

Security: A Necessary Piece of the Collaboration Puzzle

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Abstract

Educational Institutions have always been known to be the heart of complex computing systems in any region they exist especially in Africa. The existence of high end computing power often connected to the Internet and to research network grids make educational institutions soft targets for attackers. Attackers of such networks are normally either looking to exploit the large computing resources available for use in secondary attacks or to steal Intellectual Property (IP) from the research networks that institutions are normally part of.

Educational Institutions also store a lot of information about their current students and staff population as well as alumni ranging from personal to financial information. Unauthorized access to such information violates statutory requirement of the law and could grossly tarnish the institutions reputation not to mention cost the institution a lot of money during post-incident activities.

As collaborative research efforts start to take shape on the African continent, more and more institutions will start to put their information security guard down in order to allow seamless network access between collaborative research entities. In such environments is important for institutions to have good security practices as an attack on one institution could easily be propagated all over the research network by abusing the trust that exists between these computer networks.

This paper presents findings of a three phase study that was carried out among institutions in the Research and Education Network of Uganda (RENU) in 2011 to investigate the information security practices that these institutions had in place to counter information security attacks. Phase One of the study involved the use of a customised quantitative questionnaire tool. The tool originally developed by information security Governance task-force of EDUCAUSE was customised for use in Uganda. Phase Two involved the use of a qualitative interview guide in sessions between the investigator and respondents and in phase three, the data obtained was taken through analysis.

The study investigates the performance of these institutions against five core areas; Institution Profiling, Infrastructure, Policy, Human Resource and Awareness, Policy and Self Assessment.

Keywords: *RENU, Security, Educause, NREN, UbuntuNet*

1. Introduction

The use of computer systems has greatly evolved over the years since the first computer was invented. Their use in both homes and industry has varied from simple computational use to complex nuclear systems and weaponry control. The cost and portability of computer hardware has greatly reduced such that at the moment almost every household and business in the developed world can afford to own a Personal Computer (PC). The data that is stored on computers has also enormously increased and this is attributed to the evolving and reduction in costs of storage medium. It is increasingly cheaper to store and retrieve digital information on computers than on the traditional paper file system.

The number of new nodes that connect to the Internet has been seen to increase over the years. The latest technology entrant cloud computing and devices built to access cloud services has only made the traditional paper file system even more redundant. Educational Institutions have always been known to be the heart of complex computing systems in any region they exist especially in Africa. The existence of high end computing power often connected to the Internet and to research network grids make educational institutions soft targets for attackers. Attackers of such networks are normally either looking to exploit the large computing resources available for use in secondary attacks or to steal Intellectual Property (IP) from the research networks.

Universities also store a lot of information about their current students and staff population as well as the alumni. Unauthorized access to such information violates statutory requirement of the law and cost the institution a lot of money in remediation and law suits as well as ongoing reputation damage.

Over the last two years, many of the countries in Africa accessed high-speed broadband Internet connectivity by undersea cable. This exposed many insecure systems to the hostile Internet environment and as a result a number of websites have come under attack by different hacking groups all over the world. Some sites that have come under attack include government websites, business and university websites. In all attacks it still remains not clear the intention of the attacker and or what information has been lost or exposed to unprivileged individuals as a result.

Carefully designed and implemented information security practices can be used to prevent, identify and mitigate some, if not all of the information security attacks that are targeted towards educational institutions.

The rest of the paper presents results collected during a two phase study carried out among members of the Research and Education Network of Uganda - RENU

2. Methodology

The researcher approached all nine members of the RENU however only six members were willing to participate in this study.

The study was carried out in two phases using a mixed method research; the first phase involved the use of a questionnaire while the second phase involved the use of interview question guide used in sessions between respondents and the investigator. At this stage a recorder was used to record the responses of the respondent.

2.1 Phase One

In this phase of the study questionnaires were sent out to the key individuals that had been identified by the Head of Department of ICT in the participating institutions.

The targeted key respondent was the ICT director or any member of the ICT team as nominated by the Head of Department. The questionnaire was sub-divided to include the following sections; Institutional profiling, Infrastructure, Human Resource and Awareness, Policy, and Self-assessment. Each section was structured to answer a specific research question that would help the researcher understand the Information Security practices that the institution has already put in place. The following are the research questions;

- What is the institutions reliance on ICT systems and services?
- What IT Security infrastructure has been deployed at the institution?
- What is the staff composition of the ICT department?
- What policies has the institution implemented to guide students and staff on the proper use of ICT resources?
- How does the respondent assess the institutions' readiness to fight Information Security challenges?

2.2 Phase Two

In this phase of the study, an interview guide was used. The intention of the guide was to obtain more qualitative information on some of the questions that were posed on the questionnaire.

The guide was sent to the respondent in advance of the interview sessions so that the respondent could get a good grasp of the questions that were to be asked. All the interviews took place at the participating institutions premises.

3. Results

3.1 Institutional Profiling

From the results obtained most of the institutions had more than 400 staff on board and 1000 or more students. Also more than half the institutions spent UGX100 million (approx. \$40,000) or more in ICT budget items most of the institutions indicated that they spent anywhere between 10% and 20% of their ICT budgets on information security related activities. All institutions indicated that they had 3 or more information systems used within the university and that an Internet outage would greatly affect the course of business in the institution.

All institutions indicated that they offer their staff and students unencrypted means to access information systems hosted on-site. When institutions were asked the number of devices on their

networks, none of the institutions considered staff and students' personal devices as access devices on their networks.

3.2 3.2 Infrastructure: Software and Hardware

All institutions indicated that they had systems and services that they hosted and where accessible to their users while on and off campus. Much as institutions indicated the presence of servers in their infrastructure, only a few indicated that they constantly monitored and audited their access. 2/3 institutions indicated that they implemented security layers to protect their systems although only 1/6 indicated that they regularly check their systems against known Vulnerabilities.

1/3 indicated that they have fully implemented logging for security-related activities such as hardware configuration changes, software configuration changes, access attempts and privilege assignments, 2/3 have partially implemented or not implemented this at all.

2/3 indicated that they have not implemented a means of preventing and detection rogue access to their wireless networks while 1/6 indicated that they are close to completion or fully implemented this strategy.

1/2 indicated that they have fully implemented a mechanisms to manage digital identities through out their life cycle from creation to deletion while 1/3 have partially implemented and 1/6 have not implemented this at all.

5/6 indicated that their systems use automatic password changes while 1/6 indicated that this not implemented at all. Also 1/3 indicated that they have fully implemented system session time out and user management practices while 1/6 have not implemented this at all.

1/3 indicated that they have not implemented the use of a single database for authentication across all systems while 1/6 have fully implemented this.

3.3 Human Resource and Awareness

Human resource and awareness was assessed using the staff composition for the ICT department and the ICT security awareness programs that an institutions has in place.

2/3 indicated that they have an organised department whose role is to oversee the use of information technology resources on campus while 1/3 have partially implemented this or are close to completion.

2/3 institutions had ICT Security function and staff dedicated to that function although none of the staff had industry standard IT security certificates.

3.4 Policy

Policy was assessed using the existing policies that have been implemented by the ICT department and the measures taken to enforce policies and compliance.

It was found that while most institutions had authored their information security policies, only one had made the effort to make it available to their users. For a Policy to be effective it should be published and also made available to staff.

2/3 indicated that their policies do not classify the data that is stored on their servers and computers while 1/3 indicated that they are close to completion or have fully implemented this. 1/2 indicated that their policies do not specify what kind of information about the institution can be taken home while the other half indicated that they are close to completion or have fully implemented this. On taking institutional devices home, 2/3 indicated that they do not have policies that specify who is allowed to take institutional devices off the institutions premises while 1/3 indicated that they have this fully implemented. 2/3 indicated that they have not implemented or have partially implemented the strategy to specify how inter-department and office communication should be done while 1/3 indicated that they have fully implemented this.

3.5 Self-Assessment

Self-Assessment was assessed using common keywords in information security to represent most common attacks and technologies. The respondents were asked to indicate their level of understanding of each of the terms. The respondents were also asked to rate the information security readiness of their institutions.

The respondents were asked what their knowledge was of the following terms. These included Firewall, Virtual Private Network, Botnet, Intrusion Detection system, Spyware, Patching, Rootkit, VLAN, 0-day, Anti Virus, Virus, Malware, DoS/DDoS, SQL Injection, Cross Site Scripting, Access lists and Phishing.

All the respondents indicated that they fully understood the terms firewalls, spy-ware, VLAN, Anti Virus, Virus, and. It was however, concerning that none of the respondents knew about cross site scripting, Virtual Private Network, Intrusion Detection system, Patching, Rootkit, Malware, DoS/DDoS, Access lists, Phishing and very few knew about SQL injection, 0-day.

4. Conclusion

Although the initial study was to be conducted on all nine members of the Research and Education Network of Uganda, only six member institutions responded positively to take part in the study. This being more than half of the existing members, the researcher felt that the results obtained provide an overall picture of what is happening in the NREN and could be used to draw conclusions and offer recommendations to the NREN.

The following section offers the conclusions that have been drawn from the data collected. The conclusions are presented based on the research questions that were used during data collection.

Research Question 1: “What is the institutions reliance on ICT systems and services?”

The study found that the participating institutions were heavily reliant on ICT systems and services. This was exhibited by the fact that all institutions had already implemented more than three information systems of those that were asked during the study including, financial management systems, email systems and website management system. Other indicators of heavy reliance on ICT systems included; the numbers of computing facilities available to staff and student use; availability of remote access systems such as wireless systems; the perceived severity of system failure and loss of Internet connectivity to the institution to which more than half of the institutions indicated that it would be critical to the proper functioning of the institution.

Another indicator, percentage of ICT budget spent on security although had been included on the questionnaire was not considered because there was a difference in how institutions draw funds to spend on ICT security needs. Some of the institutions spend on security related infrastructure from the central budget of the university while other institutions spend from the ICT department budget. In such cases it is difficult to clearly articulate the exact institutions spending on security. Ignoring which budget is drawn from for security related expenditure; one key factor to note is that all institutions spend on information security infrastructure with the exception of one institution that deliberately did not spend on security solutions due to the fact that they use Open Source operating systems which in their view are immune to viruses. Nonetheless, the heavy reliance on Information Systems in the universities that participated in the study is a strong indicator that these institutions should have a vested interest in making sure their systems are protected from Information Security incidences.

Research Question 2: “What IT Security infrastructure has been deployed at the institution?”
Based on findings of this study, institutions have already acquired and implemented some of the cutting edge equipment and systems such as high-end border routers and latest operating systems such as Linux and Microsoft Windows 7 and Windows Server 2008. Also some of the institutions had already implemented more than one security layer such as gateway firewalls, application firewalls and anti-virus software on client machines.
All institutions were found to have already implemented a backup strategy although none had tested their strategy to make sure it is effective.

As much as newer security technologies were found to be implemented at all institutions, the absence of guiding information security policies at the institutions meant that all these technologies were being implemented subconsciously and in so doing partially improving the overall information security posture. Because of the fast evolving global Information Security community, many makers of hardware and systems have hardened them for hostile deployments such that by default some systems with no intervention of on-site security administrators are secure. A good example of such systems is Windows 7 and Linux operating systems that have been designed by their respective vendors to be secure by default. This hardened by default approach has unfortunately resulted in the fact that none of the institutions monitored these systems for abuse. Lack of activity and log monitoring in many instances results in missing of early warning signs.

Research Question 3: “What is the staff composition of the ICT department?”
According to the data collected, all institutions have an established ICT department that oversees the distribution of ICT services in the institutions. More than half the institutions have ICT staff whose role is security of institutions information assets. It was found that all security roles in the organization are merged with other roles and also none of the staff is equipped with industry standard Security qualifications such as Certified Information Systems Security Professional (CISSP), Certified Ethical Hacker (CEH), Certified Information Systems Auditor (CISA). It was also found that none of the institutions carry out background checks before they hire ICT staff.

In (Robert, 2003) the author mentions that universities are normally constrained to employ full time staff to run the security function of the ICT department. This was evident with the fact that

no institution had a fully time Information Security employee on the ICT team. Not having a full time ICT employee hinders the security function since the employee who is assigned Information Security duties will have to juggle them with his other duties. With this revelation, it was not surprise that no institution had an ongoing information security program. According to (Lowendahl, 2006) the most-important step that an institution can take to strengthen its security efforts is the appointment of a Chief Information Security Officer (CISO). The document further stresses that the institution should not stop at designating a CISO but should also give them the necessary mandate to drive the information security program.

Research Question 4: “What policies has the institution implemented to guide students and staff on the proper use of ICT resources?”

Based on findings from the study, all institutions have a written ICT policy. The challenge was with the low number of institutions that had published their policies. It was also found that institutions do not carry out policy sensitization and awareness campaigns for their staff and students. The composition of the policies was found to be lacking with none of the institutions classifying how information should be handled within the institution. Also none of the institutions include security related clauses in their contracts with third-party service provides. A number of studies (Johnson, 2009) stresses that policy should be the starting point of any information security program in any organization. In this case the absence of published information security policies not only means absence of Information Security programs at these institutions but also invalidate all attempts by institutions to implement Information security practices. Nonetheless, even in the absence of a guiding policy, this study considered the various efforts made by the institutions to implement standalone Information Security practices as valid and commendable.

Research Question 5: “How does the respondent assess the institutions’ readiness to fight Information Security challenges?”

Respondents assessed that their institutions were ready to fight information security challenges. Most of the respondents felt that their institutions were 80 percent ready to fight information security challenges. Also from the results, the respondents had primary knowledge of information security and this could be seen from the security terms that they were able to identify. Respondents were able to identify and exhibit better understanding of terms such as anti-virus, firewall, spyware, virus etc. but were not able to identify more advanced terms like cross-site scripting and SQL injection. Despite the fact that respondents felt that their institutions where ready to fight information security challenges, other key indicators especially lack of policy suggested otherwise as the security program of any organization can only be guided by its policy.

5. Summary

The study on Information Security practices put in place by RENU member institutions to protect institution systems and data from security incidences discovered that institutions have not implemented appropriate practices and procedures to protect these systems and data. This conclusion is supported by the fact that none of the institutions’ could defend any of its security practices with Policy.

Policy is supposed to be the guiding tool that is used during the implementation of these procedures and practices. For example, all institutions were found to have cutting edge equipment and software systems implemented at their institutions. However, even with such advantages, these systems were not configured appropriately and or monitored for Information Security incidences hence not performing optimally.

6. Future Research

The area of information security is still in its infancy in Uganda even within industry let alone educational institutions. However with the increase use of computing systems for both storage, access to information and research collaboration, it becomes a necessity for administrators of institutions to take information security seriously and implement Information Security controls to protect their systems and data.

Research on Information Security areas within National Research and Education Networks especially on the African continent are still not available. Future studies in this area could be beneficial for comparison purposes with results from other NRENs especially within UbuntuNet alliance, which brings together NRENs in East and Southern Africa.

In this study, the survey instrument that was used was customized from another tool that was originally developed by EDUCAUSE for the assessment of universities in the United States of America. Future studies could evaluate the possibility of designing a tool that could be used to evaluate security practices of NRENs on the African continent.

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Biography

Alex Kisakye holds a Masters Degree in Computer Science with specialisation in Information Security earned at Rhodes University and a Bachelors Degree in Information Technology earned at Uganda Christian University. Alex has over 8 years experience in managing large ICT environments within Corporate and educational institutions. His main interests are Information Security, Policy and working with organisations to achieve efficient ICT functions by using scalable solutions many of these based on open source solutions.