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Glenn G. Bartle Library Public Space Redesign

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Abstract: This project focuses on select areas of the Glenn G. Bartle Library at Binghamton University. A library system providing users with the necessary resources for success in academia is an imperative entity for any University. With technology constantly evolving, it is important to advance resources and update physical features. Concentrating on the needs of users, promotion of positive library activity, utilization of resources, and the advancement of technology, a redesign of the first and second floor Information Commons and East Reading Room shall be proposed. Several areas of research were conducted, including analysis of gate count data, user surveys, and interviews. From these responses, alternative interior design options have been created with CAD and ARENA models, with the addition of a cost analysis for the redesign. Through these efforts
23 group study rooms, 70 computers, and 2 additional printers were added to these spaces. These new additions will help the university transition with the planned increase of students by the year 2020.

Keywords: Redesign, Glenn G. Bartle Library, Library, Library Technology

spaces and computers available on the second floor mezzanine space. (Mulligan & Andrus, 2014).

These public spaces in the Bartle Library shall be redesigned to enhance the utilization of the space for all users. Certain aspects of the library cannot be changed in the redesign as per the clients criteria and the building constraints. Since a redesign of the entire library building is not planned, no load bearing walls can be removed. In addition, the library must be safe for students to use and shall therefore follow appropriate building and fire codes. Certain elements, such as the Research Help desk, where the research librarians conduct work, must be included in the design at the request of the client. At the current time, there are no budgetary restrictions on the project. The client would like there to be multiple design options with features that can be added or removed to adjust the overall cost of the design.

2. Research and Analysis

2.1 User Conducted Research

Several research methods were used to collect data about how the library space is currently utilized by students and staff, and what specific characteristics patrons of the library would like to see improved. These data collection methods included an online survey, user interviews, and headcount data collection and analysis.

The online survey was distributed to the majority of the student population on and off campus with a total of 172 responses, which is reflective of the population of the University in regards in class year. The interviews were taken randomly of current users in the library space for a total of 60 individuals over the course of three weekdays at varying times during the day. Headcount data of patrons entering and exiting the library throughout any given day was collected and analyzed in such a way to determine the number of occupants in the library at a specified time.

2.2 Research Analysis

The results from this user conducted research was collated and analyzed in reference to their relevance to the studies conducted for this project. The survey results show that students primarily use the library space for individual work. The focus for redesign should emphasize enhancing settings for primarily individual work. Another determination that can be made from the survey data is that 43.1% of students that do not use Bartle Library stated that their primary reason for not using the space was due to overcrowding. However, of the students surveyed, about half of the students never use the East Reading Room as a study space. This shows that the space in the library is being underutilized and can be designed in a way that distributes user and student crowds more efficiently. User interviews conducted depict similar results.

As this survey was conducted randomly within the Information Commons, it is assumed that the results only make up a sample of the population, but show that the majority of occupants of the Information Commons are conducting educational- related business. Although the data shows that the majority of Information Commons occupants are aware of the Research Help Desk, most do not or have not utilized the resource. Additionally, the majority of occupants know of or have utilized the East Reading Room as a resource. It is clear that many library occupants prefer to utilize their home or a space in the Bartle Library space for the majority of their work. While almost a third of patrons indicated that they were completely satisfied with the experience, common responses included adding more outlets, more computers, more printers, the cleanliness, the addition of food, an easier system to find an open seat, and the noise level being too loud. These factors and the results for this interview shall be taken into account when redesigning the new Information Commons and East Reading Room.

With regards to headcount data collection, averaged data between the Fall and Spring Semester over a period of several years was evaluated, and it was determined that the “peak” occupant times during the day appeared to be between 15:00 and 16:00, with up to a range of patrons from 850 to 950. This data does not take into account “extreme” circumstances such as finals week as it was determined that the library shall not be designed to accommodate such a brief anomaly in the semester. Further research can be conducted to determine why students utilize the library space during these specified “peak” times.

3. Design Proposal

3.1 Design Layout

There are currently three different spaces included in this redesign: the first floor Information Commons, the second floor Information Commons, and the East Reading Room. The East Reading Room is a large open space with individual study carrels. The redesign for the space creates 23 group study rooms, which will be comprised of 21 smaller rooms that can hold up to 6 people and 2 larger conference rooms that can hold up to 10 people at a time. With an increased demand for group work from the expected increase in student population, this extra space is a necessity.

The second space that is being redesigned is the first floor Information Commons. Currently, a large portion of the floor space is being taken up by the reference stacks. There is a large room adjacent to the Information Commons that houses the government documents collection, and in the proposed redesign these stacks will be condensed through the implementation of compact shelving. The compact shelving will allow for the addition of more computers and seats into the space. In addition, the redesign shall include the removal of a practice presentation room in the Information Commons. This room is no longer necessary with the addition of the group study rooms that are being added to the East Reading Room and will allow for more individual seats to be added to the Information Commons. Additional seats for users shall be created by utilizing alcoves more efficiently by placing booth-style seating into the area for individual studying. Finally, the current Computer Help Station shall be condensed and the current printing stations shall be moved to this more central location, which allows for 70 additional computers to be added to the space.

The final redesigned space is the second floor Information Commons. This redesign focuses on two areas of the mezzanine: a computer hub and a student study lounge. The computer hub, located on the east side of the mezzanine will have all new state of the art computers for the students. The desks and computer terminals will all be replaced and reorganized to allow the placement of 12 new computers. Unused coat closets will be turned into cafe height desks. On the west side of the mezzanine will be the brand new student study lounge. All current outdated wooden desks and tables will be removed and furniture will be replaced with new ergonomically designed furniture. Most of the furniture will have built in tables as part of it that can be used as a table or can be folded back into the furniture. This area is meant to be a new quiet relaxing area for students away from all the computers.

For a complete AutoCAD drawings of the redesign, please refer to Appendix 6.3 AutoCAD Models.

3.2 Aesthetics

Interior design components and aesthetics are being used thoroughly in the redesign of the space. Research has been conducted to find appropriate furniture to fill the library, utilizing Steelcase and Teknion furniture providers. The carpet flooring shall be replaced to help accommodate the desired noise level, and repainting the walls to provide for additional upgrades.

Examining the stimulus each color has on the human brain, color options for the East Reading Room and Information Commons were analyzed. For both designs, the main color of the rooms shall be white in order to create a calmer, cleaner and more focusing environment, while having other accent colors. The quiet study space shall have green, orange and blue. The green color will help maintain the serenity of the room, which will be supported by the blue color, while orange calms the user. The group study spaces shall be yellow, red, blue and brown. The yellow color will motivate the user and help maintain the brightness of the room. The red color shall stimulate discussions and excitement towards the work, but it should only be applied in small portions of the room. The Information Commons shall contain the colors yellow, orange and blue, with smaller details of red, grey and green to balance and not overwhelm the environment. These colors would help maintain a calm environment but not stimulate silence, so students will not feel uncomfortable (Adams, 2016) (Battistella, 2003) (FALCÃO, 2005).

Research conducted suggests that users prefer to work in a quiet space. Therefore, soundproofing for the East Reading Room and Information Commons was also analyzed and budgeted in order to accommodate the desired noise level. One of the main goals of soundproofing is to minimize echoes and reduce overall noise in the area. The main tools to be used for

soundproofing shall be carpet padding, implemented exclusively in the East Reading Room, sound control panels, and sheets of limp mass and acoustic foam underneath desks and on ceilings for both rooms (Aquality Assured, 2016) (Gromicko, 2016).

3.3 Furniture

The furniture implemented in the final design layout were made based on the user-research conducted, and provided by Steelcase Furniture Company. Previously, the Steelcase Company has been a successful provider for other Binghamton University design projects. The research conducted suggests that users of the library prefer chairs with wheels, and large open desk space to conduct work. The furniture provided in the redesign accommodates both individual and group study work. Each furniture item was specifically selected based on ergonomic design, flexibility, usability, and application of the space in order to maximize users while minimizing overcrowding and congestion.

3.4 Reference Stacks and Government Documents

The reference stacks, currently located in the south side of the Information Commons, occupy a significant amount of space that could be utilized for additional student and library-user seating and computer space. There exists a room adjacent to the reference stacks collection which is comprised of government documents. The Reference collections include more than
9,000 titles, occupying 878 shelves for a total of 2,000 square feet of floor space. Through the implementation of compact shelving positioned in the government documents collection room, the reference stacks can be removed from the main floor of the Information Commons and consolidated to occupy space within the adjoining room. As this revision would increase the load bearing on a smaller portion of space, safety measures are being taken to analyze the current weight of the stacks within the specified area in comparison with the weight of the compact shelving over a smaller area of space. Further discussion was taken in talking with the civil engineer of Binghamton University to insure that the floor could withstand the added load.

3.5 Technology

Technological advancements are extremely important for updating this public library space so that it may be utilized more efficiently and effectively. With the addition of 23 new study rooms in the East Reading Room, 24 16 GB iPad Air 2 will be purchased. An iPad will be placed outside of each study room so that the user may reserve that specific study room and check-in when entering the space. Additionally, a final iPad will be placed outside the East Reading Room as a general reservation resource that can access reservations of any of the study rooms. There is currently an open-source room reservation software system implemented at Binghamton University which will be used on these iPads. Student and users will have access to this reservation system online at any time with their laptop or smartphone, as well as on these iPad devices. Furthermore, the current software which detects the number of open computers in the Information Commons will be updated using Microsoft Silverlight. This technology will be advanced to allow users to identify specific computers that are vacant from their smartphones or other devices. After analysing how the Information Common's computers are used, it was concluded that it would be most beneficial to the users of the space to maintain at least the minimum number of computers in the Information Commons. Due to the consolidation and updated layout of the current Information Commons, 70 additional computers, 30
Macs and 40 PCs, will be added. With these new additions 284 new computer will be purchased, replacing the old computers and adding the additional ones, which will be comprised of 162 PCs and 122 Macs.

3.6 Printing

The major concerns of printing in the Information Commons are waiting times and printer availability. After developing an Arena simulation of the current printing system, analysis was conducted to determine possible changes for improvements. Distribution for the service times were determined from the data provided by the Information Technology Services; the interarrival time data was collected by observation. Since the data suggested a higher frequency of students during class time, the model was created based on peak library printing hours: 9:00 am to 5:00 pm. Currently, the printing station has

a total of six printers separated by two sides (three printers on each side). Two alternatives to the original model were created: a model with all six printers on one side, and a model with one additional printer on each side (Figure 6.2.1 and Figure 6.2.2). The addition of two printers decreased both wait time as well as queue length. However, the model with six printers on one side had the best results. It was clear that students utilized one side more than the other due to the proximity of the printers to the entrance (Figure 6.1.2 and Figure 6.1.3). This leads to the recommendation of having a centralized location for the printers, so that all printers are visible in the newly designed Information Commons. The addition of another printer is not necessary, but with the increase of students in 2020, it is highly recommended.

4. Design Proposal Financial Budget

4.1 Budget

As established in the project requirements designated by the client, a cost limitation was not placed on the redesign proposal. The estimated budget for the design proposal was calculated at a total of US$2,509,001.64. This estimate analyzes all design aspects of the renovation including furniture, computers, technological advancements, soundproofing initiatives, repainting and recarpeting of all spaces, and lighting updates and enhancements. The estimate has a safety measure for miscellaneous items and unknown factors as instructed by Binghamton University Physical Facilities as a 125% multiplication factor. Online estimation resources and Physical Facilities were utilized to accrue a total cost for lighting, carpeting, and painting (A Quality Assured, 2016). The complete budget for the design proposal may be seen in Appendix Figure 6.4.

Labor was discussed as one of the potential costs for the project. However, it was determined that the labor costs for this project are outside of the scope of the project. This is due to the fact that the client has stated that a schedule for the construction of the redesign is outside the scope of the project. Without a project schedule and the amount of time it would take to complete worker tasks for the redesign, it falls outside of the project scope.

5. References

Larson, E., & Gray, C. (2010). *Project management: The managerial process (5th ed.)*. New York: McGraw-Hill Irwin.

Mulligan, B., & Andrus, B. (2014). Breaking the mold: winning allies via self-discovery. *In M. K. Aho, & E. Bennett, Machiavellian Librarian Winning allies, combating budget cuts, and influencing stakeholders*. Chandos Publishing.

Battistella, M. R. (2003). *A IMPORTÂNCIA DA COR EM AMBIENTES DE TRABALHO.* Florianópolis, SC, Brazil: Universidade Federal de Santa Catarina.

FALCÃO, F. d. (2005). *A influência ergonômica da cor no ambiente.* Bauru, SP, Brazil: Anais do Simpósido de Educação da Universidade Sagrado Coração de Jesus. Retrieved from http://www.ebah.com.br/content/ABAAAAgWIAL/ainfluenciaergonomicacornoambienteeducacionalrevisao

Adams, C. (2016, March 30). Retrieved from About Home: http://ergonomics.about.com/od/ergonomicbasics/a/The_Use_Of_Color_In_Ergonomics.htm

A Quality Assured. (2016). Retrieved from https://www.aqualityassured.com/

Gromicko, Nick; Ward, Ethan. *InterNACHI*. (2016). Retrieved from About Home: https://www.nachi.org/noise-control.htm

6. Appendix

6.1 Arena Simulation Results

Table 6.1.1 Summary of Results

Model:	Avg. Wait Time (min)	Max. Wait Time	Min. Wait Time	Throughput
Original	11.6865	57.84	0	1,363
6 Printers, 1 side	1.0696	11.96	0	1,422
8 Printers, 2 sides	2.6093	38.9978	0	1,414

Table 6.1.2 Original Model Side A/B Comparison

Original Model	Avg. Wait Time (min)	Max. Wait Time	Min. Wait Time	Number In
Side A	19.01	32.06	0	896
Side B	.3023	.4052	0	535

Table 6.1.3 Redesigned Model Side A/B Comparison

8 Printers, 2 Sides	Avg. Wait Time (min)	Max. Wait Time	Min. Wait Time	Number In
Side A	4.039	38.99	0	902
Side B	.1452	7.28	0	526

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6.2 Arena Simulation

Figure 6.2.1 Original Design Simulation Model

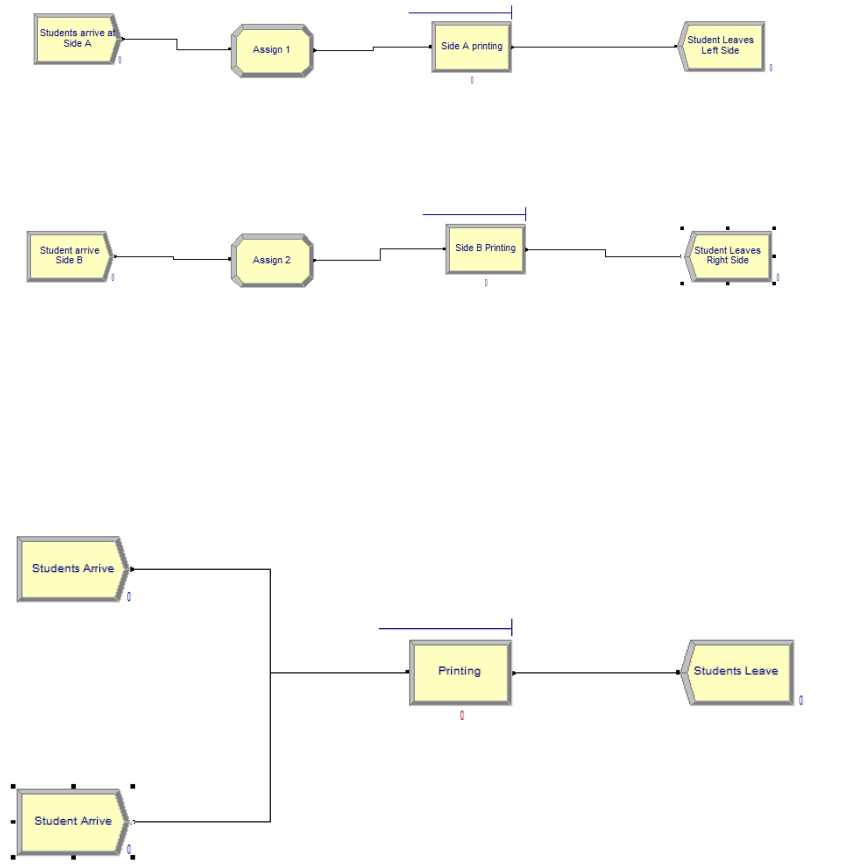

Figure 6.2.2 Redesigned Simulation Model

6.3 AutoCAD Models

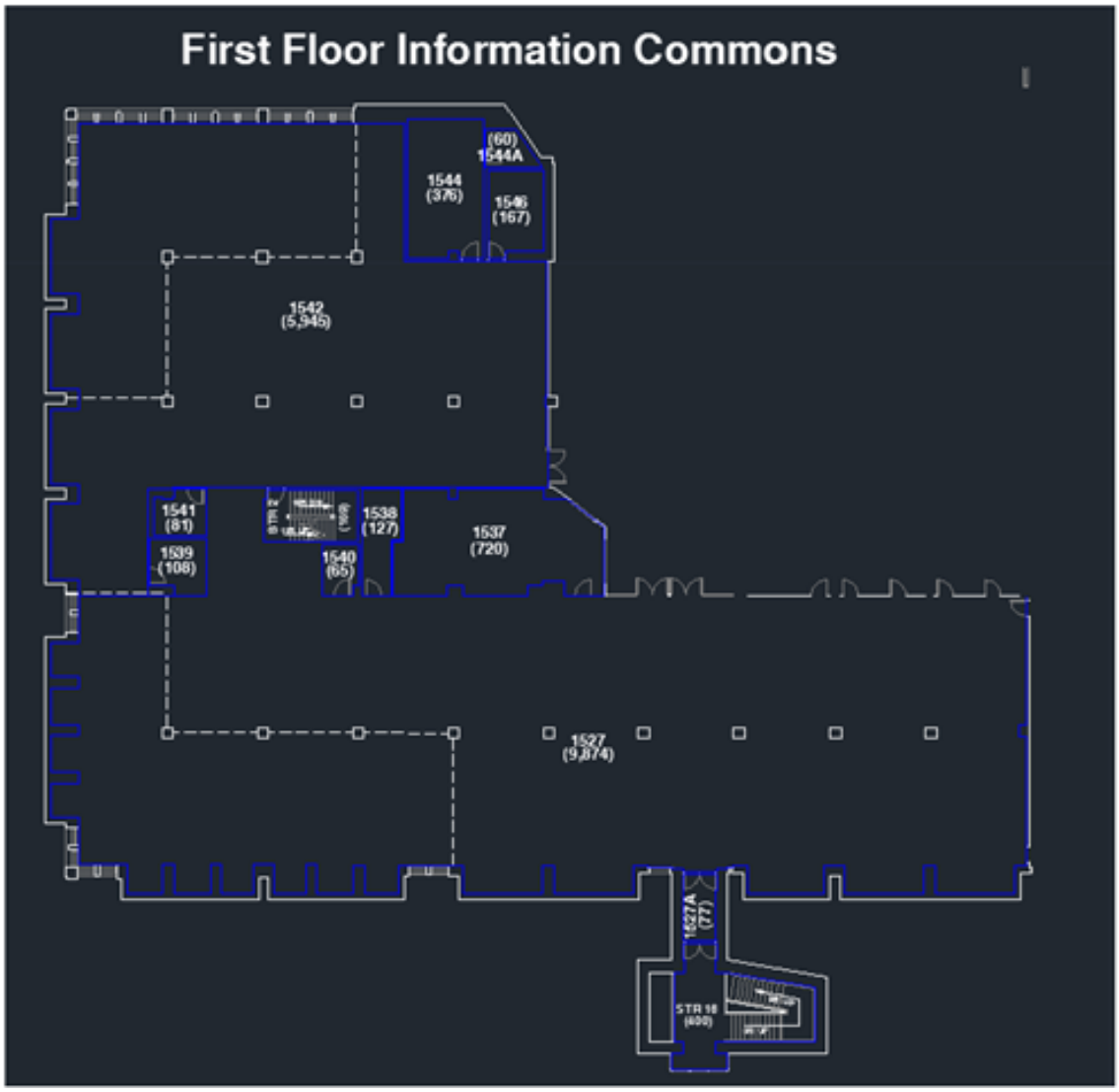

Figure 6.3.1 First Floor Information Commons Original Layout

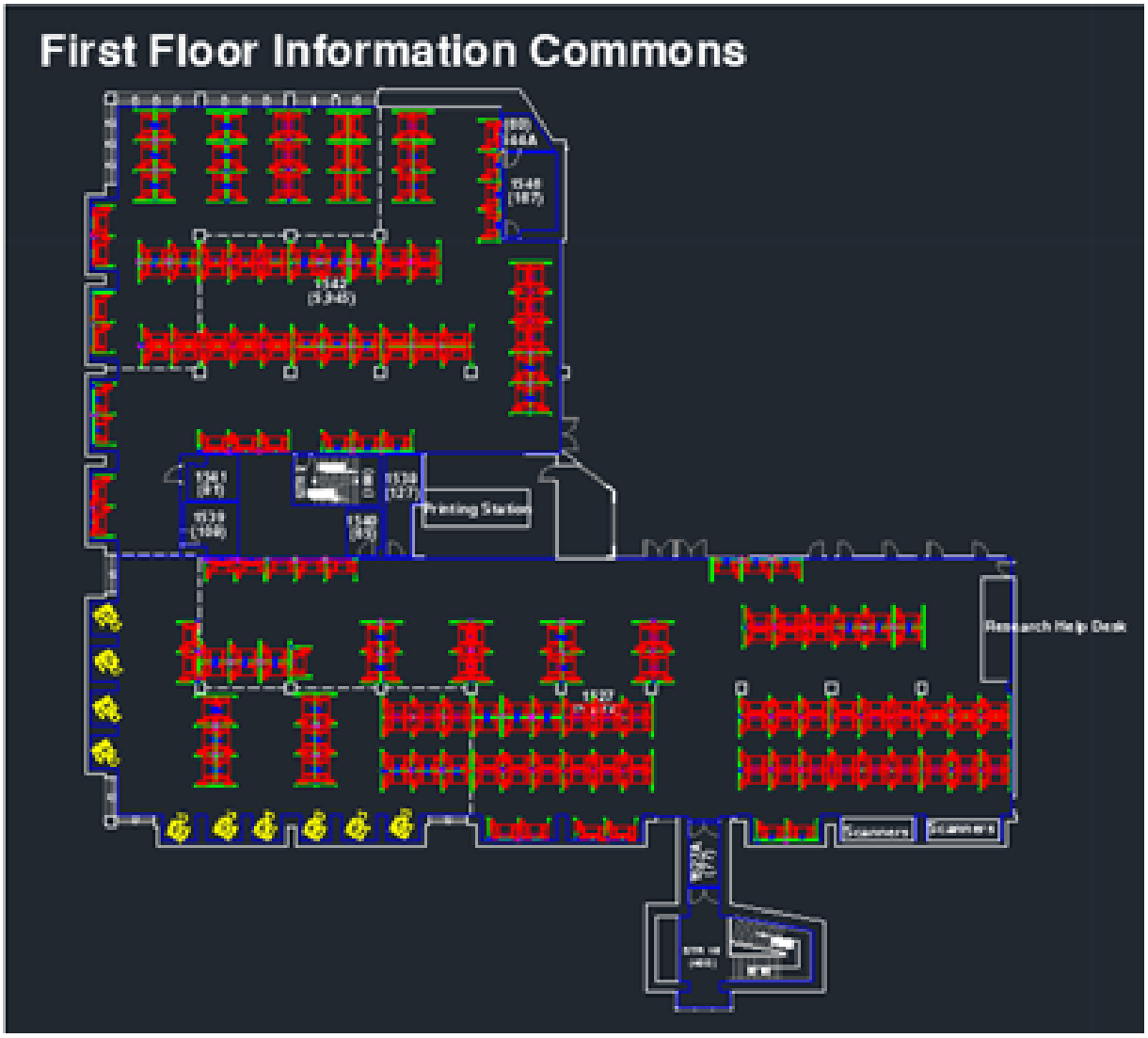

Figure 6.3.2 First Floor Information Commons Redesigned Layout

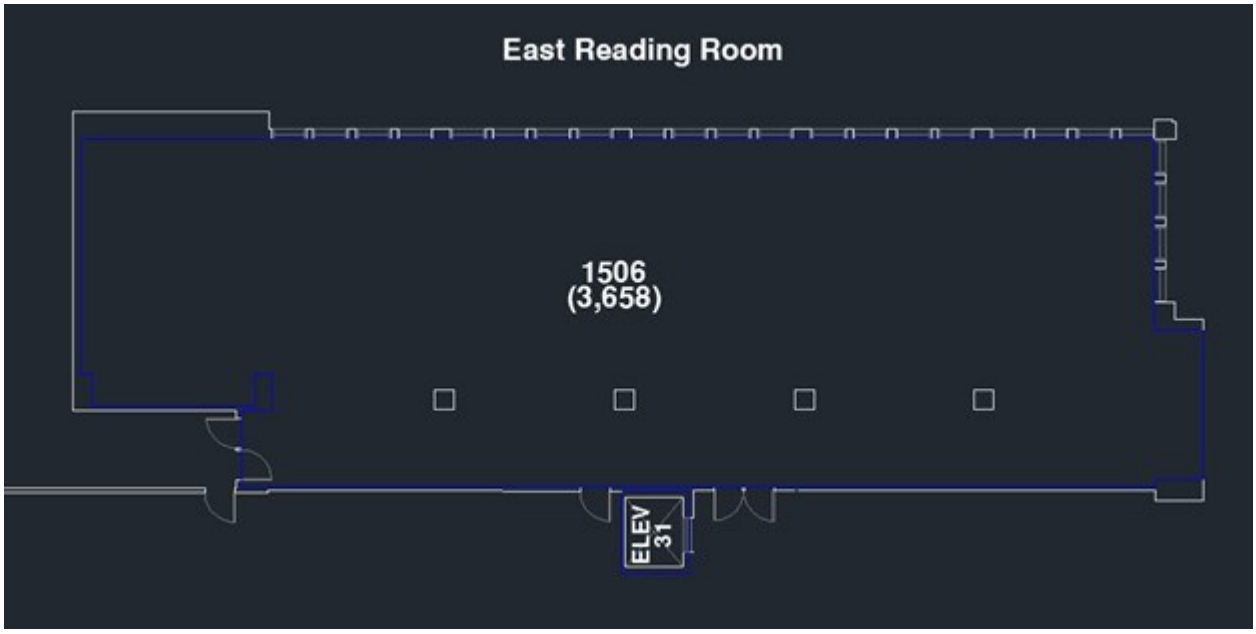

Figure 6.3.3 East Reading Room Original Layout

Figure 6.3.4 East Reading Room Redesigned Layout

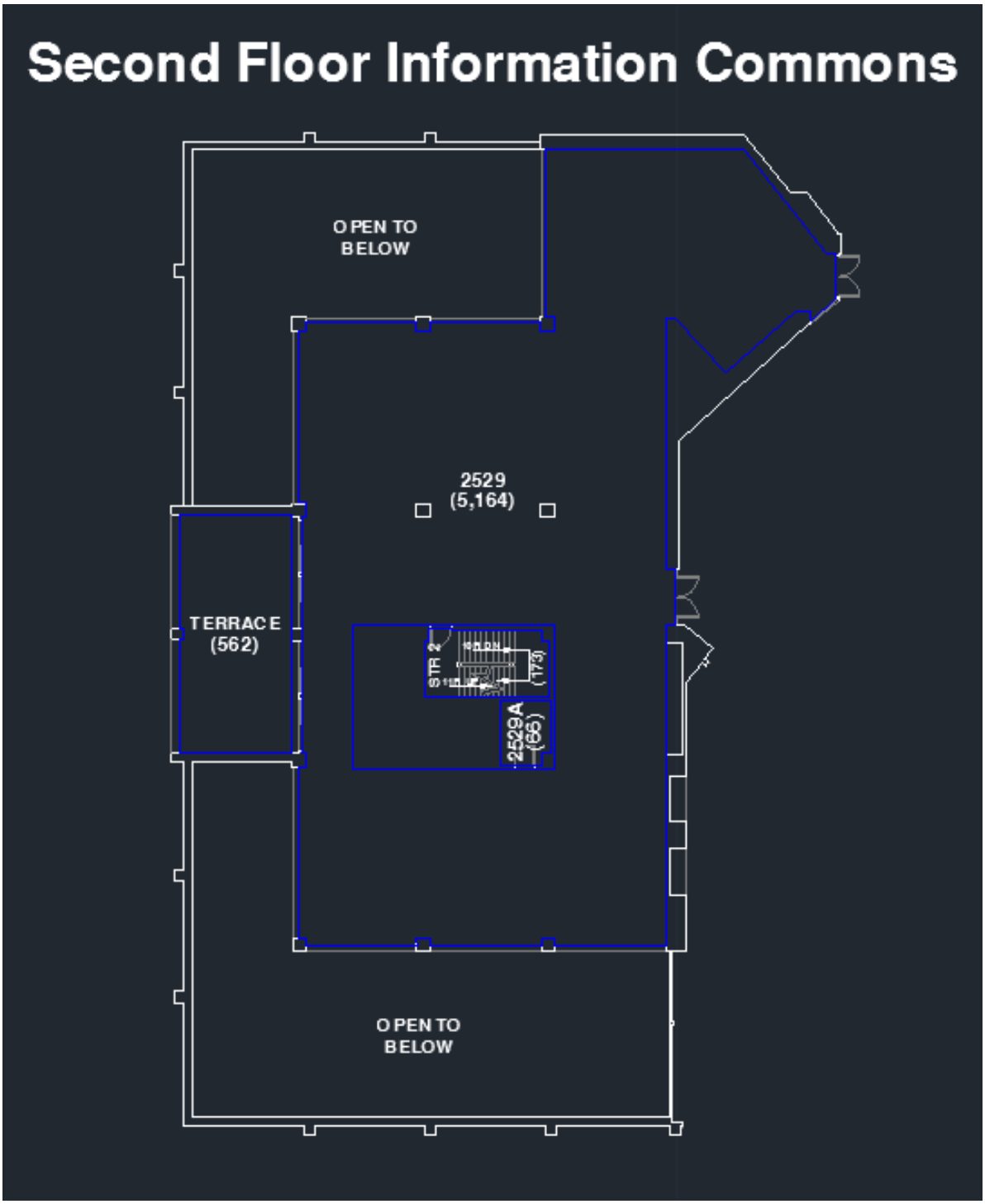

Figure 6.3.5 Second Floor Information Commons Original Layout

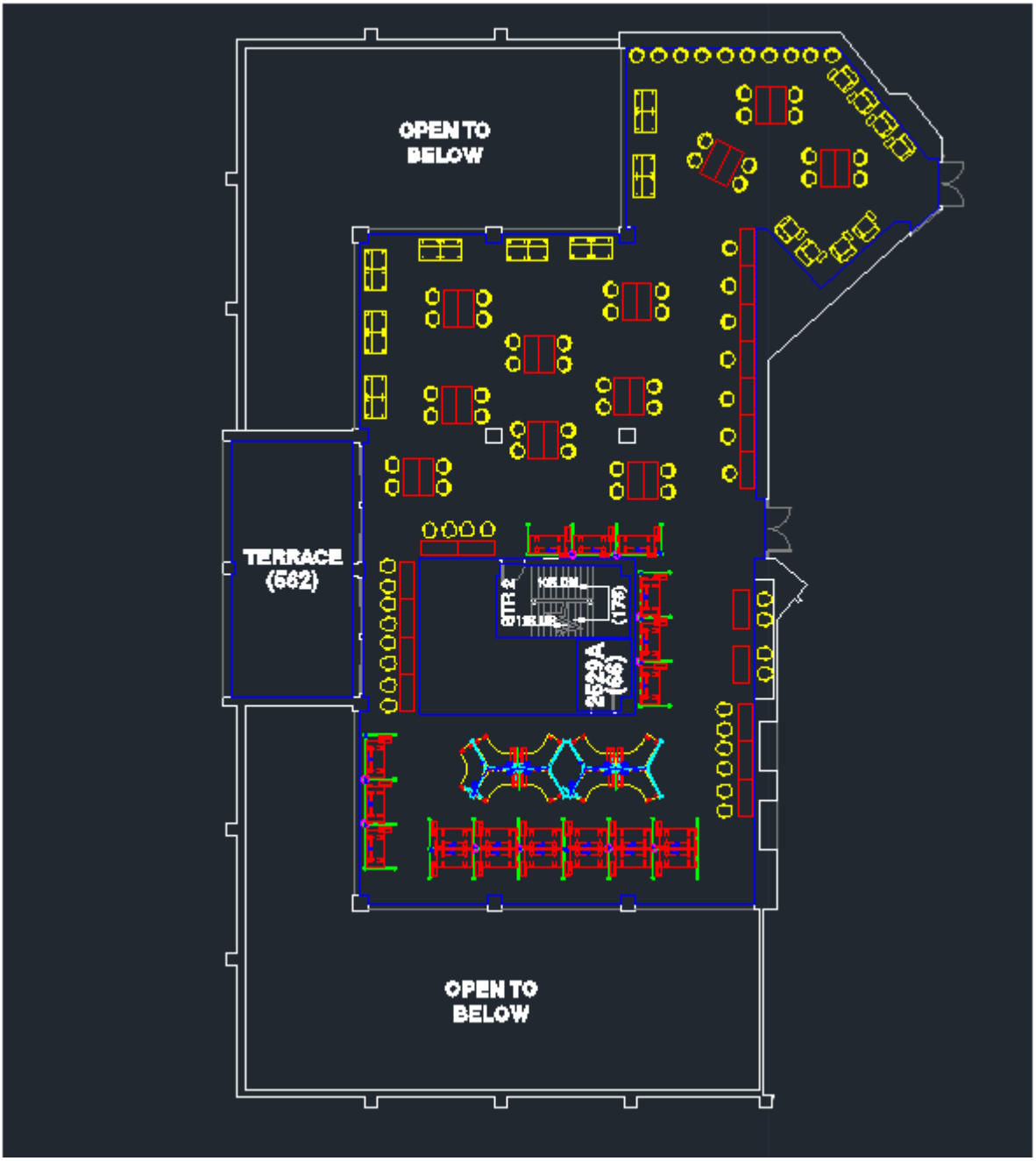

Figure 6.3.6 Second Floor Information Commons Redesigned Layout

6.4 Design Proposal Budget

Figure 6.4 Design Proposal Budget

Item Number	Item/Task	Product Details	Quantity	Cost	Total Cost
1	PC	Monitor, Computer, OS, Software	162	$600.00	$97,200.00
2	Mac	Monitor, Computer, OS, Software	122	$1,458.00	$177,876.00
3	Sound Proofing	Carpeting, Paneling, Foam	1	$59,190.00	$59,190.00
4	Steelcase Desk System 1: VF4WX4DW	Post & Beam, Series 7, Think	40	$30,547.00	$1,221,880.00
5	Steelcase Desk System 2: BD2YA6XP	SOTO LED, Buoy, Campfire Paper Table, Think, Answer, Answer Panel Systems	2	$20,256.00	$40,512.00
6	Conference Table	Table-Team: VTT3084	2	$975.00	$1,950.00
7	Chair: cobi	cobi; Chair, Swivel base, Fixed arm, 434111	178	$723.00	$128,694.00
8	Long Desk	Worksurface-Straight, Low Pressure laminate, 24D x 60W, TSTWLR2460	82	$217.00	$17,794.00
9	Lounge Half Sofa	Campfire Half Lounge	8	$911.00	$7,288.00
10	Desk Lounge Chair	Jenny Club Chair	16	$781.00	$12,496.00
11	Alcove Seating	Brody; Chair-Loung, Privacy with Footrest-Wklnge	10	$4,840.00	$48,400.00
12	Wall Additions	Construction, Sheetrock	1	$15,000.00	$15,000.00
13	Lighting	Updated Lighting	65	$1,222.67	$79,473.55
14	Carpeting	Commercial Carpeting	1	$88,000.00	$88,000.00
15	Painting	Commercial Painting	1	$3,048.00	$3,048.00
16	Glass Door	COMMERCIAL - CLEAR VU 35" X 78" CLEAR SWING DOOR	24	$349.99	$8,399.76
			Design Proposal Cost		$2,007,201.31
				Final Design Proposal Cost (125% multiplication factor)	**$2,509,001.64**