R·I·T

The Future of Teaching and Learning in Higher Education

Prepared by:

Jeanne Casares, CIO, Information Technology Services
Donna A. Dickson, Director of Faculty Development, The Wallace Center
Therese Hannigan, Associate Professor, School of Design, CIAS
Jenn Hinton, Asst. Director of Student Experience, School of Interactive Games & Media, GCCIS
Andy Phelps, Professor & Director, School of Interactive Games & Media, GCCIS

With special thanks to:

Dumbwaiter Design, LLC
Matt Olpinski, CIAS
The Wallace Center Faculty Development Team
Jeremy Haefner, Provost and Senior Vice President of Academic Affairs
James Watters, Senior Vice President of Finance and Administration

Contents

Executive summary

In September, 2011, a taskforce was charged with developing a set of recommendations for new approaches in learning methodologies and educational technologies that will add value to RIT's position in higher education. This taskforce facilitated interviews with RIT stakeholders, gathered input faculty, did benchmark research, and prepared a number of summaries for RIT leadership.

Forces of change in Higher Education

The forces of change in higher education are diverse and significant. Experts believe these forces range from technology and globalization to shifting student and employer expectations. The impact of any one of these drivers is significant and in total is transformative. Experts predict this "perfect storm" (Mayberry, 2011) requires transformation in higher education practices to make a quality postsecondary education affordable (Christensen, Horn, Caldera & Soares, 2011), relevant, accessible, and desirable.

> "The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators. Institutions must consider the unique value that each adds to a world in which information is everywhere. In such a world, sense-making and the ability to assess the credibility of information are paramount. Mentoring and preparing students for the world in which they will live and work is again at the forefront. Universities have always been seen as the gold standard for educational credentialing, but emerging certification programs from other sources are eroding the value of that mission daily" (The Horizons Report, 2012, p. 4).

Students and Technology. Changing demographics and shifting expectations for the learning environment require universities to examine teaching and learning practices. The 2009 peak of 3.3 million high school graduates is not likely to be seen again until 2020 and colleges in the North and the Northeast can anticipate significant enrollment declines over the next decade (Perfetto, 2010). Incoming freshmen are increasingly web-entrenched, as high schools continue to implement web-based tools (Smith & Caruso, 2010). College students believe use of academic technologies in their courses improves learning but report that upon graduation, the academic technologies they used in their coursework hasn't adequately prepared them for the workplace (Smith & Caruso, 2010).

Economy. Student debt in the U.S. is larger than all other forms of debt, and tuition cost is rising more quickly than prices of other goods, and then family incomes (Glater, 2007).

Employers. New-entrant skills requirements include professionalism/work ethic, oral and written communications, teamwork/collaboration and critical thinking/problem solving. Yet in a recent study, employers reported that graduates of four-year colleges are deficient in these skills.

The need for an agile, responsive University

Universities, including RIT, have addressed this shifting landscape in a variety of ways. Online courses/programs are growing in number and some universities are making their course content not only available online, but free to everyone. Use of technology to simulate everything from operation of a jet engine to the working of the human heart has allowed students anywhere in the world, to interact with professors and one another both asynchronously and in real-time, rather than requiring physical attendance in a laboratory.

RIT is well-positioned to address the changing landscape. RIT was one of the earliest adopters of distance learning. Various RIT programs are known the world over and RIT as a whole enjoys a reputation as an innovative, hands-on university that stands in stark contrast to more traditional learning environments. The success of the cooperative education program sets RIT apart from peer institutions the world over, as does our commitment to career-oriented undergraduate education.

Many academic units at RIT have augmented their curriculum with state-of-the-art laboratory systems and software environments and the campus as a whole is a technologically rich atmosphere. Several projects involving academic technology from RIT have been featured as best-in-class exemplars by groups such as New Media Consortium, Chronicle of Higher Education, and IEEE.

A range of approaches

The options to address the changing landscape can best be considered along a continuum of change. At one end of the continuum, RIT can continue its current strategy, optimizing what it already does well but doing nothing *new*. The benefit of this approach is it requires no significant resources. The risk of this approach is RIT may be outpaced by our competition in the future.

Or, RIT can adopt a multi-product approach with a formal structure for "product" development in which we innovate beyond our current degree-focused products and more systematically test new pedagogy and technology in a way that is scalable. Benefits of this approach include the ability to capitalize on efforts already underway; potential to add products through a market-based approach; opportunity to identify lower cost products. A risk of this approach is it requires a substantial culture change and buy-in during a period of substantial upheaval within the Institute.

Another option is to create an auxiliary unit within RIT, focusing exclusively on the marketing, development, and delivery of online academic products. The unity would draw from the strength of being internal to RIT but operates outside some of the current academic processes. Benefits of this approach are it minimizes short-term change to "RIT proper" and leverages existing accreditation and tax status. Risks of this approach are failures may impact the RIT brand and there is potential to cannibalize the existing on-campus market.

At the far end of the continuum is the creation of an entirely separate and potentially for-profit entity, focused on innovation in teaching and learning. Benefits of this approach are it avoids tension between the on-campus brand and activities of the new unit; the potential access to investment capital; increased agility relative to the university as a whole. Risks of this approach are it requires a significant up-front investment with a long-term return on investment horizon; revenues may be subject to taxation and other expense burdens; negotiation with faculty regarding intellectual property; and the inability to leverage the RIT brand to promote the new unit.

Conclusion

Many forces are converging—shifts in student demographics, advances in academic technology, the needs of the national economy, a rate of tuition increase that makes education unaffordable for many families—that lead experts to believe it is time to question the current model of higher education. The current model typically includes only minimal online course offerings, caters to traditional-age students, offers courses mainly on weekdays between 9 am and 5 pm from September to May, and provides discounts to attract students (Van Der Werf & Sabatier, 2009). RIT must begin to evaluate alternative models in order to be prepared to adapt in a rapidly changing educational landscape.

Background

In September, 2011, a taskforce was charged with developing a set of recommendations for new approaches in learning methodologies and educational technologies that will add value to RIT's position in the higher education market. The taskforce was directed to:

- Investigate the latest scientific research on what motivates students to learn and how students learn
- Research how other institutions are using new technologies to deliver education
- Explain how social media, mobile, and new interactive technologies might be tapped for a new learning environment at RIT
- Recommend scenarios, models, and approaches for interactive online learning that would be important for RIT to build that will distinguish RIT as a leader in a new paradigm for higher education

This report is the result of that investigation and analysis.

Changing Higher Education landscape

There are a number of drivers of change in higher education today, including (Futhey, Luce & Smith, 2011; Goldstein, 2006):

- Technology
    - The rate of technology change and growth has been exponential and is not likely to decrease. Technology is widely used at home and in K-12 school settings, influencing student expectations for technology use in higher education. Online learning1, in particular, is touted a key delivery mode in higher education that will address the majority of the drivers of change.
- Globalization
    - Globalization influences higher education in multiple ways from a need to "internationalize" the curriculum and provide support services for non-native English speakers, to supporting increasingly ethnically diverse classrooms.
- Changing demographics
    - According to a recent report (Perfetto, 2010), "between 1990 and 2009, the number of high school graduates increased by more than 35 percent, from 2.4 million to 3.3 million. The 2009 peak of 3.3 million high school graduates is not likely to be seen again until 2020" (p. 1, 2).
    - Perfetto's report (2010) also predicts that colleges in the North and the Northeast can anticipate significant enrollment declines over the next decade.

[1] In online learning, all of the course content is delivered using technology and there are no required face-to-face meetings

- Economy
    - Even when considering the net price of tuition, after taking into account grants and other forms of aid, tuition cost is rising more quickly than prices of other goods and then family incomes (Glater, 2007). As Lewin (2008) reported, published college tuition and fees increased 439 percent from 1982 to 2007 while median family income rose 147 percent.
- Changing employer needs
    - In the knowledge economy, employer needs for new entrant skills include professionalism/work ethic, oral and written communications, teamwork/collaboration and critical thinking/problem solving. In a recent study, employers reported that graduates of four-year colleges are deficient in these skills (Casner-Lotto & Barrington, 2006).
- Increased demand for accountability
    - According to Mayberry (2011) there is increased pressure being applied by the government and accrediting bodies for universities to demonstrate that a college education is a worthy investment. Says Mayberry (2011, p. 6), "The vocabulary of accountability is changing: we hear less about 'assessment' and 'learning outcomes' and more about 'competencies,' 'return-on-investment,' and 'gainful employment.'
- Changing student expectations
    - Student expectations are influenced by technology use and their parents' satisfaction is framed in terms of employability. Given the increased competition in higher education, especially from the for-profit sector, students and their parents also expect competitive pricing.

The impact of any one of these drivers is significant and in total is transformative. Experts predict this "perfect storm" (Mayberry, 2011) requires significant change in higher education practices to make a quality postsecondary education affordable (Christensen, Horn, Caldera & Soares, 2011), relevant, accessible, and desirable.

In a report from The Council of Higher Education Management Associations (Goldstein, 2006) on the future of higher education, respondents predicted that in the coming decade higher education will face more competition, be under greater pressure to reduce tuition, need to make improvements in the quality of education and do so with insufficient resources.

Technology

The 2011 Horizon Report (Johnson, Smith, Willis, Levine & Haywood) includes (in rank order) those trends considered to be key drivers of educational technology adoption in higher education as:

- "The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators in sense-making, coaching, and credentialing.
- People expect to be able to work, learn, and study whenever and wherever they want.
- The world of work is increasingly collaborative, giving rise to reflection about the way student projects are structured.
- The technologies we use are increasingly cloud-based, and our notions of IT support are decentralized" (p. 3).

The 2012 Horizons Report names those technologies most likely to be widely adopted in higher education in the *near term* as mobile applications and tablet computing.

The Educause Center for Applied Research (ECAR) study of university student perceptions of and usage of technology reports are shown in figures 1-4 (Students & Technology, 2011).

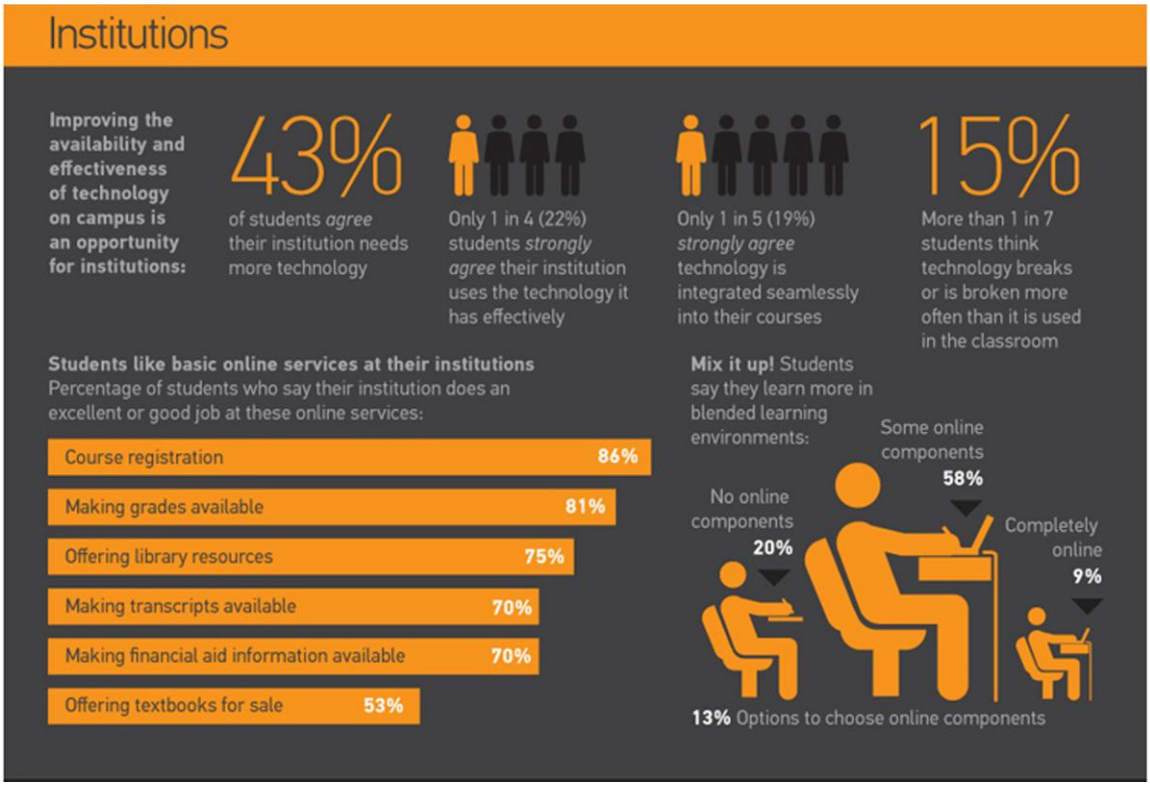

Figure 1: Student perceptions of technology use at universities (ECAR, 2011).

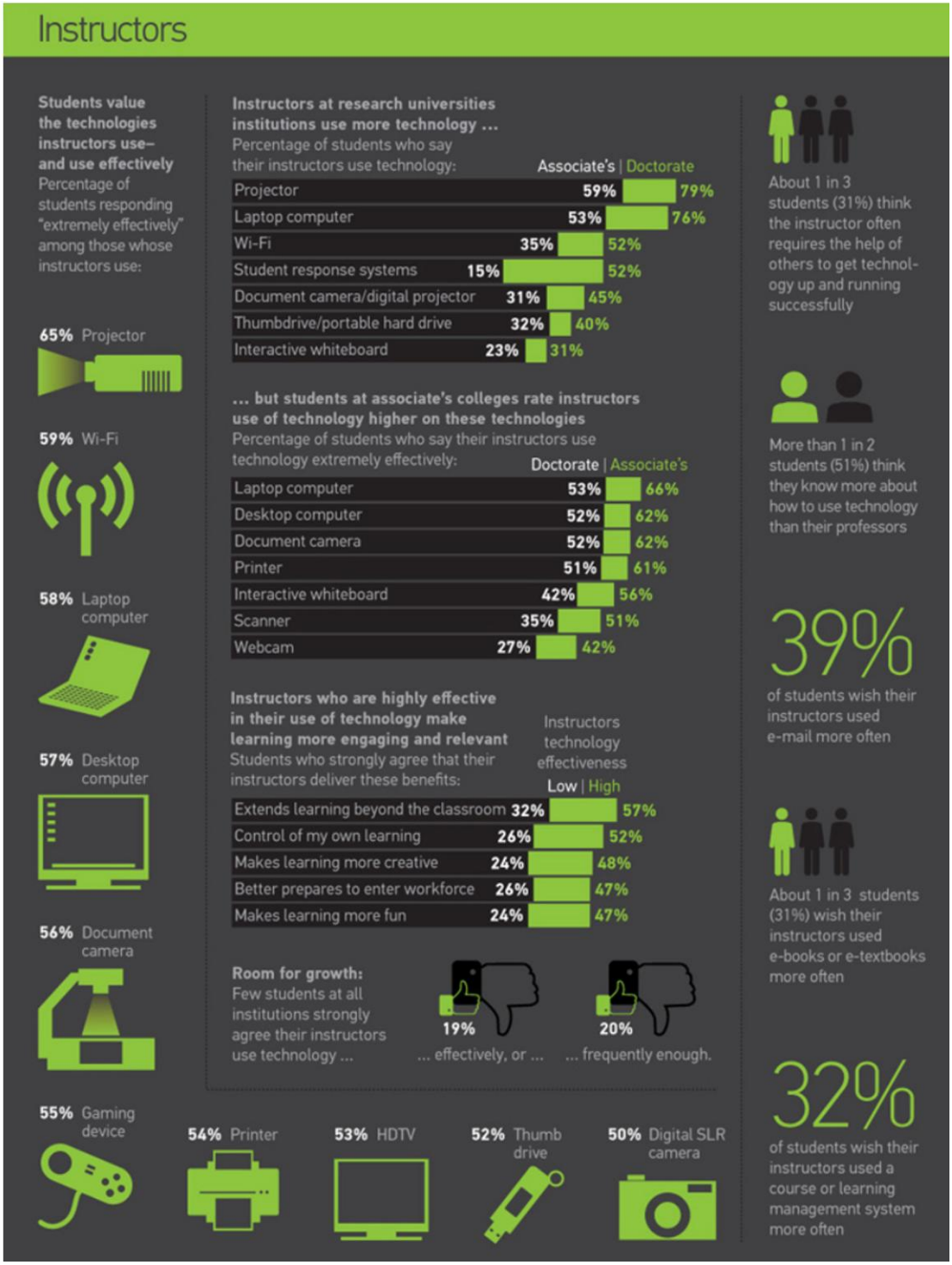

Figure 2: Student perceptions of technology use by faculty (ECAR, 2011).

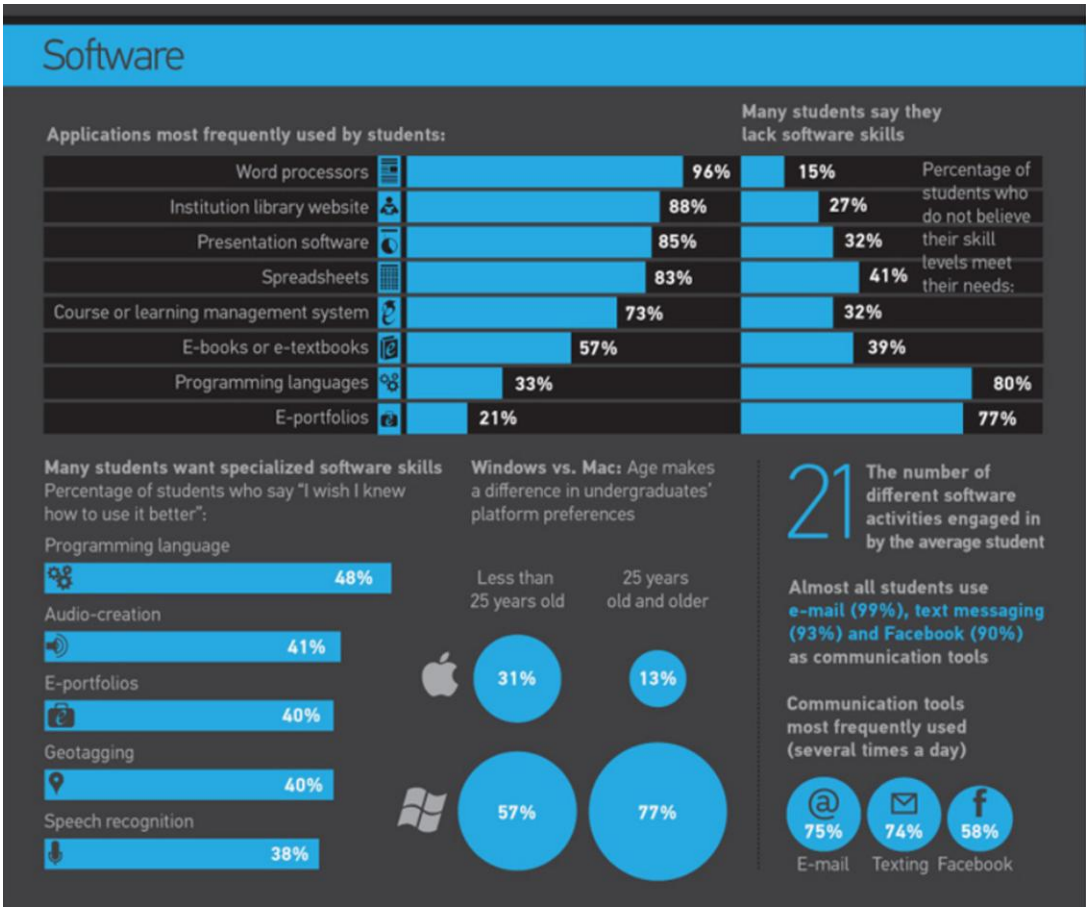

Figure 3: Student perceptions of software use in higher ed (ECAR, 2011).

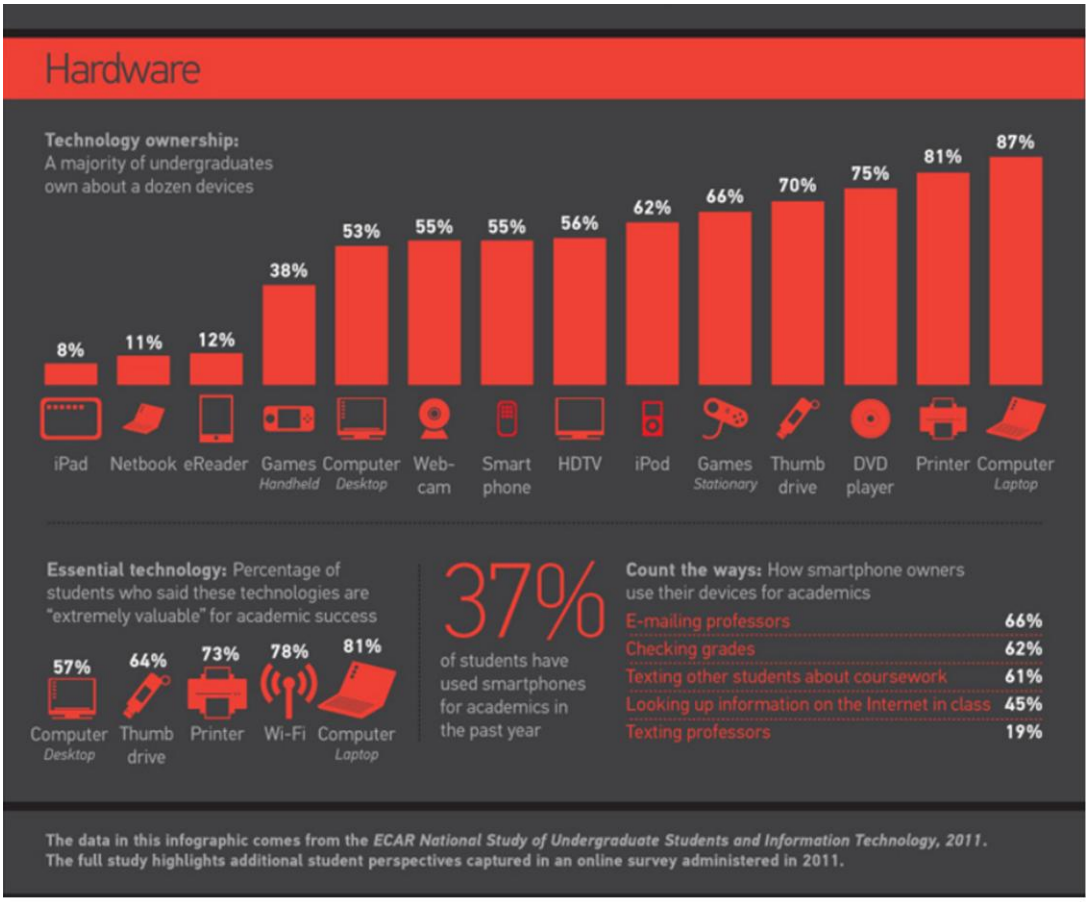

Figure 4: Student perceptions of hardware use in higher ed (ECAR, 2011).

It is important to note that incoming freshmen are more likely to "be even more web-entrenched over the coming years as high schools around the nation are implementing web-based tools" (Smith & Caruso, 2010, p. 77).

Yet, the Faculty Survey of Student Engagement (FSSE) found that of the 4,600 faculty surveyed, 79 percent report they are not using collaborative tools like the ones their students are using (Professors' Use of Technology, 2010).

A 2010 ECAR study (Smith & Caruso, 2010, p. 9) found:

- The majority of students report convenience is the most valuable benefit of information technology (IT) in courses.
- Roughly 50 percent of respondents believe use of IT in courses improves their learning.
- About 50 percent of students who responded report feeling adequately prepared to use IT as needed in their courses when entering college.
- Just less than 50 percent of respondents feel that upon graduation, the IT they used in their courses will have adequately prepared them for the workplace.

Online learning

Many futurists agree that online learning is the disruptive innovation in higher education today (Christensen & Eyring, 2011). A disruptive innovation is one that allows a simple, affordable, and accessible product to replace a product that is complex, expensive and inaccessible, even if the initial quality of the new product is inferior. Disruptive innovations have led to the downfall of many successful companies that did not recognize the potential impact of the innovation. Among the reasons online learning is expected to transform teaching and learning in higher education today includes:

- Online learning is less expensive to deliver than classroom-based education because it does not require physical plant.
- Online learning is accessible 24/7 to learners anywhere in the world.
- Online learning also appeals to the Net Generation's unique needs and expectations in a number of ways.

According to the report, *2010 Class Difference$ Online Education in the United States,* (Allen & Seaman, 2010, p. 2):

- Sixty-three percent of all reporting institutions said that online learning was a critical part of their institution's long-term strategy.
- The 21 percent growth rate for online enrollments (to 5.6 million in the fall term of 2009) far exceeds the less than two percent growth of the overall higher education student population.
- Nearly 30 percent of all students in higher education take at least one course online.

Studies have found that the quality of student outcomes in online classes is comparable to that of face-to-face courses (Allen & Seaman, 2010; Brainard, & Richards, 2010; Dziuban & Moskal, 2010).

The 2010 Educause Center for Applied Research (ECAR) study of undergraduate students and information technology found that of the nearly 37,000 students surveyed, 90.3 percent had used a course or learning management system and 35.2 percent use one daily (Smith & Caruso, 2010, p. 15).

e-books

The growth of digital textbook sales is expected to increase significantly in coming years, fueled by (Reynolds & Loffe, 2010, p. 1):

- Increased growth of online learning
- Rise in open educational resources and their use
- Proliferation and continued popularity of e-reader devices and platforms

This growth is expected to also create opportunities for new content-publishers to enter the textbook market and accelerate the formal adoption of open educational resources to supplement premium digital content.

Globalization

In many respects, globalization has already profoundly influenced higher education. Globalization is often described as the reality shaped by an increasingly integrated world economy, new information and communications technology (ICT), the emergence of an international knowledge network, and the role of the English language. Internationalization is defined as the variety of policies and programs that universities and governments implement to respond to globalization. In the higher education setting, internationalization has typically included study abroad, branch campus in other countries, or engaging in some type of inter-institutional partnership (Altbach, Resiberg, & Rumbley, 2009).

Some predict that U.S. dominance in higher education is threatened by expanding educational systems in Asia and the European Union.

Changing demographics

According to Goldstein (2006), since 1970, the number of foreign-born persons in the U.S. has tripled to 12 percent of the population; between 2000 and 2020, the non-Hispanic school age population will decline slightly while the Hispanic school age population will grow by 60 percent; and there is an increasingly older student body that pursues work and school simultaneously.

Refer to table 1 for additional information on changing student demographics.

Table 1. High School Graduate Demographics (Western Interstate Commission for Higher Education, 2008).

Percentage Growth in Public High School Graduates by Race/Ethnicity (2009-2021)				
American Indian./Alaska Native	Asian/Pacific Islander	Black non-Hispanic	Hispanic	White non-Hispanic
10.2	60.5	−2.4	88	−15.2

The gradual aging of the student population is depicted in table 2.

Table 2. Actual and projected fall enrollment[2] in degree-granting institutions, by age (1990-2016) (Van Der Werf & Sabatier, 2009).

Age	1990	1995	2000	2005	2007 (projected)	2010 (projected)	2016 (projected)
Total	**13,819**	**14,262**	**15,312**	**17,487**	**17,958**	**18,839**	**20,442**
14-17 yr old	177	148	145	199	178	177	190
18-19 yr old	2,950	2,894	3,531	3,610	3,812	4,018	4,010
20-21 yr old	2,761	2,705	3,045	3,778	3,904	4,203	4,299
22-24 yr old	2,144	2,411	2,617	3,072	3,109	3,277	3,715
25-29 yr old	1,982	2,120	1,960	2,384	2,533	2,688	3,168
30-34 yr old	1,322	1,236	1,265	1,354	1,337	1,443	1,741
35+ yr old	2,484	2,747	2,749	3,090	3,086	3,034	3,319

Economy

Published tuition and fees rose from $27,265 in 2010-11 to $28,500 in 2011-12 at private four-year colleges, a 4.5-percent increase (Supiano, 2011).

The rate of increase in college tuition has outpaced the rise in the cost of living and family income for decades. Nationally, tuition and fees have risen 439 percent since 1982, in inflation-adjusted dollars, while median family income has risen only 147 percent (National Center for Public Policy and Higher Education, 2011).

Polling by the National Center for Public Policy and Higher Education shows that public anxiety over the cost of college is at its highest level ever (Van Der Werf & Sabatier, 2009).

[2] In thousands

Changing employer needs

Employers' rate the following applied skills as critical to success at work (Casner-Lotto & Barrington, 2006):

- Critical Thinking/Problem Solving
- Oral Communications
- Written Communications
- Teamwork/Collaboration
- Diversity
- Information Technology Application
- Leadership
- Creativity/Innovation
- Lifelong Learning/Self Direction
- Professionalism/Work Ethic
- Ethics/Social Responsibility

Yet employers report their growing frustration that students graduating from four-year colleges and universities lack an acceptable level of competence in many of these areas, with the greatest skills gaps reported to be in Written Communications and Leadership (Casner-Lotto & Barrington, 2006).

The 2012 Horizons report asserts that the high value employers place on collaboration means universities much prepare students to excel in teamwork and group communication and should require tools such as wikis, Google Docs, and Skype in group project work.

Increased demand for accountability

"Higher education is encountering unprecedented pressure for accountability from both internal and external constituencies. These constituencies include legislators, the families of prospective students, accreditors, trustees, current students, faculty, and administrators—each wanting something quite different from the institution and each wanting the information for varying reasons and purposes. This pressure for accountability in higher education is actually nothing new; it has been a top concern for nearly 15 years. Today, however, the rising price of tuition is exacerbating the call for colleges and universities to demonstrate their effectiveness and to become more transparent about how resources are used" (Hawkins, in Katz, 2008, para 1)

Changing student expectations

Today's high-school students see their educational futures built almost entirely around technology. They are restless with the traditional forms of learning in higher education and are eager to incorporate the electronic tools (smartphones, ipads, etc.) that have become ever-present in their lives into their education. Students entering college today want to design their own curricula and find ways to learn in their own style. These students crave personalization and expect convenience (Van Der Werf & Sabatier, 2009).

Administrators in higher education predict that universities must prepare for these changes in student expectations, as well as their (Goldstein, 2006):

- growing expectations for services and service quality, fueled in part by the high cost of education,
- increased expectation for 24x7 access to services, and the
- increased movement of students between institutions.

According to The 2012 Horizon Report (Johnson, Adams & Cummins), "People expect to be able to work, learn, and study whenever and wherever they want to" (p. 4). The report (2012) finds that today's entering college students want simple and timely access to information but also to tools, resources and up-to-the-minute analysis and commentary. The abundant opportunities for informal learning are changing students' expectations.

Understanding the Net Generation student

The current cohort of college students is a fundamentally different type of learner and has been identified in the literature as the Net Generation (Barnes, Marateo, & Ferris 2007; Hendricks 2004).

What primarily distinguishes the Net Generation, who were born after 1982, from previous generations is the fact that they have come of age in a digitally enhanced world and, consequently, their understanding of the world has come primarily from digital sources (Tapscott, 1998). Many refer to these students as "digital natives" because they represent the first generation of students to grow up with pervasive digital technology (Prensky, 2001).

Coming of age in an environment saturated by technology, where the digital world interacts more and more seamlessly with the "real" world, means that these students represent the first generation of virtual learners—or those accustomed to seeking and building knowledge in a technology-enhanced environment. When these learners seek information, they are more likely to look for it online than anywhere else since this is the environment with which they are most familiar (Mabrito & Medley, nd).

Recent studies in brain research indicate that the brain may actually be changed by repeated and prolonged exposure to the same stimuli (Mundkur, 2005). This research points to the possibility that Net Generation students are literally wired differently from previous generations, their brains shaped by a lifelong immersion in virtual spaces. Repeated and prolonged exposure to the digital world may mean that Net Generation students process and interact with information in a fundamentally different way from those who did not grow up in this environment (Mabrito & Medley, nd).

Some perspectives on the unique characteristics of the Net Generation include:

- Net Generation students have less experience reading traditional printed text than previous generations. The average Net Generation student has spent 30,000 hours watching TV and playing video games but only 5,000 hours reading (Prensky, 2001).
- Net Generation learners rely heavily on computer technology and expect it to be part of the learning process (Philip, 2007).
- The typical Net Generation learner is digitally wired, learns by hands-on methods, seeks social interaction online, and expects such interaction to be part of the learning process (Oblinger & Oblinger 2005).
- These students spend a majority of their time in synchronous environments engaging in interactive online games and chat rooms (Leung, 2004).
- Learning through games is a significant feature of the Net Generation's learning process. N Nearly 77 percent of this population will have played interactive video or online games by high school with these games occupying a large part of their multitasking environment (Jones 2002).

According to Mabrito & Medley (nd), playing to the unique characteristics of Net generation students implies a pedagogical model similar to those that social constructivists suggest should define classroom instruction. Approaches such as fostering dialogue among students as a means of discovering ideas and developing thinking, and providing computer-networked collaboration and communication are likely to meet Net Generation students' particular learning needs and strengths.

Emerging best practices

The following exemplars were selected from among the many and diverse approaches universities worldwide are taking to proactively shape the future of teaching and learning.

Carnegie Mellon (http://oli.web.cmu.edu/openlearning/)

The Carnegie Mellon OpenLearning Initiative (OLI) provides web-based courses free of charge, to the general public. The courses are also available at a low cost to students who use the materials in accredited courses.

OLI offers two ways to use course materials. 1.) Open & Free courses are designed for individual learners who are not under the guidance of an instructor. These learners are given access to most or all course content with no set start or end dates and no enrollment is required. 2.) Academic versions are designed to be used by classes led by an instructor. Instructors from various institutions create customized course sections for their students. Instructors have access to each student's work and progress. They may assign applicable grades and or credit.

OLI is at the heart of Carnegie Mellon's strategy to deploy technology that is grounded in a research-based understanding of human learning, or what they refer to as "learning science and engineering." As such, courses available via OLI are designed by teams composed of learning scientists, faculty content experts, human-computer interaction experts, and software engineers.

Stanford on iTunes U (http://itunes.stanford.edu/)

Stanford on iTunes U provides access to a wide range of Stanford-related digital audio content via the iTunes Store, Apple's popular online music, video, and podcast service. The project includes two sites:

- A public site which includes Stanford courses, faculty lectures, event highlights, music, sports, and more.
- An access-restricted site for the Stanford community which includes coursework-linked iTunes U sites for course-based materials and Stanford Community iTunes U for the entire campus community.

Highlights:

- Makes use of a large-scale, existing platform
- Cost-effective way for students to access materials from anywhere at any time
- Completely asynchronous
- Significant campus adoption and large-scale content shift
- Courses available in a large number of topics, but in mostly traditional formats

MIT Open Courseware Initiative (http://ocw.mit.edu/index.htm)

MIT Open Courseware is a publication of MIT course materials, made available after they have been taught at MIT. There is no registration for the site and all materials are completely free to use.

Highlights:

- Certification/badges of completion rather than degrees
- Skill-based orientation
- Completely different costing model (free to take and learn, pay for certificate/credential)
- Largely asynchronous but capability for some group interaction
- Individually branded experiences by individual faculty as desired

The CUBE at British Columbia Institute of Technology (http://cube.bcit.ca/sites/cube/)

3D Simulation Development Lab, was established to design, develop and implement 3D simulation learning systems throughout BCIT's various schools as well as promote our services to other educational institutions and industry partners. 3D simulation technology with the instructor's guidance will bring major learning enhancements to conventional teaching tools such as manuals, books, and other physical materials. Students will have virtual hands-on training in the classroom using 3D technology to study the internal mechanisms of a component from a variety of angles and views, hence adding tremendous learning benefits.

Highlights:

- Not asynchronous; timed/delivered real-time with instructor/mentor/facilitator
- Different subject matter (Engineering) than is traditionally available online
- Hands-on, immersive style
- Advanced technology
- Delivered on a multitude of client technologies
- Custom platform developed by the university for its needs

DUKE University Human Simulation and patient Safety Center
(http://simcenter.duke.edu/about.html)

The Human Simulation and Patient Safety Center features an adult and a simulator, or full-size mannequins whose major organ systems have been programmed to respond appropriately to the environment and to a user's intervention by physical or pharmacologic means. The mannequins are computer controlled either at the bedside or from a distant room. The mannequins may be used to teach simple physiology and pharmacology, bedside medical examination techniques, cardiopulmonary resuscitation, and complex medical management. Highlights:

- Both on-campus and online capabilities
- Deeply immersive in a process view
- Integrated into an emerging field (medical simulation)
- Unique staffing model

KHAN Academy (http://www.khanacademy.org/)

KHAN Academy is a not-for-profit organization with the goal of changing education for the better by providing a free world-class education to anyone anywhere. All of the site's resources are available to anyone, completely free of charge.

Highlights:

- Stands apart from existing models
- Largely traditional topics in quasi-traditional modality
- Badge structure and incentives interjected throughout the experience
- Discreet chucks of subject matter
- Challenges traditional assessment models on a large scale

Abilene Christian University Connected Mobile Learning Initiative
(http://www.acu.edu/technology/mobilelearning/)

According to their site, “We've endeavored to imagine a world where classes become untethered from the stony isolation of four walls, where information is accessible in new contexts and situations, where learning becomes truly mobile, permeating our students' lives.”

Highlights:

- The "bring-your-own-device" course design philosophy emphasizes flexible course activities, such that students can participate using a wide array of mobile devices. Smaller, lighter devices with robust hardware/software programs (i.e., GPS software, Webcam, etc.) found to be more convenient for site and field-based projects and research.
- The ubiquity of Apple devices in higher-ed mobile learning initiatives is steering a lot of the research, but some universities are looking to alternatives like Android, which is considered to be the runner up in terms of market penetration.
- Customized mobile application development is becoming more pervasive for universities (e.g., interactive campus maps and directories, faculty-developed apps).

Hapara (http://hapara.com/teacher-dashboard-for-google-apps)

Hapara is an innovative cloud applications company with a portfolio of cloud products and services that provide enhanced functionality for education and enterprise deployments of Google Apps. Teacher Dashboard is an add-on for Google Apps Education Edition that makes the digital classroom safer, easier to set up, easier to use and easier to manage.

Highlights:

- Alternatives to monolithic learning management systems are emerging. Hapara is one example of a company that leverages schools' Google Apps installations for the support of teaching.

Rice University's Connexions Platform (http://cnx.org)

Connexions is a place to view and share educational material made of small knowledge chunks called modules that can be organized as courses, books, reports, etc. The site helps authors create and collaborate, instructors rapidly build and share custom collections, and learners find and explore content.

Highlights:

- Similar to Hapara, Connexions is a new model for an ecosystem, both for content creation and distribution (an alternative to the 'traditional' CMS/LMS)
- A "place" to view and share educational material made of small knowledge chunks (modules) that can be organized as courses, books, reports, etc.
- Anyone may view or contribute to the knowledge base.

Interactive French (http://www.laits.utexas.edu/fi/)

Français interactif was developed at the University of Texas at Austin in the Department of French and Italian and is a learning community website that provides improved textbook and online materials for teaching French and allows for the sharing of pedagogical best practices.

Highlights:

- Developed at the University of Texas at Austin (Departments of French and Italian); funded and created by the UT Liberal Arts
- Instruction Technology Services and currently supported by the Center for Open Educational Resources and Language Learning <http://coerll.utexas.edu/coerll/> (a National Foreign Language Resource Center <http://nflrc.msu.edu/index.php>), and the USDE Fund for the Improvement of Post-Secondary Education.
- Creative Commons licensed material supplemented with high-quality videos that accompany classroom/homework activities - appropriate for asynchronous and web-enhanced delivery modes.
- E-book includes high quality videos and classroom/homework activities that provide interactive, rich, visually stimulating and engaging experiences for the learner
- Global/international collaborative component (RhôneAlpes.tv <http://www.rhonealpes.tv/>)
- E-book can be read digitally (computer, e-reader, mobile device)
- Cost-effective-no charge, downloadable, printable chapters)--consistent with the changing business models across the education ecosystem.

Mindtap.com, Cengage Learning (http://www.cengagesites.com/academic/?site=5232)

MindTap is a new personal learning experience that combines all digital assets–readings, multimedia, activities, and assessments—into a singular learning path to improve student outcomes.

Highlights:

- With universities creating their own texts, publishers are doing everything they can to remain relevant. Mindtap is just one example of what publishers are doing in an effort to sustain themselves in the new business model for the educational ecosystem.

RIT's current state

Technology in our classrooms

There are approximately 100 general purpose classrooms, managed at the university-level, on the RIT campus that are equipped with podiums that allow faculty to project from a laptop and show media from a DVD deck or a computer.

In addition, there are 5 special purpose classrooms, managed at the university level, which have additional equipment ranging from a visualizer/document camera to dual mirrored projectors.

RIT currently has 5 auditorium spaces, managed at the university-level, which have additional equipment such as microphones, controllable room lighting, and audio systems.

Individual colleges may have additional classroom and auditorium spaces that they manage, and which include technology/equipment.

Online learning and other academic technologies

RIT has long been considered a leader in online learning and continues to enjoy a positive reputation in this area. RIT offered its first distance course in the spring quarter of academic year (AY) 1979-80. In 2002, RIT implemented the myCourses course management system, which allows faculty to deliver online courses. myCourses is provided by Desire2Learn and has been customized to meet the unique needs of our students and faculty.

RIT currently offers[3]:

- Seven online certificate programs
- One online AAS degree programs
- Two online BS degree programs
- Twelve online advanced certificate programs
- Fifteen online MS/ME/MBA degree programs
- A host of individual courses in an online or a blended format

In the last academic year (2010/11), 75 percent of all RIT faculty used one or more features in the myCourses learning management system. Sixty-two percent of all courses offered at the institute included use of one or more myCourses features.

[3] Source: http://www.rit.edu/emcs/ptgrad/_program_listing.php?display=alpha&type=online&head=online

Since the advent of online learning, RIT has also adopted other academic or educational technologies, used by faculty in traditional, blended, and online courses. These academic technologies include:

- Adobe Connect, Captive, Presenter and Connect
    - In AY 2010/11, 535 faculty and 3128 students used Adobe Connect for meetings, to share presentations, and collaborate on materials.
- iClicker
    - In AY 2010/11, 77 course sections used iclickers, which is an audience response device
- RIT Wiki
    - Last academic year (2010/11), 72 credit-bearing course sections used the RIT-supported wiki space for information sharing and collaboration
- Online Course Evaluation (OCE)
    - OCE was originally created to support student evaluation of faculty teaching online courses. Usage has grown to include evaluation of faculty teaching face-to-face courses, as an online evaluation is preferred by my departments to a paper-based system. Nearly one-half of all courses taught at RIT use the OCE system
- Clipboard
    - Use of Clipboard for online surveys has grown exponentially. Faculty-created surveys in the AY 2010/11 exceeded 620
- Bookbag
    - Bookbag is an RIT course-aware bookmarking application that instructors and students can use to share links to articles and other items relevant to the course. This tool was developed at RIT and will be made available for all faculty soon.
- Peer2peer
    - peer2peer is an online peer evaluation tool that allows students to provide their instructors with feedback on themselves and each of their team members. Ratings and comments are anonymous to other students, though they can be shared with other members of the team. In AY 2008/09, fifty-two faculty used peer2peer in their courses.

RIT's strengths

RIT has a long history of curricular and academic innovation and enjoys a strong reputation for experiential education. The university was one of the earliest adopters of distance learning, when the technology was very much in its infancy. Various programs are known the world over, and the Institute as a whole enjoys a reputation as an innovative, 'hands-on' university that stands in stark contrast to more traditional learning environments. The hallmarks of RIT as a place where the Arts and the Sciences collide have a deep resonance in preparing the students of tomorrow, and to the extent that we can capitalize on these strengths, the Institute should be able to command a leadership position in educational technology. The success of the cooperative education program sets RIT apart from peer-class institutions the world over, as does our commitment to career-oriented undergraduate education.

The campus is one of the most wired universities in existence, and the digital infrastructure underpinning many of our core systems is being revamped and extended through the semester conversion. Many individual academic units have augmented their curriculum with state-of-the-art laboratory systems and software environments, and the campus as a whole is a technologically rich atmosphere. Several individual projects involving educational technology from RIT have been featured as best-in-class leading exemplars by groups such as the New Media Consortium, the Chronicle of Higher Education, and the IEEE. RIT has a deep history of curricular innovation with several extremely relevant programs being the first of their kind anywhere in the country (Information Technology, Software Engineering, etc.) as well as others that enjoy national and international reputations in their domains.

The 2012 Horizon Report (Johnson, Adams & Cummins) identified 6 key trends that are shaping the future of educational technology in higher education: Mobile Apps, Tablet Computing, Game-Based Learning, Learning Analytics, Gesture-Based Computing, and the 'Internet of Things' methodology. Interestingly, each of these is represented by recent projects and curricular efforts at RIT: we exist on the cutting edge on many of these issues, and are significantly ahead of the timeline-to-adoption projected by this report.

There exists at RIT a rich and talented pool of faculty, staff, and administrators with both the passion and experience to explore and engage more deeply with opportunities afforded through modern educational technology and associated learning models. Should it be an administrative and planning priority, it should be possible to use these resources, in combination with new commitments, to produce new and innovative models to engage in distance and online learning.

RIT's challenges

In addition to recognizing our strengths, we must consider that RIT does face some challenges. Among our challenges is the fact that the traditional age college student populations in the North and Northeast are shrinking. This means RIT must make investments in recruiting nationwide and even globally. RIT is highly invested in our physical campuses and the traditional degree structure, which creates pressure to leverage existing investments. While the institute has made noteworthy advancements in the area of online learning and academic technologies, there is a lack of a planned, purposeful approach to development and implementation. We have an inadequate technical infrastructure. As mobile, digital, and technical needs are growing, we aren't keeping pace. Expectation is outstripping our capability each year.

Summary

The business model for the most elite colleges and for most flagship public universities will continue to be viable for the foreseeable future. At those institutions, the demand for a brand-name degree and the traditional residential model will likely remain high. The business model for for-profit colleges and community colleges is also viable into the future. They cater to older students who don't want a traditional college "experience" and who want and need courses that are available at times and in formats that fit their schedules (Van Der Werf & Sabatier, 2009).

Then there are the many colleges that don't have well-known brand names and wide recognition. In the past they have been able to maintain strong enrollments because the population of 18-to-24-year-olds has been growing. But over the next decade, that population will not increase. Those colleges will find that they need to attract more adult students, more part-time students, and more students who will want all or many of their courses online (Van Der Werf & Sabatier, 2009).

Shifts in the student demographic, coupled with the fact that tuition has increased at a rate most families are finding makes it unaffordable, lead many experts to believe that it is time to question the current model, which includes only some online course offerings, caters to traditional-age students, offers courses mainly on weekdays between 9 am and 5 pm from September to May, and gives away product at a discount to attract students (Van Der Werf & Sabatier, 2009).

RIT must begin to evaluate alternative models in order to be prepared to adapt in a rapidly changing educational landscape.

Recommendations

"Too often it is education's own processes and practices that limit broader uptake of new technologies. Much resistance to change is simply comfort with the status quo, but in other cases, such as in promotion and tenure reviews, experimentation with or adoptions of clearly innovative applications of technologies is often seen as outside the role of researcher or scientist" (The Horizons Report, 2012, p. 6).

The options for RIT to address the changing landscape can best be considered along a continuum of change as depicted in figure 5.

Figure 5: Continuum of options

At one end of the continuum, RIT can continue its current strategy and choose to do nothing *new*. It can continue to optimize what it already does well. The benefit of this approach is that no significant investment of resources is required. The risk of this approach is RIT may be outpaced by our competition as the role of the university changes in the future.

Or, RIT can adopt a multi-product approach with a formal structure for "product" development in which we innovate beyond our current degree-focused products and more systematically test new pedagogy and technology in a way that is scalable and supports wider implementation. Figure 6 shows the methodology often used in technology companies to remain agile, flexible and on the cutting edge, which would be applied to the development of RIT "products." At RIT, we currently think of degrees and certificate programs as "products." If that type product is not what students will be consuming in the future, we will not be prepared unless we apply this model to developing other products, such as Just Press Play, as well as new methods for delivery of those products, such as online.

Among the benefits of this approach are RIT can better capitalize on the grass-roots efforts already underway; the approach would strengthen decision-making throughout the "product" life cycle; an increase in our product offerings; the potential to lower the cost of educational products. Risks of this approach include that it requires a substantial culture change in terms of tolerance for risk and focus on market analysis, for example; requires additional roles and methodology; a substantial investment of resources is needed.

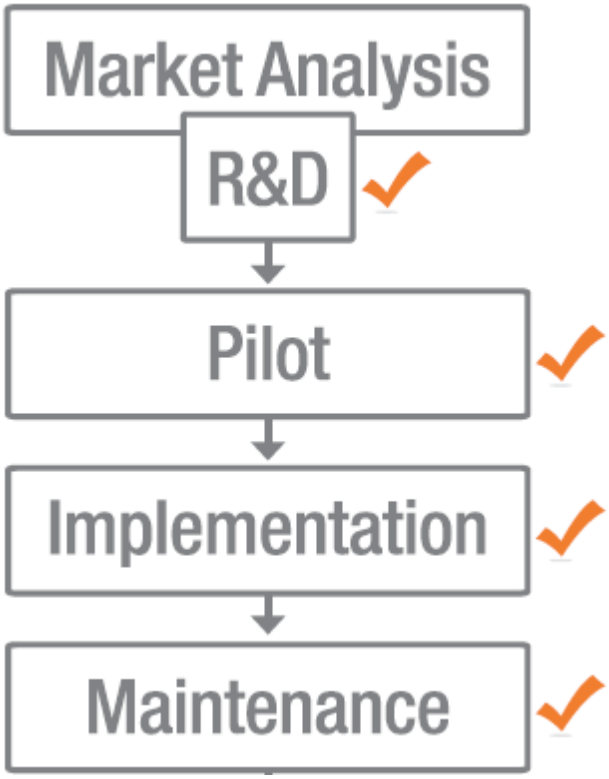

Figure 6. Product development model.

Another option is for RIT to create an auxiliary unit within RI that operates outside of the existing academic college model, and focuses exclusively in the marketing, development, and delivery of online academic products. An auxiliary unit in higher education is defined as one that operates outside of the policies, procedures, and administration of the rest of the university. Common examples of auxiliary units are residence halls, food services, and campus bookstores. Universities that "plug" a disruptive innovation into their existing business model often find that existing business model "co-opts" the innovation because as with all systems, the existing system (in this case, the business model) struggles to maintain the status quo (Christensen, et al., 2011). Therefore, experts stress that in order for existing institutions of higher education to successfully embrace disruptive innovation they must (Christensen, et al., 2011) set up an autonomous unit, unfettered by existing processes and priorities. Benefits of this approach include:

- It leverages current accreditation, taxation, and business models
- It leverages expertise and content from existing academic units
- It minimizes short-term change to "RIT proper"
- It has the potential to lower the cost of educational products
- It may increase our agility

Risks of this approach include:

- Any failures or misconceptions will be tied to the RIT brand
- There is the potential to cannibalize the existing market
- It may be perceived as weakening the brand of experiential learning

At the far end of the continuum shown in figure 5, is the creation of an entirely separate entity, unfettered by RIT's culture, systems, process, and the like, which is focused on innovation in teaching and learning. This entity may be for-profit. Some of the benefits of this approach are:

- It avoids tension between the on-campus brand and the new unit
- It offer the potential for access to investment capital
- Increased agility
- Compensation plans can be driven by performance
- More freedom to experiment with technology

Risks of this approach include:

- It requires a significant investment, with a long-term return on investment horizon
- Inability to leverage the RIT brand to promote the new unit
- Revenue may be subject to taxation and other expense burdens
- Negotiation with faculty regarding intellectual property for resale

Regardless of the approach RIT decides to take, it is vital to address three interrelated aspects, people, process and technology. Addressing only one or two will defuse the potential benefits of any of suggested options.

References

National Center for Public Policy and Higher Education. (2011). *Affordability and transfer: Critical to increasing baccalaureate degree completion*. Retrieved from http://www.highereducation.org/reports/pa_at/index.shtml

Allen, I. E. & Seaman, J. (2010). *Class difference$: Online education in the United States, 2010*. Retrieved from Sloan Consortium: http://www.sloanconsortium.org/publications/survey/pdf/class_differences.pdf

Altbach, P. G., Reisberg, L., & Rumbley, L. E. (2009). *Trends in global higher education: A report prepared for the UNESCO 2009 world conference on higher education*. Retrieved from UNESCO website: http://unesdoc.unesco.org/images/0018/001831/183168e.pdf

Casner-Lotto, J. & Barrington, L. (2006). *Are they really ready to work?* Retrieved from Partnership in 21st Century Skills website: http://www.p21.org/storage/documents/FINAL_REPORT_PDF09-29-06.pdf

Barnes, K., R. Marateo, and S. Ferris. (2007). Teaching and learning with the net generation. *Innovate 3*(4). Retrieved from http://www.innovateonline.info

Brainard, J. & Richards, A. (2010, November 5). Online learning: By the numbers. *The Chronicle of Higher Education.* pp. B28-29. Retrieved from http://chronicle.com/article/Online-Learning-Enrollment/125202

Christensen, C. M., Horn, M. B., Caldera, L., & Soares, L. (2011). *Disrupting college: How disruptive innovation can deliver quality and affordability to postsecondary education*. Retrieved from Center for American Progress website: http://www.americanprogress.org/issues/2011/02/pdf/disrupting_college.pdf

Christensen, C. M. & Eyring, H. J. (2011). *The innovative university: Changing the DNA of higher education from the inside out.* San Francisco, CA: Jossey-Bass.

Dziuban, C. & Moskal, P. (2010, October 28). *Evaluating technology-enhanced learning: Opportunities and challenges*. Paper presented at the Future of Online Education, University Leadership Council, Washington, DC.

EDUCAUSE Center for Applied Research. (2011). *Students & technology: The 2011 ECAR national study of undergraduate students and information technology infographic*. Retrieved from http://www.educause.edu/studentsAndTechnologyInfographic

Futhey, T. Luce, R. & Smith, J.M. (2010). Drivers of change in Higher Education. *Educause Review 45(*1), p. 12-13.

Glater, J.D. (2007, October 23). College Costs Outpace Inflation Rate. *The New York Times*, p. A23. Retrieved from http://www.nytimes.com

Goldstein, P.J. (2006). *The future of Higher Education: A view from CHEMA*. Retrieved from http://net.educause.edu/ir/library/pdf/ECP0602.pdf

Johnson, L., Smith, R., Willis, H., Levine, A., & Haywood, K. (2011). *The 2011 Horizon Report*. Retrieved from New Media Consortium website: http://www.nmc.org/pdf/2011-Horizon-Report.pdf

Johnson, L., Adams, S., & Cummins, M. (2012). *The NMC Horizon Report: 2012 higher education edition*. Retrieved from http://net.educause.edu/ir/library/pdf/HR2012.pdf

Jones, S. (2002). *The Internet goes to college: How students are living in the future with today's technology*. Retrieved from Pew Internet & American Life Project website: http://www.pewinternet.org/Reports/2002/The-Internet-Goes-to-College.aspx

Katz, R. N. (Ed.). (2008). *The tower and the cloud* [PDF version]. Retrieved from http://www.educause.edu/thetowerandthecloud

Leung, L. 2004. Net-generation attributes and seductive properties of the Internet as predictors of online activities and Internet addiction. *CyberPsychology and Behavior 7*(3), pp.338-48.

Lewin, T. (2008, December 3). College may become unaffordable for most in U.S. The New York Times, p. A19. Retrieved from http://www.nytimes.com

Mabrito, M. and Medley, R. (nd). Why professor Johnny can't read: Understanding the Net generation's texts. *Innovate 4*(6). Retrieved from http://www.innovateonline.info

Mayberry, K. (2011). *RIT 2020: strategic planning in a perfect storm*. Retrieved from Rochester Institute of Technology website: https://www.rit.edu/provost/sites/rit.edu.provost/files/rit_2020_0.pdf

Mundkur, N. (2005). Neuroplasticity in children. *Indian Journal of Pediatrics*, *72*(10), 855-857.

Oblinger, D. & Oblinger, J. (Ed.). (2005). *Educating the Net Generation*. Retrieved from EDUCAUSE Resource Center website: http://www.educause.edu/ir/library/pdf/pub7101.pdf

Perfetto, G. (2010). *The end of higher education enrollment as we know it* (White Paper No. 1). Retrieved from Admissions Lab website: http://www.admissionslab.com/Education/WhitePapers/FreeWhitePaper01TheEndofHigherEducation.aspx

Philip, D. 2007. The knowledge-building paradigm: A model of learning for Net Generation students. *Innovate 3*(5). Retrieved from http://www.innovateonline.info/

Prensky, M. (2001). Digital natives, digital immigrants, part 1. *On the Horizon 9*(5), pp. 1-6.

Professors' use of technology in teaching (2010, July 25). *The Chronicle of Higher Education.* Retrieved from http://chronicle.com/article/Professors-Use-of/123682

Reynolds, R. (2010). *Digital textbook sales in U.S. higher education: A five year projection*. Retrieved from Xplanation blog website: http://blog.xplana.com/reports/digital-textbook-sales-in-u-s-higher-education-—-a-five-year-projection/

Smith, S. D. & Caruso, J. B. (2010). *The ECAR study of undergraduate students and information technology, 2010* (Research Study No. 6). Retrieved from EDUCAUSE Center for Applied Research website: http://net.educause.edu/ir/library/pdf/ERS1006/RS/ERS1006W.pdf

Supino, B. (2011, November 4). Rise in sticker price at public colleges outpaces that at private colleges. *The Chronicle of Higher Education*, *58*(11), A24. Retrieved from http://chronicle.com/article/Rise-in-Sticker-Price-at/129532

Tapscott, D. (1998). *Growing up digital: The rise of the Net Generation*. New York, NY: McGraw-Hill.

Van Der Werf, M. & Sabatier, G. (2009). *The college of 2020: Students*. Retrieved from http://www.collegeof2020-digital.com/collegeof2020/students

Western Interstate Commission for Higher Education. (2008). *Knocking at the college door: Projects of high school graduates by state and race/ethnicity, 1992-2022*. Retrieved from http://www.wiche.edu/info/publications/knocking_complete_book.pdf