# Wasted Resources: A Human Performance Analysis of the Printing Process in the General Computer Lab at the Watson School of Education

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## Executive Summary

The Watson School of Education (WSE) houses a general computer lab for students with 30 computers loaded with Microsoft Office, as well as unlimited access to both the internet and a printer. Over the past three years the amount of printer toner, paper, and maintenance costs has greatly increased. It was also observed that a large quantity of print-offs were being wasted. In response to this growing problem the director of information technology instituted a policy limiting the number of print-offs per day to 10, per student to be enforced by the graduate assistant on duty at the time. Even after this attempted intervention print costs continue to increase and there is no sign that print-offs have become sustainable. This report suggests the implementation of an automated printing system. Each student would receive a certain number of print-outs per semester free of charge and would be charged a nominal fee per print-out thereafter. This report also recommends the implementation of formal communication system between the graduate students and the director of information technology.

## Perception Analysis

### Roles

Individuals involved in this process fit into three categories: sponsors, champions, and stakeholders. In this performance improvement initiative the sponsor is the dean of the school and indirectly the taxpayers of North Carolina. The dean provides the money to purchase the toner, paper, and maintenance contracts. Without the dean the lab would not be in existence.

The champion in this scenario is the director of information technology for the school. This person feels that far too much paper and toner is going to waste. They point to the large amount of paper found in the recycling bin as evidence of this waste. The director, however, is confident that a consensus can be reached which will provide the students with the ability to print off school related material in a sustainable manner.

The stakeholders in this initiative include students of the school who utilize the lab, graduate assistants who supervise the lab, as well as the businesses who supply the paper, toner, and printer maintenance.

**Perceptions**

Many of the students who use the lab feel like they are doing nothing wrong. They feel like their technology fees pay for the computer lab and so they should be able to print off as many pages as they like. Even when a graduate assistant confronts these students, they often either claim they did not know about the limit (even though it is clearly stated on the walls and the printer) or that everyone else is doing it so they thought it was ok. Other students claim to witness colleagues printing of printing off Power Point notes for their entire class, looking at the 20 copies once, finding a mistake and throwing all of the freshly printed paper into the recycling bin.

The director of technology (DOT) has heard the student's claim that they should be able to print as much as they like since they pay technology fees and says the technology fee does not provide the money to run the labs. In fact, the money is assigned to the lab at the discretion of the dean. In the past the DOT was told by the dean to sharply reduce the amount of paper, and toner consumption as they have noticed the these amounts steadily rising over the past three years. In response the DOT implemented a ten page limit, per student, per day (supervised by the graduate assistants) but has continued to see an unacceptable use of paper.

The graduate assistants say they limit the number of pages as much as they can but because their computer work station is located across the room from the printer and they do not have control of the print queue, the consumption is very difficult to control. This is the case when they are in the room. They are often called to other parts of the building to make minor technology-related repairs or move computers.

**Information Needed**

More information needs to be gathered from students who use the lab, the DOT, and the graduate assistants who supervise the computer lab. Data covering the amount of paper wasted could also be gathered through student observation and the amount of paper found in the recycling bin. Numbers showing the amount of paper and toner being consumed can be obtained from purchase orders.

### Cost of Performance Issue

Many students feel the technology fee covers the cost of printing and so if the administration needs to recoup this money they will simply raise the technology fee. According to estimates made by the DOT the WSE spends close to $1000 a semester on paper and $500 a semester on toner cartridges. The DOT says this number has continued to rise over the past three years and if it does not get under control they will have to require students to bring their own paper to print.

## Performance Analysis

### Organizational and Environmental Issues

*Current Performance*

The Watson School of Education (WSE) is one of five academic divisions which together comprise the University of North Carolina at Wilmington (UNCW). UNCW is a regional university located in southeastern North Carolina with an approximate student body size of 12,000. WSE is North Carolina's third leading producer of teachers and enrolls approximately 1,200 undergraduate and 300 graduate students. WSE offers degrees in elementary education, middle grades education, secondary education, special education, instructional technology, school administration, and curriculum and instruction.

The Watson School of Education is governed by a mission statement, the need for continued accreditation from the National Council for Accreditation of Teacher Education, and a conceptual framework. All of these governances require that WSE produce teachers who are technically competent and who are able to successfully integrate technology into their curriculum. As part of the WSE curriculum all undergraduate students are required to take Education (EDN) 303, a course which is titled instructional technology. Within this class students learn the Microsoft Office Suite and how to use technology to enhance their teaching. Each semester WSE offers at least eight EDN 303 classes, on the Wilmington campus. In addition to the students in EDN 303, WSE offers over 160 additional classes which often require computer access to send

e-mail, participate in online discussions, and/or print off papers. It is to meet the needs of these students that the computer lab in room 111 was created and currently maintained.

WSE is led by an administrative team consisting of a dean, an associate dean for academic programs, an associate dean for outreach alliances, and four department heads. The four departments which comprise WSE are: the Department of Early Childhood and Special Education, the Department of Elementary, Middle and Literacy Education, the Department of Instructional Technology, Foundations, and Secondary Education, and the Department of Educational Leadership. The school has forty-seven full time faculty members distributed among the four departments.

There are three computer labs located in the Education building: a general computer lab open to any student of the university, the MIT computer lab reserved for classes and students in the Masters of Science in Instructional Technology program, and a third lab reserved for undergraduate level instructional technology classes. All of the labs in the education building are funded by the WSE without the assistance of student technology fees. The team charged with managing the lab consists of a director of information technology, a technology lab assistant, and three graduate assistants (see Appendix A for organizational chart). The director of information technology and technology lab assistant are both full time positions who have many different responsibilities in addition to managing the computer labs. The graduate assistants are graduate students working 20 hours a week and taking full class load. In addition to answering all computer related questions posed by students in the lab, and keeping the printer stocked with paper, the graduate assistants are often called away from the lab to troubleshoot instructional technology for faculty, complete video projects, and transport a cart filled with laptops to various classrooms.

*Optimal Performance*

The Watson School of Education has a clear vision and organizational chart. Employees are aware of their job responsibilities and know where to turn if they have a question. The school is funded through the UNC system, student tuition and fees, grants, and donor contributions. Both grants received and donations have continued to rise over the past three years. WSE has a sound financial future.

**Management Systems**

*Current Performance*

In February of 2005 WSE moved into its current building. It was previously located in a much smaller building named King Hall. In King Hall both the director of information technology and technology lab assistant's offices were located in the rear of the computer lab allowing both individuals to effectively supervise the lab and communicate regularly about any hardware or software issues in the lab. In the current education building, the director and lab assistant's offices are located on two different sides of the building on the third floor while the general computer lab is located on the first floor. This change in geography requires the director and lab assistant to rely much more on the graduate assistants' perception of lab needs. There is currently no policy in place which requires the graduate assistant to communicate directly with the director of information technology or lab assistant on a daily basis. Because of the location of their office, the graduate assistant must either go out of their way all the way up to the third floor or call them on the telephone. Since there are three graduate assistants working separate shifts at different times of the day, communication is difficult. There have been a number of occasions when work has been duplicated or not completed due to a lack of communication among the graduate assistants, the technology assistant, and/or the director of information technology.

Since moving into the new building the director of information technology noticed a sharp rise in the amount of printer toner paper being used in the general computer lab located in room 111. Upon further review he noticed that there was an abundance of paper in the recycling bin located next to the printer. It appeared that a number of students had printed out numerous documents they simply did not need and thrown the paper in the recycling bin. In response to this perceived need the director instituted a 10 page limit, per student, per day to be enforced by the graduate assistants on duty in the lab.

*Optimal Performance*

Ideally there would be a formal communication policy in place to facilitate communication. Possible solutions could include a list serve, a work report that would be filled out daily by each graduate assistant, restructuring of job responsibilities, and/or relocation of offices.

**Physical and Technical Systems**

*Current Performance*

Since moving into the new building in February of 2005, the Watson School of Education has purchased brand-new equipment. All computers are on a three year lifecycle meaning that after three years they are replaced. All classrooms contain a presentation podium with a desktop computer, document camera, DVD/VCR combo, ceiling mounted LCD projector, and amplified speakers. The general computer lab contains a presentation podium, thirty Dell computer workstations loaded with the Microsoft Office 2003 Suite, and an HP LaserJet printer with a 500 sheet capacity.

Students have access to the computer lab beginning at 8a.m. to at least 5p.m. (some weekdays 9p.m.) every weekday the school is open. The lab is open on Saturdays from 9a.m. to 1p.m. to accommodate students who need access on the weekends. In addition to the computers in the Watson School, all currently enrolled students also have access to four computer labs at various locations around campus. One lab located in the library is open until 12 midnight six days a week.

*Optimal Performance*

Since becoming technologically proficient is required of all students at WSE, it is imperative that students have access to computers and various other types of technology when needed. Computer lab hours should be posted. Computer labs should be accessible by all students no matter their work schedule.

**Human and Social Systems**

*Current Performance*

The Watson School of Education is different from other performance problems because the “workers” include both the employees of the school (administration, faculty, and staff) as well as the students who are currently enrolled. The administration, faculty,

and staff appear to be successfully working together when needed without incident. However the dynamic between the students and lab assistants and among the lab assistants appears to be strained. While the 10 page print limit policy is posted on the walls of the general computer lab as well as on the printer itself, students regularly print off more than 10 pages and the amount of waste found in the recycling bin remains constant. Print-offs found in the recycling bin often contains content irrelevant to school work (fantasy sports, Mapquest directions, consumer reports, mixed drink recipes, etc.).

As stated earlier graduate assistants have other job responsibilities outside the computer lab and consequently are not always there. Even if the graduate student is in the lab it is often difficult to tell if a student is printing off more than their 10 page limit due to the location of the printer in relation to the graduate student station (see Appendix B). The printer is located in the back the lab across from the door, while the graduate assistant is stationed in the front of the room. No system is currently in place which monitors the number of pages being printed from any given computer. If the computer lab is near capacity it makes it that much more difficult because many students are often printing at the same time.

If the graduate assistant is able to identify a student who is in violation of the stated policy they then must confront the student. The students are often confrontational and complain that they pay a technology fee which pays for printing (which is not the case), or that they only use the lab a few days a week so they should be able to print off more than 10 pages per visit. Next the lab assistants are instructed to take away the print-outs in question and tell the student they have used up their printing privileges for the day. Students often become disrespectful of graduate assistants at this point and often storm out of the lab. Unfortunately there is no system in effect which monitors the students who are violating the policy so a student could be caught by one graduate assistant and then simply wait until another graduate assistant is on duty and continue to print.

Another problem in the human and social systems occurs amongst the graduate students. While some graduate assistants do recognize the need for policing the number of print-outs others simply ignore it to avoid confrontation. This is difficult for the graduate assistant who is making an effort to conserve paper because the policy is not

being enforced lab-wide. This has caused some animosity among the graduate assistants and lowers the morale of the group as a whole.

*Optimal Performance*

Ideally there would be a system in place which would allow students to print-off all necessary school related documents and nothing more. A way to reduce the amount of paper being printed would require that students only print-off what is exactly necessary.

## Gap Analysis

| What is happening? | What should be happening? | Gap |
|---|---|---|
| Graduate assistants are not forwarding pertinent information regarding computer repair etc. to the director of information technology. | A formal communication policy should be in place which requires each graduate assistant to communicate any hardware, software or human resource problems before they leave their shift. | Lack of communication |
| Not all the graduate assistants enforce the 10-page limit policy which causes conflicts between other graduate assistants and students. | The 10-page print limit policy should be enforced at all times. | Lack of worker motivation |
| Education students who use the general computer lab often print off many more printouts then they need and in the process needlessly waste resources. | Students should only print-off the minimum of what is absolutely necessary. Students should not be printing off anything which is not school-related. | Flawed incentives |
| Students believe that a technology pays for their printing costs | Students should understand that all costs associated with the computer lab are paid for by the Watson School of Education with no assistance from their technology fees. | Lack of information |
| Because of the often confrontational relationship between students and graduate assistants, students are hesitant to solicit the graduate assistant's help with their class work. | Students and graduate assistants should have a collegial relationship that allows for a free flow of information. | Flawed environment |

This is the second time around for this problem. This same problem was identified in the past and a policy was implemented as an intervention. Unfortunately, the policy was not successful in solving the problem and now the problem must be revisited and more human resources expended to prevent further hemorrhaging of paper and toner resources.

The gaps in this performance problem include a flawed environment, lack of information, flawed incentives, lack of motivation, and a lack of communication. It appears that one performance problem (students wasting resources) is causing and/or compounding many of the other performance problems (flawed environment, lack of information, flawed incentives, lack of worker motivation).

Improving the communication structure of the lab would not only help to solve this performance problem but also any other problems whether they relate to hardware, software or human systems. Very few solutions can be solved without "buy in" from the top therefore any problems in the computer lab cannot be solved without direct communication with the director of technology and in turn the dean of the school.

**Data Collection**

Information was gathered primarily through interviews, observation, and the acquisition of related documents. Students were spoken with on an informal basis and asked a number of questions including:

- Do you print-off more than the 10-page limit per day?
- If so why?
- Do you feel comfortable asking the graduate assistants for help?
- If no, why not?
- Do you print things which do not relate to your school work?
- If so why?

Numerous questions were asked of the director of information technology including:

- Does a student technology fee help fund the general computer lab?
- Has wasted resources in the computer lab been a problem in the past?
- Why do you think this policy change has not been successful?
- Is there something you wanted to do before instead of the policy change but were not able to do for financial or other reasons?

Stakeholders in the form of graduate assistants were not spared the interview. Many questions were asked of them including:

- Do you enforce the 10-page limit policy?
- If not, why not?
- How is your relationship with the students who use the lab?
- Do you regularly communicate with the director of information technology?

Purchasing records were also obtained which showed an increase in the amount the amount of printer toner, paper, and repair costs over the past four semesters. It was recognized through observation that indeed a large amount of paper was being pitched into the recycling bin next to the printer. Upon review of the contents in the recycling bin, many print-outs had no relevance towards class work.

**Gaps and WSE Mission and Goals**

While having unlimited printing capabilities does not hinder the goal of the Watson School to produce technically competent teachers, it does affect the Watson School's ability to fund other projects. Because the cost of printing documents unrelated to school work is so great, other viable projects are not able to be funded.

**Costs**

At the current rate of paper and toner consumption the Watson School of Education will be spending more than $3,000 per semester. If each student only used their limit 10 print-offs per day, it would cost the Watson School a little more than $1,500 a semester. This is a conservative estimate because these numbers reflect the cost of paper purchased specifically for the lab. In reality the graduate assistants often take paper from the main office supply closet if they are in a hurry or unable to fine the technology lab assistant.

## Intervention Design

*Intervention One*

This intervention strategy suggests instituting a new printing system. This new system would track the number of print-outs each user made throughout the course of the semester. Each user would receive a set number of print-outs per semester. The user would be free to print whatever they would like but would be held responsible for any print outs over 100. Once the balance of print-outs had been exhausted the user would have the option of purchasing more print-outs at a reasonable cost.

*Phases of Intervention One*

1. Director of Technology researches vendors and associated costs, solicits bids
2. DOT selects vendor and sets roll out date to install new system
3. New system is rolled out; on-site training is offered to graduate students, DOT, and technology lab assistant on the use and maintenance of the system

*Intervention One Example*

Sarah enters the lab and sits down at one of the computers. She opens a word document off of her flash drive and goes to File-Print and is asked to name the document. Sarah then goes to the printer station where there is a computer monitor and ID card reader. She slides her college ID through the card reader. The reader accesses a database which keeps a balance of her printouts. If she has a remaining balance she is able to select her print job off of the screen and have it print. Upon printing her document that number of pages is debited off of Sarah's print account.

*Intervention Two*

In an attempt to resolve the lack of communication between the director of information technology and the graduate assistants, I recommend that a formal policy be implemented which will require graduate assistants to fill out an electronic questionnaire at the end of each shift. Questions will include:

- What time did you arrive?
- Approximately how many students utilized the lab today?
- Were there any confrontations with students that we should know about?

- What type of assistance did you provide to students?
- Are there any software or hardware problems?

*Intervention Three*

Another possible intervention involves changing the location of the printer from the back of the room to near the front of the room next to the graduate assistant's work station. This intervention would allow the printer to be more closely monitored by the graduate assistants as each time someone printed they would have to walk up to the front and pick up the print-offs. Graduate assistants would be able to cancel jobs if they noticed certain students printing off more than their limit.

These interventions would affect all four of the levels of performance in the following ways:

*Organizational System*

This intervention is costly because additional computer infrastructure expertise would be required. The Watson School would need to obtain assistance either from the information technology group on campus or a contractor. The dean would have to believe in the project enough to allocate the funds unless another funding source in the form of a grant could be secured.

*Management System*

The director of information technology would have to act as project manager and facilitate bids from various vendors capable of completing the work and would then supervise the installation process.

The electronic questionnaire would allow the director of technology to be more aware of the everyday events that occur in the lab therefore making him a better manager.

*Physical and Technical Systems*

Additions would have to be made to the existing technological infrastructure in the form of a new server, computer monitor, card reader, and database. Since the existing technology infrastructure is strong the additional hardware should not be a problem.

*Human and Social Systems*

The human and social system was the system with the most performance problems and therefore has the most to gain from this intervention strategy. One major performance gap involved the enforcement of the 10-page print limit. Some graduate assistants valiantly enforced this policy while others simply ignored it. This intervention proposal takes away the responsibility of enforcing the policy from the graduate assistants and places it on an objective electronic system. If implemented this new system would assure equal enforcement of the policy no matter what graduate assistant was working.

Students who use the lab to print off papers will also be better served with this new electronic system. Instead of having to wait in long lines or sift through piles of wasted paper they will know exactly when their papers will print. The student can send a number of documents to the printer over the course of an hour, get up slide their ID card and print off all of their documents at the same time.

Relationships between graduate assistants and students will also become more collaborative under this proposed intervention. Because they are not worried about getting in trouble for printing off too many pages, students will gladly approach graduate assistants for software assistance. A more collegial environment will prevail with the free-flow of information.

| | | | |
|---|---|---|---|
| | **Implement New Formal Communication Policy** | **Change location of the printer** | **Implement automated printing system** |

## Feasibility Analysis

| | R | W | RI | R | W | RI | R | W | RI |
|---|---|---|---|---|---|---|---|---|---|
| Cost effectiveness | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Staff support | 1 | 1 | 1 | 2 | 5 | 10 | 2 | 5 | 10 |
| Organizational change impact | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Barriers to implementation | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| # steps to implementation | 1 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 6 |
| Available resources | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Dependency on time/urgency | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| # functions affected | 2 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | 2 |
| # people affected | 5 | 1 | 5 | 5 | 1 | 5 | 5 | 1 | 5 |
| | | | | | | | | | |
| **Total** | | | **12** | | | **23** | | | **29** |
| | | | | | | | | | |

| **Legend** | | | |
|---|---|---|---|
| R = Risk | Highly desirable/low risk = 1 | Moderately desirable/moderate risk = 2 | Not desired/high risk = 3 |
| W = Risk Weight | High importance or value = 1 | Moderate importance or value = 5 | Low importance or value = 10 |
| RI = Risk Index | RI = R x W (1 = optimal) | | |

The implementation of a new formal communication policy is very low risk and cost and would have an immediate impact. The biggest challenge would involve creating the survey instrument. The Watson School already has a site license for the software and plenty of server space so it would only be a matter of requesting one of the graduate assistants to create the survey.

*Location of the Printer*

Changing the location of the printer would also be very low risk and low cost. If the graduate assistants were willing to take a more active role, changing the location of the printer would allow them to better enforce the existing 10 page policy. Unfortunately there would be no way to ensure students were not coming in during different graduate assistant's shifts and printing off their 10 page documents. This intervention would also punish students who may not visit the lab everyday and may need to print-off more than 10 pages at a sitting.

*New Print System*

Implementing a new print system is bar far both the most costly and difficult to implement of the three. It is also the best solution for everyone involved. Not only does it take the responsibility away from the graduate students to police each student, but it ensures each student receives an equal number of printouts. The risks and costs are high but so is the return on investment (ROI). With paper and toner cartridges steadily increasing in price and student usage continuing to grow this new print system will have paid for it self within two years. While reducing the amount of wasted resources is the main priority, the implementation of this new print system would also address many of the other issues in the general computer lab including animosity between graduate assistants and students.

## Evaluation

*Formative Evaluation*

Formative evaluation in the form of survey tools and observations will occur at major milestones throughout the intervention process to ensure that the appropriate objectives are being met. Input will be sought from all stakeholders (students, graduate assistants, the director of information technology, technology lab assistants, and the administrative team). The formative evaluation will be used to gauge stakeholder reaction to the intervention.

*Summative Evaluation*

A summative evaluation will occur six months after the intervention(s) has been instituted to measure the true effectiveness of the program. This comprehensive evaluation will measure both the stakeholder reactions as well as return on investment and affect on the organizational, managerial, physical and technical, and human and social systems.

*Data Collection*

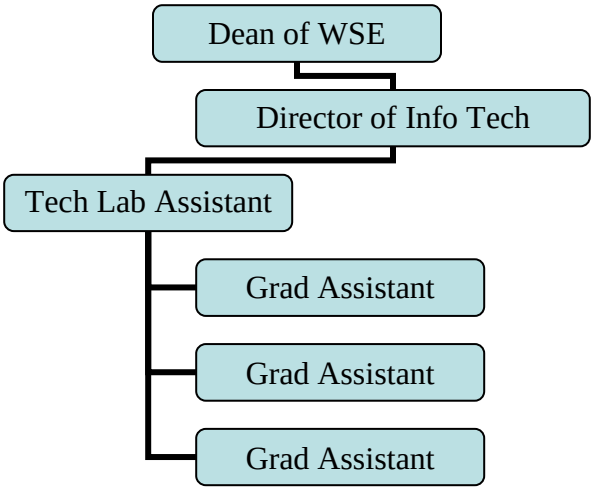
Data will be collected initially using observation and survey tools. These tools will give the performance technologist an idea of what is going well and what needs to be modified or improved. Anonymous and random surveys will be given to various stakeholders in an attempt to receive an even sampling with all stakeholder interests being served. Observation will occur in the lab to identify stakeholder perception and attitude toward the new system.

Both quantitative and qualitative data will be collected during the summative evaluation period. Surveys and observations will constitute the qualitative data meant to measure the attitudes of stakeholders. In addition qualitative data in the form of purchase orders for printer toner and paper, surveys, and revenue reports generated thanks to the automated print system will also be taken into account. This quantitative and qualitative data will be used to measure the impact of the intervention.

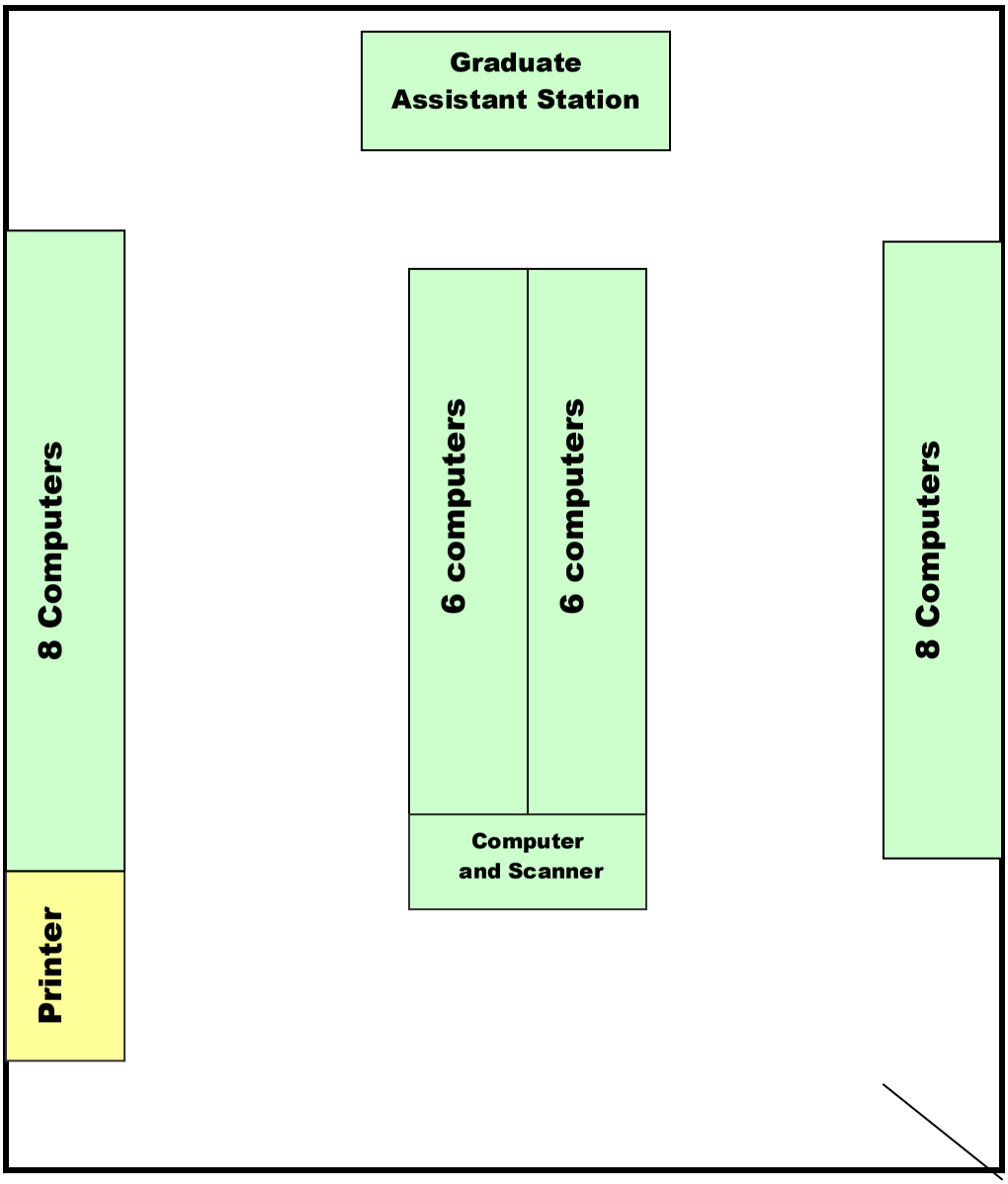
*Analysis*

The quantitative data will be analyzed using statistical programs. Qualitative data will be analyzed in narrative form and organized by stakeholder category and relevance.

## Appendix A


Dean of WSE
Director of Info Tech
Tech Lab Assistant
Grad Assistant
Grad Assistant
Grad Assistant

## Appendix B


Graduate Assistant Station
8 Computers
6 computers
6 computers
8 Computers
Computer and Scanner
Printer