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Prepping for Cloud – A New Look at an Old Alliance

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Abstract

Cloud Computing is taking off and a study by Sand Hill Group estimates hundreds of thousands of new jobs in the U.S. will be created that support cloud computing technologies. An IDC Whitepaper states that IT departments must develop these new skills now that can allow them to scale at the speed of business while maintaining an infrastructure and architecture that is predictable, repeatable, and reliable. What is also needed is having the appropriate training and education that will enable IT departments to be more agile and more prepared to respond to business needs. Many corporate IT departments look to colleges and universities as part of the solution. Are students being prepared for these new roles? Findings from research show that data storage, cloud technologies and Big Data should be taught, but there are prohibiting factors for including these topics in a curriculum. The EMC Academic Alliance program was started in 2006 with the goal of partnering with universities to teach "open" courses, meaning the courses are technology oriented and not vendor specific. Today, the program has expanded so universities can offer courses in Information Storage & Management, Cloud Infrastructure & Services, and Data Science & Big Data Analytics. East Carolina University is building a curriculum using the courses and preparing students for new jobs in these technologies.

Keywords: Cloud, Cloud Computing, Virtualization, Storage Technology, Storage Industry, Industry-Education Relationships, Storage Education, Storage Courses and Curriculum, Cloud Infrastructure and Services, Storage Technologies, Information Infrastructure Technologies, Information Storage, Information Technology Education, Computer Science Education, EMC Academic Alliance Program, EMC Proven Professional Program, Certification

1. INTRODUCTION

EMC is a global leader in enabling businesses and service providers to transform their operations and deliver information technology as a service (ITaaS). Fundamental to this transformation is cloud computing. Through innovative products and services, EMC accelerates the journey to cloud computing, helping IT departments to store, manage,

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protect and analyze their most valuable asset—information—in a more agile, trusted and cost-efficient way. EMC ranks 152 in the Fortune 500 and had reported revenues of $20 billion in 2011, the largest revenue year in EMC's 33-year history (EMC Corporation, 2012). EMC created the EMC Academic Alliance program to partner with colleges and universities to help build a highly skilled pool of future cloud/storage managers and professionals. This paper presents findings on preparing students for cloud technologies through the EMC Academic Alliance program.

2. RUSH TO CLOUD

The market for public cloud computing services is large and growing, even if the exact numbers vary widely. IDC estimates the market for public cloud products and services at $16B in 2010, growing to $56B by 2014. Gartner more optimistically estimates the cloud market at $150B by 2013 while Merrill Lynch estimates the market at $160B by 2011.

The conclusion is that market for public cloud infrastructure, platforms and applications is large and growing much more quickly than any other type of IT spending (Nichols, 2010 & Swoyer, 2010).

A deeper look into CIO spending priorities shown in Figure 1 reveals that both Public and Private Clouds are being created, and that Virtualization and Storage are essential for a successful Cloud infrastructure (Cuvix, 2012).

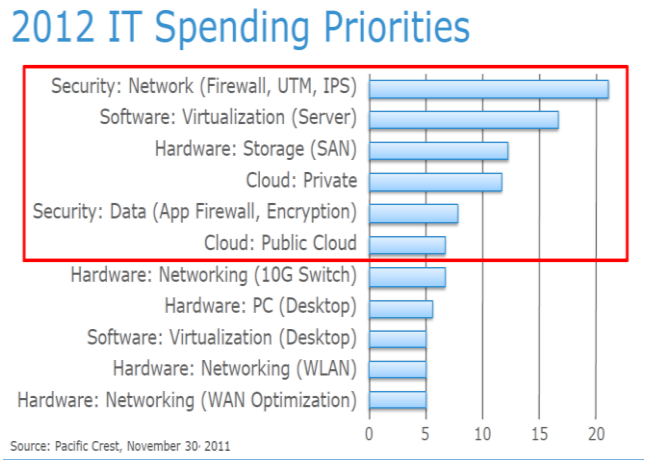

Figure 1 – CIO 2012 Spending Priorities

IT Pillars and benefits from cloud

Two integral components of the cloud infrastructure are the storage layer, which may often include storage arrays using SAN and NAS topologies, data replication techniques for business continuance and virtualization (both server and storage). Storage, once considered peripheral, has gained in strategic influence, truly becoming (in the words of author George Reese) "one of the seven pillars of Cloud computing (Reese, 2010). As cloud computing evolves, the seven layers form the foundation of a complete vendor cloud computing strategy. The vendors in cloud computing will not only develop strategies for all seven pillars, but also a strategy for integrating them into a comprehensive cloud offering (Reese, 2010). From an EMC perspective, two of the key drivers are Virtualization and Storage. CIO spending substantiates this too.

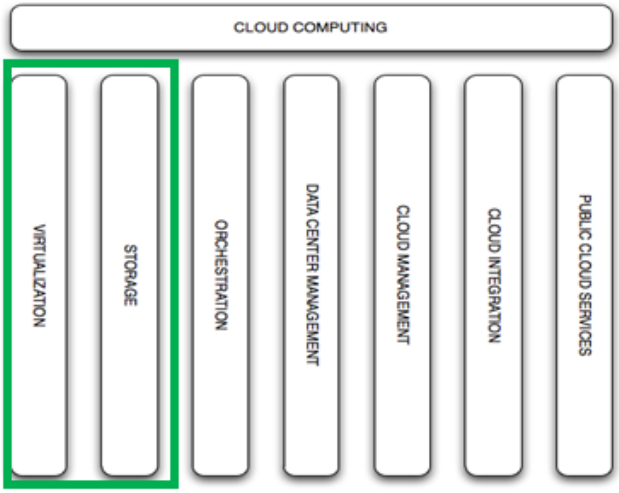

Figure 2 – Seven Pillars of Cloud

Cloud Computing has the potential to transform a large part of the IT industry, making software more attractive as a service and shaping the way IT hardware is designed and purchased (Armbrust et al., 2009). The benefits of cloud are clear –automated infrastructure, agility for application development, anytime/anywhere mobile access, and opportunities of big data. ITaaS is the framework for putting the IT pieces together (Elias & Mirchandani, 2012).

Concern for a lack of cloud and storage skills, and training

Morrill poses the question on the adoption of cloud computing in the enterprise, and the

influence that is having on the ability to hire employees who really understand cloud computing, virtualization, security, etc (Morrill, 2011). He further states that Cloud Computing did not originate in the college environment, there are few colleges that are taking cloud computing seriously enough to be developing or teaching courses in this subject and that educators are not prepared to teach cloud computing. In general, all but the most prestigious colleges are simply not able to teach this not so new but still cutting edge technology (Morrill, 2011). Shrivastava is very clear in his study that there is a shortage of skilled manpower in the industry. Capable, experienced, and skilled individuals are usually not available to be hired. Major factors for this skills shortage include lack of storage technology education in the marketplace and in academia (Shrivastava, 2011). Interestingly, college graduates do get hired - 29% of managers said they would look to hire a recent college graduate. In trying to train employees, companies employ many methods, but there is a need for wider and deeper training focusing on underlying technology concepts, planning, design, and management. This will enable cloud/storage professionals to independently and more efficiently design and deploy infrastructures that fully leverage the capabilities of all applicable technology segments (Shrivastava, 2011). For both hiring and training, certified individuals are viewed most favorably.

Where is Cloud being taught? San Jose State offers a graduate level course in their extended studies program (San Jose State University, 2012). Carnegie Mellon University in Qatar created an undergraduate course in Cloud Computing (Carnegie Mellon University in Qatar, 2012). In terms of research, little else could be found indicating that colleges and universities are independently able to teach these topics and that they are preparing students for the cloud technology careers of the future.

The colleges and universities participating in the EMC Academic Alliance program teach the Information Storage & Management course and can also include the courses in Cloud Infrastructure & Service and Data Science & Big Data Analytics. The authors researched if the topics of Information Storage and Cloud Infrastructure are being taught at colleges and universities and if there is any preclusion to teaching these topics.

3. RESEARCH METHOD

Quantitative research (questionnaire) was used to investigate how colleges and universities have implemented the alliance program and what factors were perceived as important in the process. Qualitative research was used to interview specific survey respondents. Orlikowsky and Baroudi (1991) state that a quantitative research methodology is appropriate where quantifiable measures of variables of interest are possible, where hypotheses can be formulated and tested, and inferences drawn from samples to populations(Orlikowski & Baroudi, 1991). Surveys represent one of the most common types of quantitative, social science research. In survey research, the researcher selects a sample of respondents from a population and administers a standardized questionnaire to them (Orlikowski & Baroudi, 1991). The methods researchers use when designing, conducting, analyzing, and reporting the results of surveys vary according to research goals, the population surveyed, and the type of survey that is used. Liebscher states that survey research does not belong to any one field and it can be employed by almost any discipline (Liebscher, 1998). According to Campbell and Katona, it is this capacity for wide application and broad coverage which gives the survey technique its great usefulness (Campbell, 1953).

Surveys tend to be weak on validity and strong on reliability. The artificiality of the survey format puts a strain on validity. Since people's real feelings are hard to grasp in terms of such dichotomies as "agree/disagree," "support/oppose," "like/dislike," etc., these are only approximate indicators of what we have in mind when we create the questions. Reliability, on the other hand, is a clearer matter. Survey research presents all subjects with a standardized stimulus, and so goes a long way toward eliminating unreliability in the researcher's observations. Careful wording, format, content, etc. can reduce significantly the subject's own unreliability (Howell et al, 2008).

4. FINDINGS

The authors wanted to determine if colleges and universities are teaching storage and cloud technologies in degree programs. If the topics are being taught, are the course offered as elective or as a core course? Additionally, the authors wanted to know what were the

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obstacles and objections to teaching storage or cloud. Faculty were asked to complete a survey. They were also offered the opportunity to provide opinion in the form of comments as to what they felt were the key reasons to teach, or not to teach courses on storage and/or cloud. The results were examined and the findings presented in the next section of this paper.

The authors recognize there is bias from faculty participating in the EMC Academic Alliance program. This may affect the validity of the research. The authors did include other faculty in the survey that are not part of the EMC Academic Alliance program. Faculty responding to this survey, regardless of their connection to EMC, resoundingly supported teaching storage and cloud technologies. This was expected and confirms the reliability of the data. The surveys were collected from the East Coast of the United States and all of Canada as the authors wanted to test the attitudes in this geography only. The authors recognize that global coverage would provide more information from a larger audience and provide the opportunity for greater differences of opinion. Future research, if conducted, will include participants from other parts of the world.

The authors used an online survey site (SurveyMonkey.com) as the data repository for responses. An email was sent to 1,411 faculty members inviting them to participate in the survey. There were 32 responses (2.2%) from faculty and reasons for the low response rate could include; timing (the survey was sent in May 2012, the busiest time of the year for a U.S. faculty member), topic not essential, and possibly one of the authors being seen as non-academic. In conducting the research, the authors wanted to find out if Information Storage and Cloud Infrastructures should be taught in IT/CS curriculum, if faculty were teaching these topics and what would preclude a faculty member from teaching these topics. As shown in Table 1, the majority of faculty feel that Storage and Cloud should be taught as part of an IT or CS curriculum.

Table 1 – Teaching Data Storage and Cloud

	Information Storage		Cloud Infrastructure	
Should these topics be taught?	%	Number of responses	%	Number of responses
Yes	93.8	30	100	30
No	6.3	2	0	0

Faculty felt that Information Storage should be a Core course offering while Cloud Infrastructure should be elective based. While there is strong sentiment to include these topics as part of a curriculum, the adoption and implementation for teaching these topics is not as strong. Refer to Table 2.

Table 2 – Teaching Information Storage and Cloud Infrastructure

	Information Storage		Cloud Infrastructure	
Are you teaching these topics?	%	Number of responses	%	Number of responses
Yes	46.9	15	50	16
No	53.1	17	50	16

Furthermore, when asked what precluded faculty from teaching these topics, the most often cited reasons were lack of knowledge, lack of course materials and a lack of time which meant the curriculum was already full. Refer to Table 3.

Table 3 – Reasons for Not Teaching

	Information Storage		Cloud Infrastructure	
What precludes you from teaching?	%	Number of responses	%	Number of responses
Not Enough Knowledge	45.2	14	54.8	17
Lack of Materials	38.7	12	50	15
No Room/Time	41.9	13	45.2	14

Faculty can resolve the issues of gaining knowledge and course materials by participating in the EMC Academic Alliance program. Faculty were asked if Academic Alliances strengthen or weaken IT/CS programs and overwhelmingly the response showed that faculty understand that vendors can fill voids where needed. Refer to Table 4.

Table 4 – Benefits of Academic Alliance Programs

Benefits of Academic Alliance Programs

Strengthen	93.1% based on 27 responses
Weaken	6.9% based on 2 responses

Faculty want to teach the topics of Information Storage and Cloud Infrastructure. Through the EMC Academic Alliance Program, faculty can gain the knowledge, get access to course materials and prepare students.

5. EMC ACADEMIC ALLIANCE PROGRAM

EMC Corporation created the EMC Academic Alliance program in 2006 to partner with colleges and universities to provide technical courses to teach students about storage technologies. In an earlier paper, Van Sickle et al. profiled the EMC Academic Alliance program citing the reasons for creating the program and profiling the alliance in use at Penn State University, Ball State University, North Carolina A&T, and the University of Massachusetts at Dartmouth. Courses are taught by faculty. Several colleges are using the course to teach students about the design of storage technologies and the "big picture" of an information infrastructure. The course is "open" and focused on storage technologies, not products. EMC also provides knowledge transfer to faculty. There is no cost to join and no cost to obtain the courses (Van Sickle et al., 2007).

Today, the program has over 800 institutions globally participating and over 50,000 students have completed the Information Storage & Management course. The Information Storage & Management course is taught as an upper level elective and in some institutions it is a core course requirement for a degree. The Information Storage & Management course provides instruction in storage arrays (monolithic, modular) storage network topologies including SAN, NAS, DAS, storage replication processes for both local and remote replication, virtualization (both server and storage) introduction to Cloud, IT as a Service, and storage management.

The EMC Academic Alliance program has expanded. Courses are now also offered for Cloud Infrastructure & Services and Data Science & Big Data Analytics. An IT/CS department could create a new degree program offering for Cloud Technologies with these courses. The Cloud Infrastructure & Services course is focused on virtualization and cloud infrastructure technology concepts and principles applicable to any vendor environment. Topic covered include; business drivers and characteristics of cloud, Cloud deployment, service models, benefits, and challenges, virtualized server, storage, network, desktop, and application, business continuity in a virtualized environment, Cloud infrastructure, services creation and management, Cloud security concerns, solutions, and best practices, and best practices for migration to the Cloud.

The Data Science and Big Data Analytics course will teach students to reframe a business challenge as an analytics challenge, deploy a structured lifecycle approach to data analytics problems, apply appropriate analytic techniques and tools to analyze big data, and provide a compelling story with the data to drive business action. Students will use open source tools such as R, Hadoop, and Postgres.

EMC has taken the lead and successfully introduced storage technology and cloud curriculums (and certification) in hundreds of universities as well as in the open market via public classes. However, a great deal more needs to be done to solve this industry-wide bottleneck into lucrative employment opportunities for aspiring professionals. EMC continues to expand the program and will add more colleges and universities to the program.

One of the many IT/CS programs that participate in the EMC Academic Alliance Program is East Carolina University. ECU is using courses offered by EMC to prepare students for jobs in Cloud and Information Storage.

6. EAST CAROLINA UNIVERSTIY INTEGRATES CLOUD TECHNOLOGY COURSES

At East Carolina University (ECU), the Department of Technology Systems offers the undergraduate degree Information and Computer Technology (ICT) program and Industrial Technology program (concentration in ICT). ICT is responsible for preparing graduates for advanced academic studies, as well as employment in traditional areas of IT such as computer networking, information security, IT support, and Systems Administration. ECU is a participating member of the EMC Academic Alliance and uses the Information Storage & Management course as an elective offering in the ICT program. The course has been taught 3

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times with a total of 47 students participating. The course is taught by ECU faculty and covers important aspects of Storage Technologies: SAN, NAS, replication, information security, information management, and virtualization.

As other areas of IT have emerged, ECU student employment opportunities have opened up in areas that include data center management, virtualization and storage administration within financial institutions, large health care organizations, and contractor support service centers.

This section will cover how the ICT program evolved to include new education and career opportunities for our students and expanding the use of the EMC Academic Alliance program.

ECU started to experiment with virtual labs in some IT courses in 2006 (Li, Toderick & Lunsford, 2009). In the summer of 2009, representatives from EMC Academic Alliance (EAA) extended an invitation to the ECU ICT faculty to attend a week-long Faculty Readiness Seminar on Information & Storage Management (ISM) at their North Carolina facility. The seminar was extremely well organized and professional, and resulted in the two faculty achieving EMC Information Storage Associate Professional certification (EMCISA). EAA provided the course content, and the ISM course was initially offered to 6 ICT seniors during Spring semester, 2010. EAA extended exceptional support that continues to this day. Upon completion of the course, 3 of the 6 students passed the EMC certification. All student feedback indicated a high degree of satisfaction with the course material and subject. In 2012, EAA teamed with Network Development Group (NDG) to enhance the curriculum with approximately 10 ISM labs using NetLab+ (Network Development Group, 2012).

Also during the summer, 2009, ECU joined the VMWare IT Academy. A course using Academy curriculum in Virtualization Infrastructure Technologies was offered during the Spring semester, 2010. The course examines current virtualization technologies and infrastructure management techniques. 23 hands-on labs are performed by students using local hardware and Virtual Computing Lab (Li, Toderick & Noles, 2010).

In Spring semester, 2012, EMC released courses on Cloud Infrastructure & Services (CIS), Backup and Recovery Systems & Architecture and Data Science & Big Data Analytics. There were sufficient resources to offer CIS to ICT students in 2012, and student surveys will be used to evaluate the course and provide feedback to EAA. Backup and Recovery Systems & Architecture and Data Science & Big Data Analytics are being evaluated for possible adoption in later semesters. ECU had 24 students enrolled in the inaugural delivery of the CIS course.

An anonymous, quantitative questionnaire was given to approximately 80 students enrolled in the courses offered this summer. 36 responses were received. Students who were enrolled in multiple courses were asked to respond only once. While the course prerequisite excluded freshmen, only juniors and seniors responded. Table 5 shows the student enrollment and delivery method over the past two years, by course.

Table 5- Student Enrollment by Year

Semester / Year	**Course**	**Student Enrollment**	**Delivery Method**
Spring 2010	*ICTN4505 - ISM	6	Online
	*ICTN4505 - VirtTech	20	Online
Summer 2011	ICTN4700-VirtTech	43	Online
	ICTN4750-ISM	20	Online
Summer 2012	*ICTN4406 -CIS	24	Online
	ICTN4700-VirtTech	41	Online
	ICTN4750-ISM	20	Online
*- Generic course designation.			

Table 6 measures how students gauged their knowledge of storage, virtualization, and cloud technologies prior to the beginning of the courses.

Table 6 – Degree of Knowledge

	Degree of Knowledge			
Subject	Great Amount	Some	Little	None
Storage Technologies	13.9% (5)	72.2% (26)	13.9% (5)	0
Virtualization Technologies	25% (9)	52.8% (19)	22.2% (8)	0

Cloud Technologies	2.8% (1)	50.0% (18)	47.2% (17)	0

These courses have been offered as approved electives for ICT. The popularity of these electives speaks to course quality and employment opportunities for ICT graduates.

7. CONCLUSION

CIO's are spending to create Private Cloud Infrastructures to meet their companies IT and business needs. Integral components of the cloud infrastructure are the storage layer and virtualization. Storage, once considered peripheral, has gained in strategic influence, truly becoming of the seven pillars of Cloud computing" (Reese, 2010). Faculty in IT/CS programs recognize the transformation occurring in IT and the need to teach Information Storage and Cloud Infrastructure. From the research conducted, faculty believes that these topics should be taught. Students recognize the need to learn these topics and do actively enroll in these courses as evidenced by the ECU survey. However, these topics are not being taught universally. There is a lack of knowledge for teaching these topics as well as a lack of course materials. Joining the EMC Academic Alliance program is an optimal solution because it provides faculty with the knowledge and course materials at no cost to teach these important topics as part of an IT/CS curriculum. Leading programs such as East Carolina University have partnered with EMC to utilize these course offerings to build IT programs that will prepare students for jobs in this new Cloud environment.

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