

University of Colorado Boulder

Global Engineering Artifact Project Proposal

Connecting students with the world through technology

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11/14/2014

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Introduction

The Age of Information has provided us with a unique opportunity to learn about the world. Technology and the internet are connecting all corners of the globe. As businesses and cultures expand across borders, being connected to the events and identities across the world is a valuable skill in today's society. Because of the University of Colorado Boulder's (CU's) strong position in the United States and across the world, students at the CU are in a unique position to learn about the world and become better connected with our global community. Global Engineering Artifact Project will connect the students and visitors in Kittredge Central Residence Hall (Kitt Central) at CU with global events and help foster a global identity for today's society. The Artifact Project will also provide an opportunity for current engineering students in the Global Engineering Residential Academic Program (Global Engineering RAP) located in Kitt Central to gain valuable skills in a team oriented design project while creating the Artifact. This will benefit their studies and enhance their degree.

The Artifact will be located in the common space in the first floor near the desk in the south wing of Kitt Central. It will consist of an interactive projection screen on the wall opposite the desk. Using current technology, any projector on the market today can be made interactive. This technology transforms the ordinary projection surface into a large touchscreen. This screen will run a custom app, which will incorporate current events, numerous languages, and global concepts along with other interactive apps to provide a global experience for users.

The Artifact will be designed and built by students in the Global Engineering RAP. This project provides opportunities for students to invest and strengthen the community in Kittredge Central while learning the fundamentals of team oriented project design. Furthermore, this project will challenge students' technical skills, requiring them to learn additional skills and enhance existing ones.

The initial installation of the Artifact will require the assistance of Housing and Dining and Facilities Management to remove a bulletin board that is currently mounted on the wall, to mount the projector on the wall, and to provide power to the projector. After the initial installation, the Artifact will require minimal, if any, maintenance from Housing and Dining or Facilities Management. The students in the Global Engineering RAP will maintain the Artifact and update it as needed. Considerable design efforts will be focused on making the Artifact reliable and low maintenance. An owner's manual will be created so Global Engineering students in future years can maintain the Artifact.

Funding for this project will primarily come from the Global Engineering RAP. Diane Sieber, the Director of the Global Engineering RAP, has reserved \$6,000 of RAP funds for this project. Given the cost of the materials, such as the projector, the target cost of the Artifact is between \$3,000 and \$6,000.

Designing of the Artifact began in September 2014. In the spring of 2015, parts will be ordered and the Artifact will be installed. After several weeks of testing and debugging, the Artifact will be ready for an official unveiling. The target completion date for this project is May 1, 2015, which is the end of the spring academic semester.

Artifact Description

Interactive Display

The Artifact will contain an interactive projection display. Using software from Ubi Interactive, a Microsoft Kinect, and a computer running Windows 8.1, any projection system can be transformed into an interactive environment. You simply swipe your hands along the wall and the display responds as if it were a touchscreen. The newest version supports Air Gestures, so one does not even need to touch the wall. You swipe your hands through the air. This way, the wall will not get dirty from all of the fingerprints of the users. The following figures below show how the software allows you to control the screen. All images are from Ubi Interactive's [website](#) or their [YouTube channel](#). Figure 1 is from the Ubi Interactive website and show sliding the hands apart on the wall zooms in on the map.

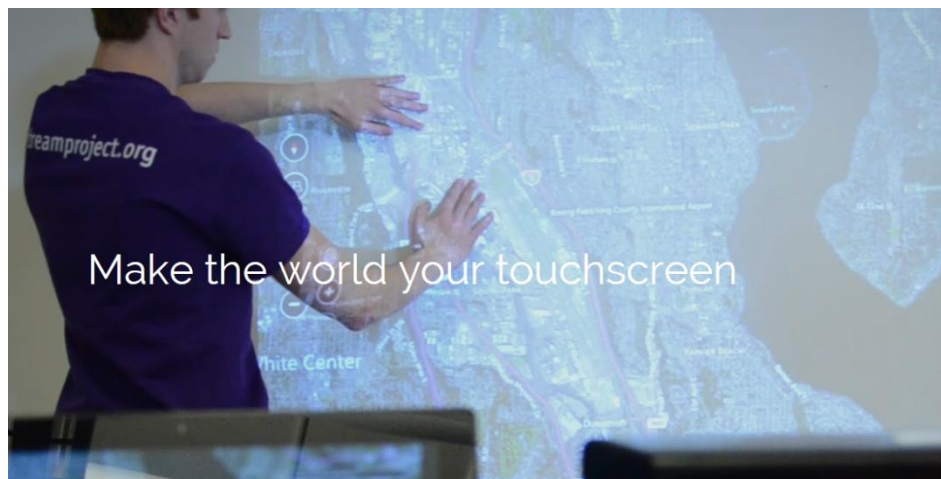


Figure 1: Ubi Interactive Screen while touching the wall

Figure 2 below is a still from Ubi Interactive's YouTube channel and show how Air Gestures are used without touching the screen. Here, the man is rotating a model of a plane by moving a fist through the air. The Kinect sensor is black, and it can be seen just below the center of the screen. The Ubi Interactive software with Air Gestures is the best choice for the Artifact, because it will keep users from touching the wall, which will produce less wear on the paint.

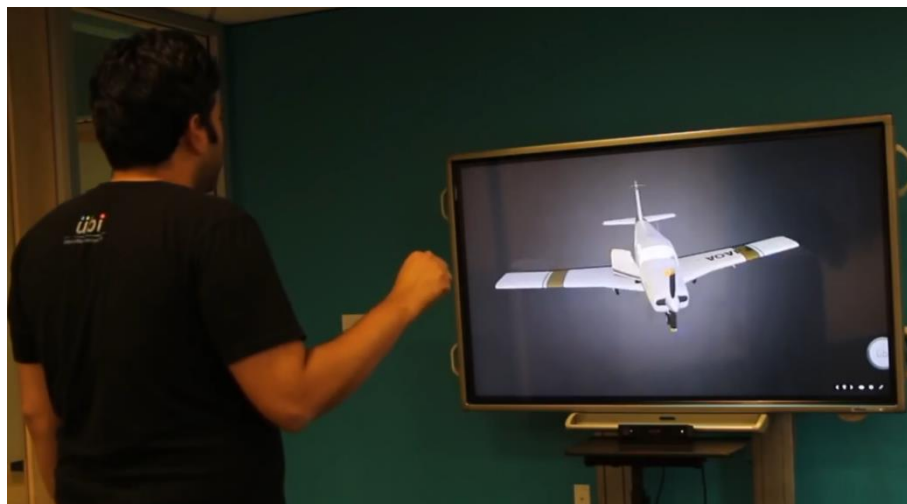


Figure 2: Ubi Interactive with Air Gestures rotating a plane model with a fist.

Figure 3 below illustrates how easy it is to set up an interactive display with the Ubi Interactive software. The Artifact will use a Windows V2 Kinect (to support Air Gestures), a PC running Windows 8.1, and projector to display the image on the wall. Details about each component of the set up are described in their respective sections below.

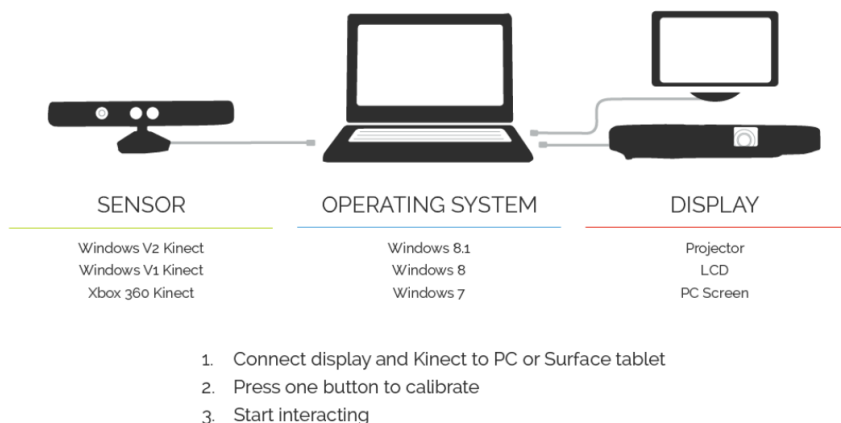


Figure 3: It is easy to set up Ubi Interactive software.

With the set up described in Figure 3, any touch enabled app for Windows 8.1 can be used and controlled through the interactive screen. Ubi Interactive software cost [\\$680](#) with an academic discount for the multi-touch business edition that support taps, swipes, and zooms.

Location of Display

The Artifact will be located at the front desk area of Kitt Central. The interactive display will be on the wall, which currently has the bulletin board that says, “Welcome to Kitt Central”. See Figure 4 below.



Figure 4: The interactive screen will replace the Welcome to Kitt Bulletin Board

This bulletin board will need to be removed to have a clear image on the wall. This wall was chosen for the display, because it is centrally located and all students and visitors who

enter the building pass by this wall. Figure 5 below shows how the bulletin board on the selected wall is centrally located between the main doors of Kitt Central. Every student and guest entering the south wing of Kitt Central passes through the glass door on the right side of Figure 5. Residents then enter the residential wing by passing through the glass doors in the left side of Figure 5 or the wooden door shown in Figure 4. By placing the Artifact on this wall, it will provide a global experience for the greatest number of people.



Figure 5: The chosen wall is located between the primary doors to the building.

Currently, there is a touch screen display in this area of Kitt Central, and it can be seen in Figure 4 above. This is a screen that is provided and managed by Housing and Dining. While the Artifact also has an interactive screen, it serves a different purpose than the housing and dining screen. The housing and dining screen provides information about the CU campus and events occurring on campus. The Artifact will provide a way for users to connect with the world through current global events and to explore multiple languages. Like the housing and dining screen, the Artifact will display current news feeds; however, the Artifact will allow the user to select a headline and read the story. This will invite the user to think critically about global issues and events. Furthermore, the Artifact will display news from several different news agencies in several different languages. This will provide different perspectives on current events, as news in one country is not always news in another. Currently, the housing and dining screen does not support either of these features. Great care will be taken when selecting news agencies to minimize inflammatory and/or insensitive stories. The topics and headlines will be informative, educational, and thought provoking.

If this arrangement is not viable, then the image may be projected on the glass wall in the entryway or the entire Artifact may be installed in the new Idea Forge Maker Space, which is next to Kittredge Central in the Fleming Building.

Projector

The projector will be mounted on the same wall as the projection screen. This may sound counterintuitive, but Epson and other projector manufacturers sell projectors that do just this. The projector mounts on wall and projects its image below it on the same wall. This type of projector is called an ultra-short throw projector, and this type was chosen because it is simpler to install, and the beam or light does not shine in people's faces as they pass by the desk in Kitt Central. A conventional projector has both of these drawbacks, and would need to be located across the walkway and behind the desk.

The chosen projector is an [Epson PowerLite 585W WXGA](#) ultra-short throw projector, and it costs about \$1,200 with an academic discount. The projected image can range between 60 inches and 100 inches, which will adequately fill the space on the wall. Assistance from Housing and Dining or Facilities Maintenance will be required to install the projector on the wall. It comes with a wall mount, but the design team does not know enough about the structure of the wall to know how to mount the projector securely.

The other challenge is powering the projector, and there are at least two methods to do this. The design team would appreciate the input of Housing and Dining or Facilities Maintenance as to which method is best for the building. The first method involves connecting the projector to a power outlet on the same wall as the projector. This outlet is near the floor, and the power cord would have to be routed securely around the wall so that the cord does not interfere with the projector. If it is practical, a new plug could be installed up near the projector to eliminate the need to route the cord. This method does not require an extension cord as the projector has a 15 foot power cord, but will likely involve several more holes in the existing drywall. It may also be more expensive than method 2.

Method 2 for powering the projector involves using an extension cord to run above the ceiling tiles to a plug behind the desk. This will require a 40 foot extension cord, but it will not make any holes in the existing drywall. This method will be cheaper than method 1, and several other cables, namely internet and video, will need to be routed through the ceiling anyway. See the Computer section for more details on these cables.

The projector bulb will need to be replaced periodically. With the brightest settings, Epson says the bulbs should last for 4,000 hours. The Artifact will be running from 7am to 1am (18 hours/day) each day of the academic semester. There are about 16 weeks in an academic semester, so the projector will run for about 4,032 hours during a given year. This means that the projector bulb will be replaced once a year (or every two academic semesters) assuming that the projector does not run during the summer months. The projector has an Eco Mode which extends the life of the bulb up to 6,000 hours by reducing the brightness. With the Eco Mode enabled, the bulb will last three academic semesters (or 6,048 hours). If the image can still be clearly seen on the wall in daylight in Eco Mode, then the Eco Mode will be used.

Replacement bulbs cost \$79 from [Epson](#), and the Global Engineering RAP will pay for the replacement bulbs and change them as needed. Since these projector bulbs contain a small amount of mercury, then they will need to be properly disposed of at a hazardous waste facility. The nearest facility is the Hazardous Materials Management Facility at 1901 63rd Street in Boulder, Colorado 80301.

Epson projectors feature free [software](#) that can be installed on the controlling computer. This software allows the computer to turn the projector on and off programmatically. The projector receives these commands through an Ethernet cable. This software will be responsible for shutting the projector off at 1am and turning it back on at 7am. As this is done automatically, there is no need for the community assistant or anyone else working the Kitt Central desk to maintain or be responsible for the Artifact's operation.

Kinect Sensor

The Microsoft Kinect V2 sensor is an infrared sensing device that can track the movement of hands and fingers. It connects to the computer driving the interactive display with a USB cable, and can be purchased on the [Microsoft Store](#) for \$180 (this cost includes a 20% academic discount). The Kinect should be mounted such that it has a clear view of the user's hands, but will be out of the way of people passing near the projection area. Two possible mounting locations meet this condition. Since the top of the projector mount is flat, the Kinect may be secured to the projector mount. Initially, it will be secured with zip ties or adhesive mounting pads. If those methods are insufficient, then additional mounting options will be considered. If that location is not satisfactory, then the Kinect may be hung from the leading

edge of the wood paneling on the ceiling. Since the wood is antique, no holes will be drilled in the wood. Instead, a thin wire or twine will be looped through the paneling to suspend the Kinect. See Figure 6 below for the leading edge of the wood paneling.



Figure 6: The Kinect could be hung from the leading edge of the wood paneling

Computer

The Artifact will be controlled from a computer, which will be located behind the Kitt Central Desk. This computer is connected to the Kinect and the projector, and it runs the App, which is displayed on the screen. The computer will be located behind the Kitt Central Desk in a slot in the corner. In Figure 8 below, the computer would be located in the slot that is circled in red. This slot is 14 in by 28 in by 19 in. The computer is a tower design, and the case fits within this spot. This computer will be running for almost constantly, so extra care was taken to build a computer that is reliable and properly cooled.



Figure 7: The computer's location behind the desk is circled in red.

For the initial set up, an extra monitor, that the Global Engineering RAP already owns, will be used. However, this computer will not normally be connected to a monitor, because it prevents unwanted changes to the Artifact. The components for this computer are listed in Table 1 below.

Table 1: Computer Components Cost

GPU-GeForce GT 720	\$60
WD RE2 500 GB internal hard drive Serial ATA-300 3.5" 7200 rpm	\$45
Raidmax Smilodon atx-612wbp computer case with 500W power supply	\$100
Intel® Core™ i5-4690 CPU/MSI Z97-G55 SLI ATX MB/8GB DDR3 1866, Kingston Hyper X Fury Red Memory Bundle	\$374
Cooler Master Hyper T2 - Compact CPU Cooler with Dual Looped Direct Contact Heat pipes	\$16
Total	\$595

The total cost of this computer is \$595. By building the computer, it allows greater flexibility with the components. For example, the internet card must support two Ethernet channels, one channel to the projector, and one channel to the Ethernet jack in the wall for the campus internet. This is not a standard option on many computers, so building a custom tower allows this part to be included.

Once the computer is built, it will need a static IP address, licensed to the Global Engineering RAP. Since all computers on campus are registered to the network, a static IP address allows the Artifact's computer to operate independently of any one student's registration. This way, if the student graduates or transfers to another school, the Artifact will not have to be renewed on the network with another student's credentials. Furthermore, campus internet users must periodically re-register their computer to maintain access to the internet. A static IP address would free students from manually re-registering the Artifact.

If the above computer is not a viable option, then a pre-built computer from Dell can be purchased from Dell for about \$500.

Cables and Connections

Several cables will be needed to connect the various components of the Artifact. Some of the cables have been mentioned earlier in this document, but all of the necessary cables are summarized in this section. Table 2 below lists the types of cables needed in the Artifact.

Table 2: Cable Connections

Cable Type	Length	Connection
Female to Male USB - A Extension	50 ft	Kinect to Computer (data)
HDMI	50 ft	Computer to Projector (sound and video)
CAT 5e Ethernet	50 ft	Computer to Projector (communication)
CAT 5e Ethernet	25 ft	Computer to Ethernet Jack (internet)

The distance from the project on the wall to the computer behind the desk is 36 feet. This is an underestimate, and it will be beneficial to have extra length available. Therefore, the cable lengths were rounded up to 50 feet between the projector and the wall. The 25 foot Ethernet cable connects the computer to the Ethernet jack on the wall. Since the both are behind the desk, this cable is shorter than the others are.

A 50 foot HDMI cable costs about [\\$28](#), and a 50 foot Ethernet cable cost about [\\$10](#). The USB cable is an extension on the Type A, male USB port on the Kinect. Therefore, this cable should be 50 feet long with a Type A, female connector on one end and a Type A, male connector on the other end. This USB cable costs about [\\$20](#). The 25 foot Ethernet cable costs about [\\$5](#).

The cables will be routed from the projector on the wall through the ceiling panels and down along the wall near the mailboxes behind the desk. From there, the cables will be routed below the desk to the corner where the computer will be located. Routing through the ceiling appeals in this design, because the cables are out of sight, and no holes need to be made in the walls. The design team will work with Facilities Management to ensure that the cables are routed safely through the ceiling and do not interfere with any other system that may be located above the ceiling.

App

The project team is developing an app in the C# language using the Unity Game Engine that will be run on the interactive screen. The app will create a global experience for the user by providing RSS new feeds of current news from around the world, information about countries of the world, a description of the Global Engineering RAP, fun games, weather reports (local and international), and more. The sources for the RSS news feeds will be selected carefully so that the content is appropriate and educational. The app will also be able to display content in several different languages to raise awareness of the world's languages. Figure 9 below shows an early screenshot of the app's homepage.

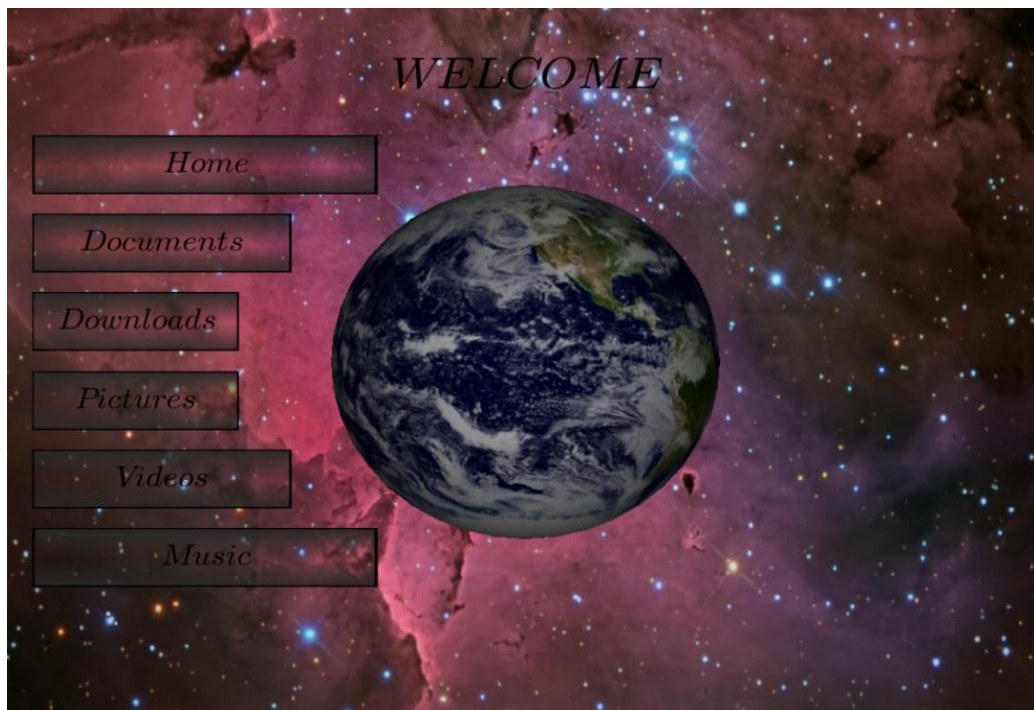


Figure 9: Early Screenshot of the App's Homepage

The app features a spinning globe with a background of stars. The buttons on the left side of the image will eventually be evenly distributed around the globe, and they will provide access, to news, weather, global information, games, and other apps. Live news feeds will scroll across the bottom on the screen. The user will be able to select a news headline, and then full story will open on the screen.

Project Timeline and Key Deliverables

Planning for the Global Engineering Artifact Project began in early April 2014. The project team was formed in early September 2014, and the design work began then. Design work continued throughout the fall semester. It is projected that parts will be ordered early in the spring semester of 2015 and the Artifact will be built and tested through the spring of 2015. This end date of this project will be May 1, 2015, the end of the spring academic semester. Before this date, it is desired to have an official unveiling of the Artifact. See the project timeline in Table 3 below.

Table 3: Timeline and Key Milestones

Event	Date	Notes
Project Begins	Early April 2014	Begin planning and obtaining preliminary approvals
Student Design Team Formed	9-4-14	
Choose an Idea and Theme	10-2-14	Choose an interactive touchscreen
Project Plan Completed	11-13-14	
Approval by Housing and others	December 2014	
Begin ordering parts	January and February 2015	
Install Artifact	March 2015	
Test and Refine	April 2015	
Official Unveiling	Late April 2015	
Project Completed	May 1 st , 2015	

The key deliverables for this project will be a formal project proposal, design details (including engineering drawings, schematics, and code), the completed artifact, and an owner's manual so Global Engineering students can maintain the Artifact in future years.

Project Budget

The budget for the Artifact is shown below in Table 4.

Table 4: Artifact Budget

Ubi Interactive Software (with educational discount)	\$680
Epson PowerLite 585W WXGA projector (with educational discount)	\$1200
Replacement projector lamps(x3)	\$250
Kinect V2 Sensor	\$180
Computer Components	
- GPU-GeForce GT 720	\$60
- WD RE2 500 GB internal hard drive Serial ATA-300 3.5" 7200 rpm	\$45
- Raidmax Smilodon atx-612wbp computer case with 500W power supply	\$100
- Intel® Core™ i5-4690 CPU/MSI Z97-G55 SLI ATX MB/8GB DDR3 1866 Kingston Hyper X Fury Red Memory Bundle	\$374
- Cooler Master Hyper T2 - Compact CPU Cooler with Dual Looped Direct Contact Heat pipes	\$16
<i>Computer Total</i>	<i>\$595</i>
Cables	
- 50 ft HDMI cable	\$28
- 50 ft USB cable	\$25
- 50 ft Cat 5e Ethernet cable	\$10
- 25 ft Cat 5e Ethernet cable	\$5
Total	\$2,973

The cost for the Artifact is \$2,973. The Global Engineering RAP has approved a budgeted between \$3,000 and \$6,000. Since the preliminary costs for this project are right at \$3,000, the Artifact is meeting its expected budget.

If additional sources of funding are needed, project funds could be solicited from the Dean's Office in the College of Engineering and Applied Science or one of the student run funding board on campus, such as the Engineering Excellence Fund.

Primary Stakeholders

The primary stakeholders for this project are described below. They are grouped by department or program.

- Housing and Dining
 - Paula Bland-Associate Director of Housing
 - Must approve any installation in Kitt Central
 - Victoria Vanderwerf-Kittredge Area Coordinator
 - Must approve any installation in Kitt Central
 - Nicole Stella-Kittredge Central Hall Director
 - Must approve any installation in Kitt Central
 - Will likely be the liaison to Facilities Management
- Facilities Management
 - Must approve any installation and building modifications in Kitt Central
- Global Engineering RAP
 - Diane Sieber-Global Engineering RAP Director
 - Must to approve the design and the budget
 - Will Derryberry-Project Manager
 - Must support the design
 - Monitor project scope, schedule, and budget
 - Attend weekly meetings with Diane and run the individual project meetings
 - Student Design Team
 - Includes: Blain Vannice, Audrey Randall, Soham Shah, Darwin Wood, Ian Murphy, Sam Thornton, Mackinley Kath, Shannon Hessler, Charlie Vail, Connor Cheek, and Sean Downs
 - Design and build the Artifact
- Residents in Kittredge Central
 - Will be the primary users of the Artifact along with guests and visitors
- Herbst Faculty
 - Including: Leland Giovanelli and Scot Douglass
- Other Stakeholders
 - Katherine Pickens McConnell-Mechanical Engineering Advisor