and across institutions will develop over time.

Second, libraries are and will continue to be called on to provide access to materials held outside the institution, and that access will need to be consolidated and seamless. For decades, libraries have provided access to scholarly materials produced by external vendors. In addition, many libraries now have links between their catalog and materials available on the Web (not held by the library). This trend is expected to continue. While seamless integration of these materials will make the library's role less visible to its users, it will provide better access to the materials needed by the institution's students and scholars.

Finally, the expertise of librarians is likely to be seen as a resource that the library can share with its parent organization. Rather than serving solely as intermediaries between users and documentary information resources, librarians' roles will expand so that they will be expected to contribute their personal expertise as a resource within their scholarly community.

Selection of Resources by Information Seekers

Some symposium participants argued that information load is the current crucial issues for those seeking information, while others questioned whether information overload is a real problem since people don't generally experience it. There was general consensus, however, that people are seeking information they can trust and are having difficulty determining which information and information resources can be trusted. There are many current forms of recommendation systems: crowdsourcing supplies recommendations (such as on Amazon), individual librarians provide recommendations for reading, other experts provide recommendations through book reviews or other channels. Librarians clearly have a role to play in creating recommendations and making additional recommendations available, particularly in multidisciplinary scholarship.

In addition to the traditional focus of these authority and trustworthiness issues on traditional scholarly materials (i.e., published works), the same kinds of issues are now arising in relation to data sets. More and more data sets are becoming available, but most lack annotation and it's impossible for a potential user to determine the quality of the data. Some additional processing will be needed to transform sets of linked data into knowledge bases. This type of processing can and should be undertaken by future information professionals.

Management and Support of Information-related Scholarly Activities

In many universities today, two different organizations share responsibility for support of information-related scholarly activities: the library and the information technology (IT) organization. Most university chief information officers (CIOs) today are IT managers rather than information managers, and it is not unusual for the university librarian and the CIO to be in parallel positions in the university hierarchy. Some of the symposium participants argued that this is an outdated model, and that research management should be the goal. Because of the influence of technology-based education, particularly in the form of distance education, it was also argued that both research and teaching processes must be managed at a high level to be supported well.

There is an important role for i-schools to play in educating people who can fill this type of role in the future. Those seeking this career path must understand scholarly workflows, from the beginning of the knowledge creation cycle, through data collection and analysis, to publication and long-term stewardship of a variety of intellectual products. In addition, they need to understand teaching and learning and the ways that information and information technology can enable more effective learning processes. With a better understanding of the underlying processes of scholarship, future information professionals will be better able to support the information-related scholarly activities of their institutions.

Data Stewardship

A thread that was woven throughout the discussions of the day was the concern for handling data sets. Federal agencies are now mandating that scholars maintain and make available their raw data for other scholars to use. Very large research teams and well-organized disciplinary groups are likely to have the intellectual and financial resources to address this mandate for themselves. At the other end of the

spectrum, very small data sets will be of less interest for secondary analysis or other forms of re-use. In the middle are data sets that would be useful to additional scholars (particularly in the humanities), but have inadequate support for their long-term stewardship. Libraries have an important role to play in this arena.

Libraries can get involved in data stewardship, first, by helping grant writers develop the data management plan that is now a required part of proposals to many agencies. At the next phase, an institutional repository may already be in place and able to manage the incorporation of data sets as one type of item that can be deposited for long-term maintenance. Some libraries may want to play a more active role, with embedded librarians serving as data stewards within departments or research teams. Like some other campuses, UNC-CH is already in the process of developing a data stewardship plan for the campus and, if implemented, it could serve as a model for others.

The Context in which Change Can Be Made

The discussions described above illustrate a variety of changes that could be made over the next few decades. Only a few of them could be accomplished by individual actors; most will involve at least an institution. However, given other general trends, it seems even more likely that most of them will be accomplished at an even higher level of consolidation. For instance, individual institutions will each play a role in developing future collections and providing data stewardship, but they will become interdependent in providing access across collections of knowledge resources and data. As a change is under consideration, the level at which the change can be enacted will need to be considered.

In addition, strong and forward-thinking leadership will be needed to enact the kinds of changes discussed here. In particular, leadership will be needed in situations in which the end game is not known and there are no obvious solutions to a problem, i.e., where there are no “duh” answers. The same is true in situations in which risky opportunities arise; leadership will be needed to move forward if the potential pay-off is to be obtained. I-schools can and should play a role in educating these future leaders.

Emerging Societal Changes

These observations from the symposium participants can be assembled into a characterization of a possible future society. Indeed, the rapid evolution of information technology may dramatically change the purpose for libraries over the next 40 years. As Breeding pointed out in his initial remarks, we can expect to see at least two generations of changes in library institutions before 2050, driven by changes in society. A library will need to track societal changes, focus on the set of activities that provide the highest benefit, and adopt relevant technology.

There are multiple emerging societal changes that were referenced or discussed by the symposium participants and that can be used to understand possible futures. One significant change is the emergence of knowledge bases, with the ability of the system to answer natural language questions. The emergence of global knowledge bases is being driven by the development of global networking. This enables any person to discover and access information resources. Similarly, this enables a library to

federate with other information repositories. An institutional library may become a component in a global library. The institutional library will be able to focus on a local area of expertise, while providing access to information supplied by other libraries. This implies that a library can contribute local knowledge to a global knowledge base and be recognized as the authoritative source for specific knowledge. This also implies that a library may federate with other institutions to provide access to a comprehensive set of knowledge. The result will be a federated global knowledge base that is accessible by all persons.

A second major change in society is being driven through commercialization of education and commercialization of knowledge bases. Online courses, distance education, and Massive Open Online Courses (MOOCs; Lewin, 2012) are already providing learning opportunities that decouple education from formal (and physical) attendance at an institution. When knowledge can be accessed over a network, the differentiation between a commercial knowledge provider and a library will be blurred. A user may select a resource based on credentials (how authoritative is the source). Similarly, a student may select an education institution based on the perceived value of the graduation certificate. The freedom to choose source of knowledge and source of education will require libraries to focus strongly on the needs and expectations of their primary constituents.

A third major change in society is being driven by the emergence of Big Data. The analysis of data is now recognized as a fourth form of science (observation, experiment, simulation, data analysis). It is no longer sufficient to manage large data collections; the ability to analyze the data is equally important. Very large data sets are difficult to move. Hence the ability to analyze data in place will become necessary. As institutions accumulate massive collections, they will become the authoritative source for specific sets of knowledge generated by specific data analyses. A library will be strongly motivated to enable computation on its digital holdings, to ensure that the knowledge content can be extracted and is available for use by other researchers. This positions the library as the authoritative source for that knowledge content and ensures their relevance within a global knowledge repository.

A fourth major change is the development of personal knowledge sources and crowd sourcing. Individuals will become the “domain experts” for their own personal knowledge bases, while also being able to participate in global knowledge initiatives. For example, each person will be able to monitor their own personal health, monitor the environment in which they live, and build a knowledge repository that represents the impact the environment has on them (pollutant ingestion), and their impact on the environment (carbon neutrality). The aggregation of this information through epidemiological studies will be important for global response to societal health issues. The ability for individuals to participate in global knowledge generation initiatives (e.g., as citizen scientists) is equally important. A simple example is the participation in research by students. This validates the student’s learning, enables students to make an original discovery, and motivates students to pursue a specific educational initiative.

The emerging capabilities provided by information technology evolution are transforming the ways in which individuals can discover, access, and use information and knowledge. The new capabilities are driven by the ability to handle projects of a very large scale (petabytes of data, gigabyte/second networks, teraflop execution rates, global interconnectivity), and by the transition from information-based access to knowledge-based access. These observations can be combined into possible future visions for the next two generations of libraries:

1. Transition to an authoritative institutional information repository. When born digital content dominates, a search for relevant information can be based on the content of documents and data sets. A simple form exists today through Google, which can index the digital contents of a library. An authoritative information repository validates assertions about the information content that is indexed. The assertions may be governed by statements about the completeness of the collection, or about the source of the content, or about the consistency of the material. Each library will be able to publish assertions about the content. A user can then map their expectations about the information content to the library assertions to select a relevant resource. The ability to assert the properties of authoritative data will become increasingly important when information is published by competing institutions and governments.

2. Transition to an authoritative global knowledge repository. The simplest example of knowledge-based access is the IBM Watson demonstration.[72] Human cultural knowledge was captured in a database less than a terabyte in size. Natural language queries were turned into evaluation of about 200 relationships across the content, with a response time measured in tenths of a second. The system outperformed human cultural knowledge experts. Google, Microsoft, Apple, and Wolfram are pursuing similar systems to answer natural language questions (Giles, 2012). The Google knowledge base has 500 million entities, indexed with tens of thousands of different types or relationships. The Microsoft knowledge base has 350 million entities. The Wolfram Alpha computational knowledge engine supports 50,000 types of algorithms and equations on ten trillion pieces of curated data. What is the impact of knowledge manipulation at this scale on the future of libraries? If you can discover relevant information through a natural language query, will you need a librarian?

Libraries are on the path to evolve from repositories for books, to information repositories, and to knowledge repositories. An information repository, such as Google, indexes the content of each book. Relevant information can be found based on combinations of keywords. A knowledge repository indexes relationships. Relevant information is then found through the intersection of responses across multiple types of relationships. Relationships may include:

- Logical / semantic relationships

[72] http://www-03.ibm.com/innovation/us/watson/what-is-watson/index.html.

- Temporal / procedural relationships
- Spatial / structural relationships
- Functional /algorithmic relationships
- Organizational / group relationships
- Familial / genetic relationships
- Epistemological / systemic relationships

By evaluating many types of relationships, the search space for a query can be expanded. By then looking for the intersections across the relationship results, the answer can be found. This was the basis for Watson's success. A knowledge base not only analyzes relationships across the local content, but can also correlate information with external knowledge repositories. If current trends continue, a global knowledge base will emerge over the next 40 years that indexes human knowledge.

Implications of These Trends

Based on the trends discussed at the symposium and on which we have elaborated, multiple implications can be inferred for the future of libraries and education. They include:

- Impact of scale on education and on content (all of human knowledge)

What will a student need to learn if a knowledge base can answer natural language questions? Remember that Wolfram is automating the evaluation of algorithms and equations for scientific data. Given web access, a student anywhere in the world will be able to pose a question on any subject and get an answer, including questions that require execution of mathematical functions. An expectation is that Information Engineers will still be needed to assemble the knowledge bases and tune the relationships that are evaluated for specific communities.

- Impact of massive scientific data collections

As collections grow in size, they become harder to move for analysis. The co-location of processing with storage will be needed to keep a knowledge base current. Given the ability to mine features from scientific data through the detection of specific temporal, spatial, and algorithmic relationships, the management of scientific data collections will be feasible within digital libraries. As of January 2012, the Library of Congress has about 285 terabytes of data.[73] A single analysis of a rupture of the San Andreas Fault takes a day to run and generates 500 terabytes of data.[74] The management and analysis of scientific data collections will require information engineers who can link feature processing algorithms to massive data collections.

[73] http://www.loc.gov/webarchiving/faq.html#faqs_05.
[74] http://www.scec.org/m8/.

- Impact of the coalescence of libraries and supercomputers.

The library should become the creators of new knowledge by extracting it from knowledge bases. This requires processing power to apply the procedures that extract information from data, determine whether a required relationship is present, and reify the relationship as knowledge that can be queried. The basic capabilities exist today within policy-based data management systems. Procedures that identify features within data sets can be automatically applied on ingest. Relationships between features can then be mined and stored in a knowledge base. Hardware storage systems now support policy-based data management systems within the storage controller. This means that storage can become "intelligent", with data deposited into the storage being automatically indexed for inclusion in a knowledge base.

The challenge is the creation of each new type of relationship or identification of each new type of feature that becomes relevant. The system must then reprocess the contents to identify whether the new feature is present, and analyze relationships between the new and old features. This will require processing power to continually update the knowledge base.

An implication is that the library of the future can serve as both the knowledge base and the analysis platform in which new knowledge (relationships) are identified. In this sense, a digital library and a supercomputer center will have similar capabilities, and will require similar managerial, administrative, and technical support.

- Impact of personal(ized) knowledge repositories

Google provides customized search results today for individuals. A similar capability will be available through knowledge repositories. An individual will be able to construct a personal knowledge repository. Such a repository can define the set of relationships that must be satisfied by external data streams before ingestion is allowed and add the information to a personal knowledge repository.

Within a professional career, a personal knowledge repository will serve as an essential reference collection, and its creation can be viewed as one purpose for attending school. An example of this is being provided at SILS today, through the LifeTime Library. A student can assemble a personal knowledge repository and maintain it even after graduation. The ability to update the repository is a form of continuing education that links students back to their alma mater.

- Impact of high performance networks on education

We already see Massive Open On-line Courses that enable thousands of students to participate in a single course (Lewin, 2012). With a knowledge repository, such content can be delivered asynchronously to students on demand. The need for formal classes will change.

Education is a social activity in which students learn best within a cohort. Given a virtual cohort, assembled at an arbitrary time, students will be able to participate at will. Student participation will then depend upon the motivation behind learning a specific topic. We may see education driven by businesses, with students learning "on the job". We may see education driven by the rapid pace of technology evolution, with graduates taking refresher courses to learn new technology. We may see

students motivated by a degree from a respected institution. We may see students motivated by their virtual cohort to do as well as their peers. We expect education to be a continuing activity, in which students continually learn new techniques for interacting with the global knowledge base.

- Impact of collaborations as a preferred mode of research and learning

Researchers need the ability to collaborate with other researchers to compare results, acquire larger sets of data for analysis, and develop new research initiatives. Digital libraries are collaboration environments that enable users to assemble sharable collections. A digital library can choose to implement "collection spaces" in which users can assemble personal collections. By sharing the "collection space" with collaborators, a digital library can enable research projects that span institutions.

Students also benefit from the ability to share ideas and experiences with their peer group. Learning is a social process, in which a consensus is developed within a group as they interpret phenomena, achieve a joint understanding of new ideas, and communicate ideas. Students also strongly benefit from the ability to engage in research projects. The digital library should provide student access to scientific data collections, and under appropriate policy control enable students to participate in research initiatives. Just as they serve more mature scholars, digital libraries can provide collaborative environments for student learning.

Taking an Entrepreneurial Approach to Innovation and Problem Solving

The rapid change of information technology requires the ability to assimilate new knowledge, and compare new approaches with old approaches. This is a form of wisdom, the ability to understand how different knowledge bases are related (relationships between relationships) and the innovative ways in which they can be applied to existing problems and novel opportunities. If information professionals, and the i-schools that educate them, take a reactive stance in regard to the trends discussed above, we will fail to realize the potential advances that can be made in core information activities: the creation and management of information content, the communication of information and knowledge from its creators to its users, and the transformation of information into knowledge that can benefit individuals, organizations, and society. Instead, we need to take an entrepreneurial approach: pay close attention to societal trends, particularly those related to information and information technologies; generate innovative ideas that can take advantage of those trends to provide value to our constituents; provide the leadership necessary to implement those ideas. By taking this approach, we can enrich our current information technology as we look toward 2050.

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Conclusion

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The IP 2050 Conference has been a fitting conclusion to the year we have spent celebrating the 80th anniversary of the founding of SILS. What could be a more appropriate way to end a celebration of the past, than to look ahead to the future? In the year 2050 SILS will be observing its 118th year and it is intriguing to imagine that in that year, the then dean and faculty might be planning another symposium looking ahead to IP 2100.

It is very difficult to summarize all the idea and concepts we have shared over the past two days. If one word predominated it was "information," and I, for one, feel as though I am suffering from information overload. We all learned so much from the presentations and conversations that have been a part of IP 2050. One of the most obvious things we realized is that it is impossible to accurately predict the information world of 2050. However, each of the presentations provided helpful insights and some themes did emerge. It is clear that the environments in which future information professionals will work will be very different and many of the functions they perform will be new, however, there will still be a need to connect people to information. The schools that prepare information professionals are in a strong position and the programs they offer will be critical as we move to the even more information intensive world of 2050. However if the i-Schools wish to maintain their position, they will need to be more entrepreneurial and risk-taking because there will many more competitors in this new environment. Each of the presenters gave us a slightly different glimpse of the future; here are brief overviews of each.

Mike Eisenberg predicted that by 2050 we will be living in an ubiquitous intelligent environment. Education will be transformed. Each student will have an individual educational plan. I especially enjoyed learning about his notion of information alchemy which transforms data into wisdom.

Bill Graves reminded us of the need to take on the economic issues. We have to follow the money, and technology will be a means of helping us achieve a new model of an educational commons available to all.

Liz Liddy showed us the importance of taking an entrepreneurial stance if we want to succeed. She emphasized the need to take risks and be agile; she stressed the need for not only i-Schools but for entire universities to become more entrepreneurial.

David Silver shared with us the intriguing course he teaches at the University of San Francisco. He reminded us that it will be even more important in a more technology-intensive world to remain connected to the natural world and the changing seasons. I think we will all remember his adage, "Log off before you blog off."

Mary Chute spoke of the blurring of boundaries between the information professions. She also reminded us that although the environment is changing, the mission and the timeless values of libraries will endure.

Charles Lowry spoke of the increasing importance of open access material and asked us to consider what librarians will do to insure open access. He also posed the question of how we should educate future information professionals when the materials that used to be found only on library shelves are fully available on the internet.

Joanne Marshall spoke of the library workforce and the changes that she has seen over her own career. She stressed the importance of linking research to practice and of demonstrating the worth of information agencies by using evidence-based and outcome measurement.

Nancy Roderer used Wordles to illustrate the competencies of today's information professionals. There is already a great diversity of types of information professionals and by 2050 there will be even greater diversity. At that time, there will be even more organizations that will be considered information agencies and the competition will increase.

Ann Caputo described five trends that are affecting all of us, and she too stressed the growing competition in our field. She enumerated the most important skills and attributes that will be needed for tomorrow's information professionals: creativity, risk-taking, communication, listening and understanding, and agility and flexibility.

Bonnie Carroll spoke of the power of IT to expand human capabilities. She also predicted a darker future where users are the prey and information the predator and where individual privacy is in danger of being compromised. She too described the blurring boundaries between information professionals and the continued need for these professionals in the future.

Buck Goldstein recalled how in the past information professionals got left at the starting gate with revolutionary breakthroughs in search (Google) and design (Apple). There is a need for information professionals to be included in the conversations of today's and tomorrow's information problems. He also stressed the need for more entrepreneurial thinking at the intersection between innovation and execution.

Duncan Smith presented a fascinating group of case studies of individuals who had been successful entrepreneurs. All of these individuals shared some key attributes. They all: 1) had a customer or community focus; 2) used information to help a community achieve its goals; 3) used technology as a means and not an end; 4) realized the importance of collaboration and teamwork and 5) had personalities marked by curiosity and a spirit of inquiry.

Marshall Breeding described the disruptive forces that may affect us in the future. The changes in technology that will occur by 2050 are impossible to predict. We will go through two or three more technology cycles by them. There will be changes in higher education that will lead to a transformation

in the library technology landscape. There will likely be a consolidation of institutions and a blurring of boundaries between information agencies.

Lorcan Dempsey spoke of the structural changes that will result as we move from a document-centric to an information-centric future. He described the rivers of data that have resulted as transfer costs have gone down and described the role that libraries might play in this new networked world.

Roger Schonfeld explained some trends in academic information that will affect the future: the growing digitization of primary and secondary research material; the fact that discovery is not bounded by institutions or resources; and the changes in instructional methods that are occurring as we try to teach students more efficiently and bring down the costs of higher education.

In summary, I think it is important to go back to a statement made by Mary Chute earlier today. She said that we do forecasting not to be right but so that we are not caught unaware. It is clear that we would be very foolish to try to predict the information world of 2050, but some themes have emerged many times during these presentations that will help us move more confidently toward the future. The first is the need to develop more risk-taking, entrepreneurship, and agility in information professionals. The second is for us to be willing to break down silos as the blurring of boundaries between information professions and information agencies continues to grow. The third theme is the requirement for multi-disciplinarity in our field and the growing realization that individuals cannot work alone but must use teamwork to successfully meet the demands of the changing information world. As Buck Goldstein reminded us we must "open the tent" and look for ways to join forces and seek partners in new ventures. And the final theme of this conference is that above all we have to be proactive. As Joanne Marshall stated, we have to be the imaginers and the creators and the ones who will move our profession into the future we desire.

I will close by saying that we, the information professionals of 2012, need to recognize that change is inevitable and welcome the changes that are before us. But at the same time we must keep our eyes firmly on the future we hope to achieve. We are living in a world of increasing competition and our future is not assured. We will have to be nimble and always attuned to our changing environment to ensure our future success. The conversations of the past two days will help us all move more adroitly toward the information world of 2050.

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Information generation, management, and use now pervade all aspects of work in the knowledge economy. As such, there is an increasing need for information professionals who can develop and apply sophisticated techniques and tools for preserving, accessing and managing information of all kinds. Information and library science (ILS) programs have a long track record of preparing information professionals to work in libraries, archives, museums and government agencies where new forms of information work are constantly emerging. Today, ILS graduates are also finding employment opportunities in a wide array of profit and non-profit settings in positions such as database administrators, information architects, Web designers and social media strategists.

Preparing and sustaining a vital information professional workforce that will continue to lead and succeed in this ever-changing electronic environment is a fundamental challenge for educators, employers, policy makers and other stakeholders. This book is a compilation of papers created by some of the profession's finest leaders who discuss the possibilities and pathways that lie ahead for information professionals.

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