

The background features a large, modern architectural structure with a glass facade and a dark, angular base. In front of the building is a wide, paved area with several rows of parked cars under a clear blue sky.

A C O R N

G R A P H I C S Y S T E M

BY ANGELA BELLO

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A C K N O W L E D G M E N T S

I'm extremely grateful to my dear and beloved husband, Julian Badillo, for his enormous collaboration, and I would like to extend my sincere thanks to the ACORN team:

Tony Tiradani,
Lila Anderson,
Beau Harrison,
Eileen Crowley,
and Erik Gottschalk

Their practical suggestions and patience made possible the present work. Finally, I'd like to recognize the help that I received from:

Wendy Tritt
and Aleksandra Giza

who provided me with encouragement and patience throughout the duration of this project.

O V E R V I E W

This project facilitates graphics identity and system icons for the ACORN project at Fermilab Physics National Laboratory by conveying ideas of renovation, modernization, expansion, and cutting-edge technology.

O b j e c t i v e

The main objective of this project is to create the visual aesthetics of the accelerator control system corresponding to ACORN that reflect a world leader accelerator facility and a pioneer in physics research.

The Client

Fermi National Accelerator Laboratory is a high-energy physics facility that studies the fundamental nature of matter and energy.

Mission

Fermilab's mission is to drive discovery by

- Building and operating the world-leading accelerator and detector facilities.
- Performing pioneering research with national and global partners.
- Developing new technologies for science that support U.S. industrial competitiveness.

Audience

Project Team's members as Developers, Managers, Scientists, Constructors, and Fermilab's community related to the project during the construction and execution stages.

Also, the project includes stationary pieces and display for public events for a secondary audience.

Fig. 1. Wilson Hall Main Building at Fermilab



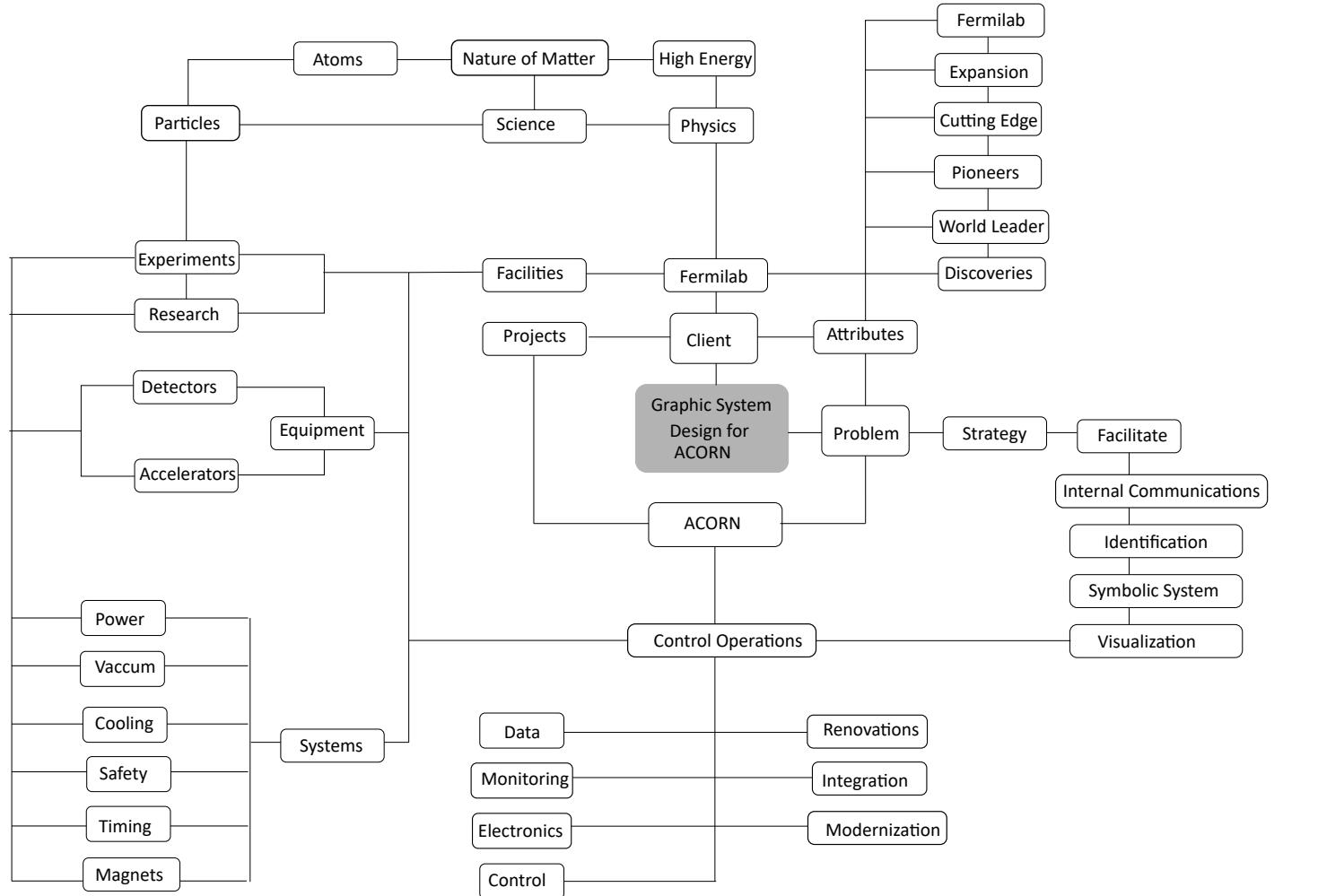
Problem

The project ACORN requires a customized identification that represents its goals; Alongside, a graphic system that contributes to increasing the general understanding among team members and the Fermilab community.

My Observations

It is crucial to be familiar with the Laboratory and specifically with ACORN Project to achieve a better understanding, I intend to combine standard elements in an aesthetic tone the abstract and complex ideas among the team to develop the project.

Mind Map



RESEARCH

Concept

The acronym ACORN stands for Accelerator Controls Operations Research Network.

The project will modernize the accelerator control system and replace end-of-life accelerator power supplies to enable future operations of the Fermilab Accelerator Complex with megawatt particle beams.

The control system will be a unified system that satisfies user requirements, is integrated with and supports operating experiments, is maintainable and adaptable to future needs, and empowers users to achieve research goals.

Understanding Fermilab

A key part of this project is to resemble how a physics research facility operates. To do so, the project's teams share a source of basic concepts associated with the basics.

Fermi National Accelerator Laboratory is a high-energy physics facility that studies the fundamental nature of matter and energy. In simple words, they explore how the world is built and how it works.

The main part of their research focuses on matter at the smallest scale, in other words, elementary particles, pieces of matter that cannot be divided into anything smaller. During the last decades, scientists have looked deeper and deeper into the atom, they have found the smallest things human beings have ever seen before.

Benefit of Particle Physics

- Medicine
- Homeland Security
- Industry
- Computing
- Science

Observations

I understand, now there are more questions, so what is an Accelerator? In brief, next, a summary explains my understanding based on the sources supplied by the team.

Fig. 2. Minos Detector at Fermilab



How they do it ?

To dive in this operation, we must consider the main actors at Fermilab:

Accelerators

The collision of particles at high energy, allows physicists not only to look at what's inside these particles but also to use the energy of their collisions to create different, more massive and more exotic particles of matter.

Detectors

An instrument for counting particles, visualizing tracks, measuring particle energies, recording time of flight, and identifying different particles.

Data Analysis

To analyze the enormous amount of data, particle physicists have always relied on some of the most powerful computers in the world, quickly adopting new computing technologies.

Accelerators

These machines drive discovery; their main aims are research and innovation. Unraveled the mysteries of matter, energy, space, and time-solving some of society's challenges.

The experiments at the accelerator seek a greater understanding of nature by searching for new phenomena and particles and by investigating the properties of the particles and forces. For this purpose in the accelerator interior, the particles collide by increasing their kinetic energy can be converted into mass, meaning heavy particles that did not exist before the collisions started.

Scientists can study these particles through their subsequent decays into lighter particles, which may decay into even lighter particles. All of this takes place in a split second, but detectors record data that allow scientists to piece together what happened. The accelerator collides hundreds of millions of particles per second.



Fig. 3. Control Room at Willson Hall Main Building

Data Analysis

Researchers create software that selects only the most interesting collisions, and they use those collisions to pick out difficult-to-uncover particles and phenomena. Scientists expect that some of these collisions may produce particles of dark matter or those predicted by theories beyond the Standard Model, such as supersymmetry and extra dimensions.

Observations

For my research and personal interest, I went beyond the basic concepts that I don't consider relevant to include here; however, I explored some basic concepts.

Accelerator Complex

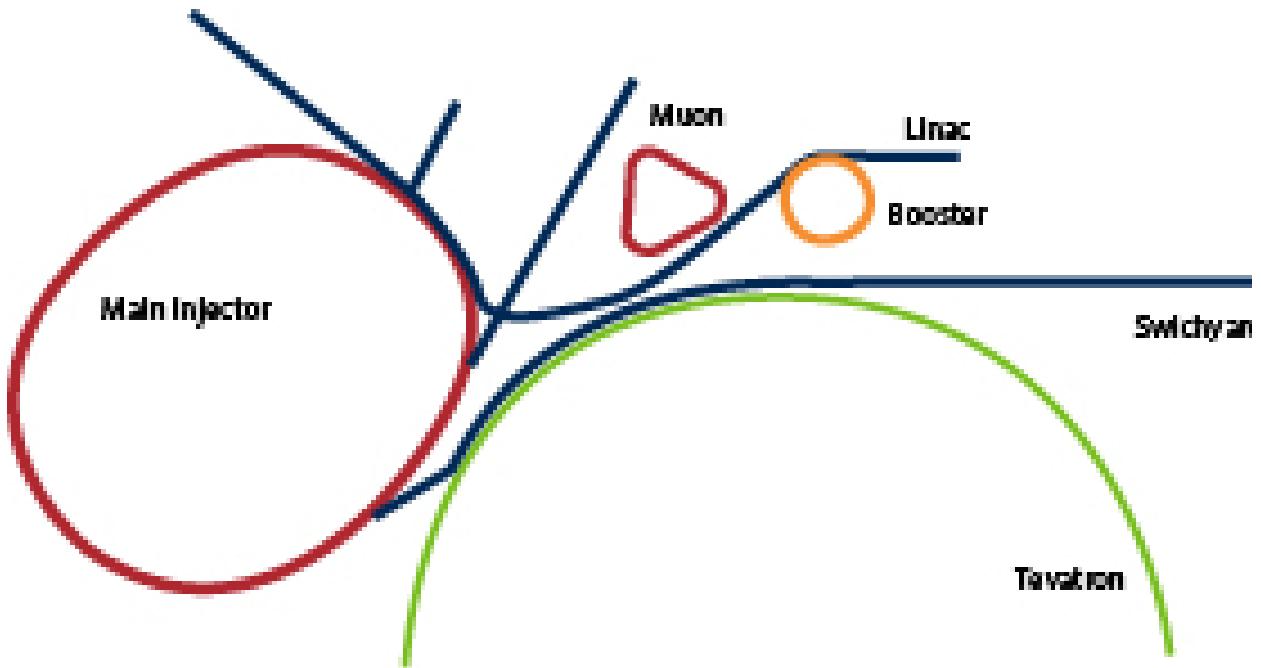


Fig. 3. Diagram of the Accelerator Complex

The accelerator complex comprises four particle accelerators and storage rings—the Linac, Booster, Recycler, and Main Injector—the last of which produces the world's powerful high-energy neutrino beam and provides proton beams for various experiments and R&D programs

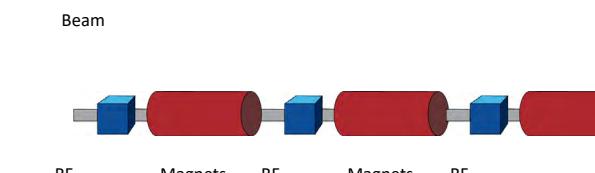


Fig. 4. Linear Accelerator

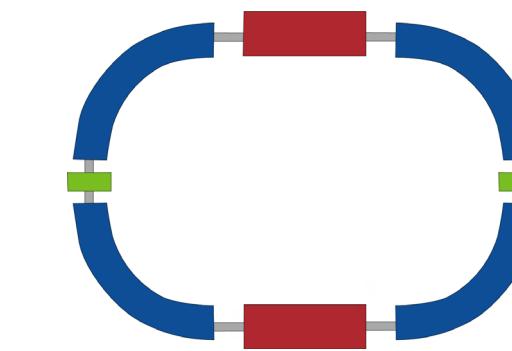


Fig. 5 Synchrotron

An Integrated Control System is an ensemble of interconnected, distributed control and computing systems for different control domains and purposes. At this point, it is relevant to talk about the intricacies of the operation of the accelerator. To explain this, examine the main components that make up particle accelerators:

Magnets

Magnets change the direction of particles' trajectory. Accelerators either use permanent magnets or electromagnets. Electromagnets change their fields by adjusting the amount of current we supply them.

RF cavities.

Radio Frequency (RF) systems accelerate charged particle beams. The RF cavity is an electro-magnetically resonant structure.

Specific Project: ACORN

Many complex physical processes have to be concerted, such as proton beam acceleration, neutron beam production, and the characterization and conditioning of experimental material samples. These processes depend on others enabling magnetic field generation, equipment cooling, motion control, supply of electrical power, and highly sophisticated measurements for their characterization. The related equipment (electromagnets, neutron detectors, cooling systems, etc.) are controlled and monitored by operating staff, engineers, and researchers through many different and distributed but interconnected control systems.

The development of the ACORN, Accelerator Controls Operations Research Network, requires a team of specialists in many fields, such as industrial automation, software engineering, computer science, safety engineering, network infrastructure design, electrical engineering, accelerator technology, neutron scattering technology, and even natural sciences domains. That is why ensured mutual understanding by defining a system that provides a better way to visualize the systems, applications, users, control devices, electronic equipment, physical equipment, etc.

Fig. 5. Minos Detector

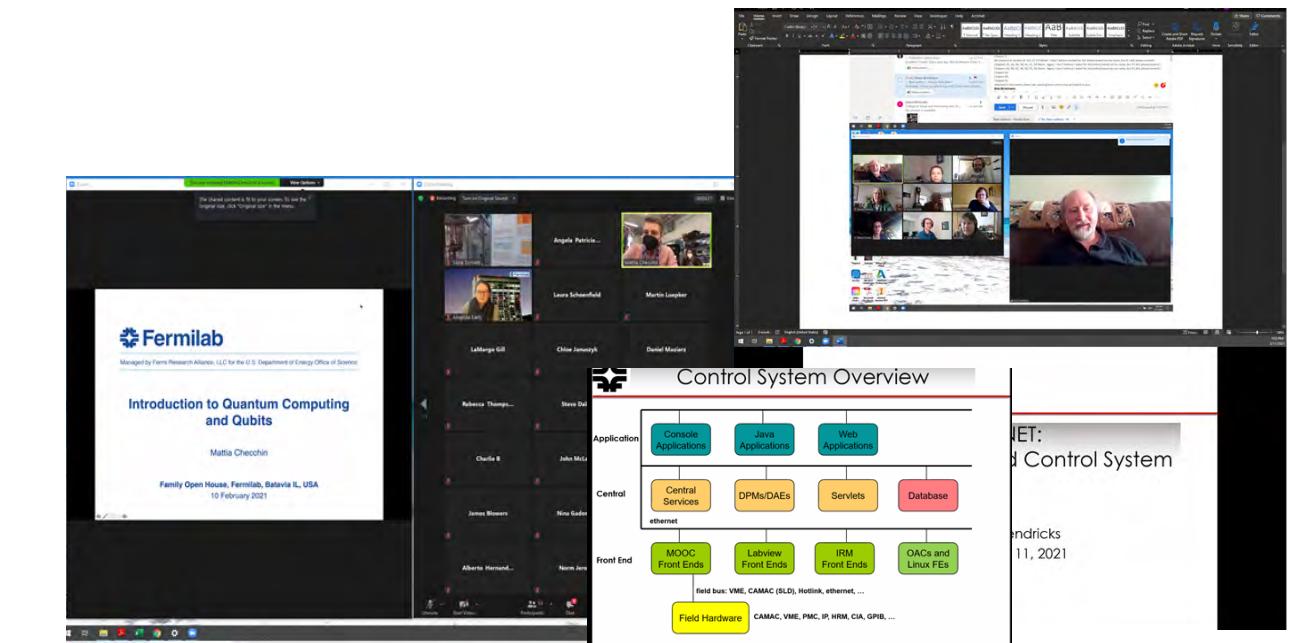
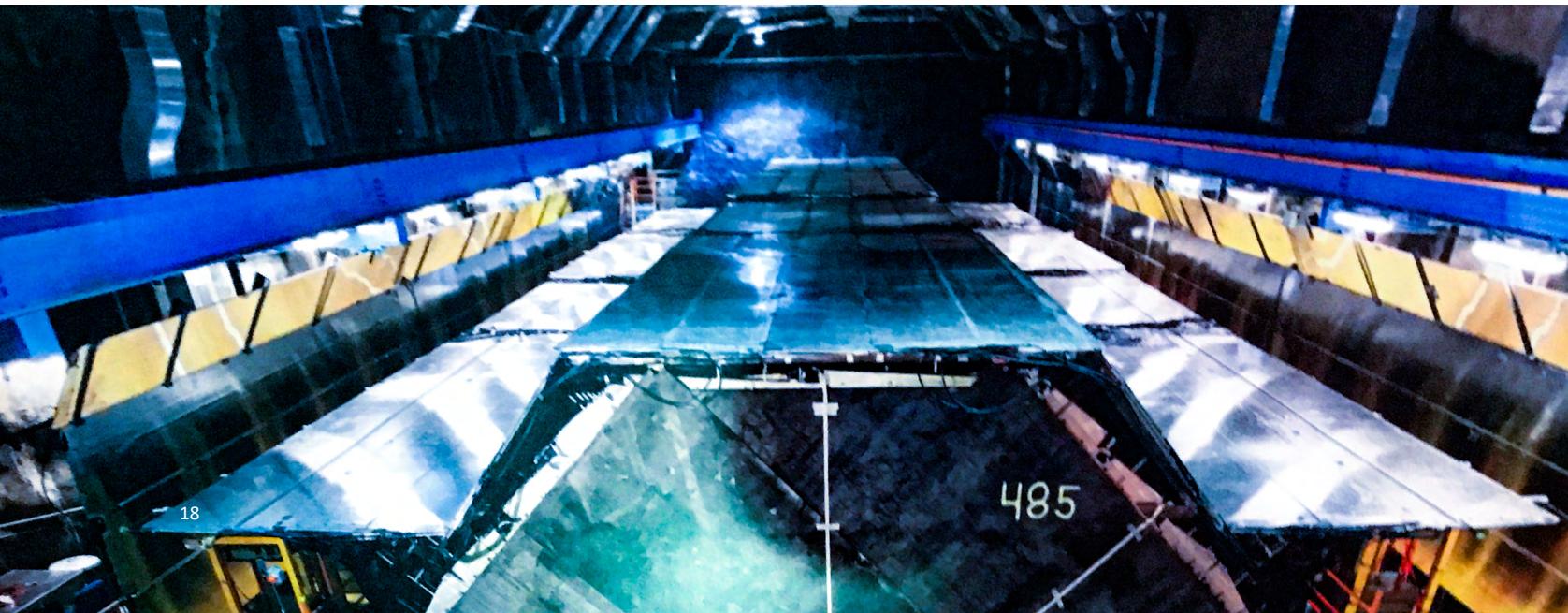


Fig. 4. Screen Shots of Meetings and Conferences attended

Resources

Observations

To get involved in the scientific world of Fermilab, I attended a couple of meetings with the team and a workshop in which Fermilab's employees spread the latest scientific developments and topics.

Fermilab's Graphic Standards

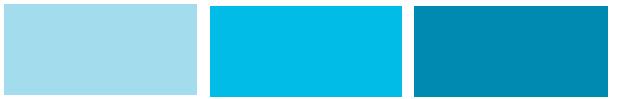
Color Pallets

Primary



NAL Blue Light	NAL Blue	NAL Blue Dark
RGB: 65, 182, 230	RGB: 0, 76, 151	RGB: 0, 40, 85
Hex: #41B6E6	Hex: #004C97	Hex: #002855
CMYK: 67, 2, 0, 0	CMYK: 100, 53, 2, 16	CMYK: 100, 69, 8, 54

Secondary



Marlin Blue Light	Marlin Blue	Marlin Blue Dark
RGB: 153, 214, 234	RGB: 0, 181, 226	RGB: 0, 133, 173
Hex: #99D6EA	Hex: #00B5E2	Hex: #0085AD
CMYK: 34, 0, 5, 0	CMYK: 75, 0, 5, 0	CMYK: 93, 4, 8, 24



AL Green Light	NAL Green	NAL Green Dark
RGB: 120, 190, 32	RGB: 76, 140, 43	RGB: 54, 87, 59
Hex: #78BE20	Hex: #4C8C2B	Hex: #36573B
CMYK: 65, 0, 100, 0	CMYK: 76, 3, 100, 18	CMYK: 59, 0, 69, 75



Prairie Gold Light	Prairie Gold	Prairie Gold Dark
RGB: 245, 225, 164	RGB: 254, 209, 65	RGB: 234, 170, 0
Hex: #F5E1A4	Hex: #FED141	Hex: #EAAA00
CMYK: 0, 4, 27, 0	CMYK: 0, 11, 80, 0	CMYK: 0, 30, 100, 0

Fonts

Primary Typefaces

Helvetica Bold

abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
0123456789

Helvetica Bold

abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
0123456789

Substitute Typefaces

Arial Bold

abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
0123456789

Arial Regular

abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
0123456789

Observations

As a designer, it is essential to be creative.
Also, sometimes, it is necessary to adapt
to already established standards; this work
followed Fermilab's graphic standards.



Red Light	Red	Red Dark
RGB: 175, 39, 47	RGB: 138, 42, 43	RGB: 100, 51, 53
Hex: #AF272F	Hex: #8A2A2B	Hex: #643335
CMYK: 5, 96, 80, 22	CMYK: 0, 97, 87, 53	CMYK: 30, 85, 59, 70



Orange Light	Orange	Orange Dark
RGB: 246, 141, 46	RGB: 203, 96, 21	RGB: 185, 71, 0
Hex: #F68D2E	Hex: #CB6015	Hex: #B94700
CMYK: 0, 54, 87, 0	CMYK: 1, 72, 100, 7	CMYK: 2, 77, 100, 9



Gray 45	Gray 75	Rich Black
RGB: 167, 168, 170	RGB: 99, 102, 106	RGB: 0, 0, 0
Hex: #A7A8AA	Hex: #63666A	Hex: #000000
CMYK: 0, 0, 45	CMYK: 0, 0, 75	CMYK: 75, 68, 67, 90

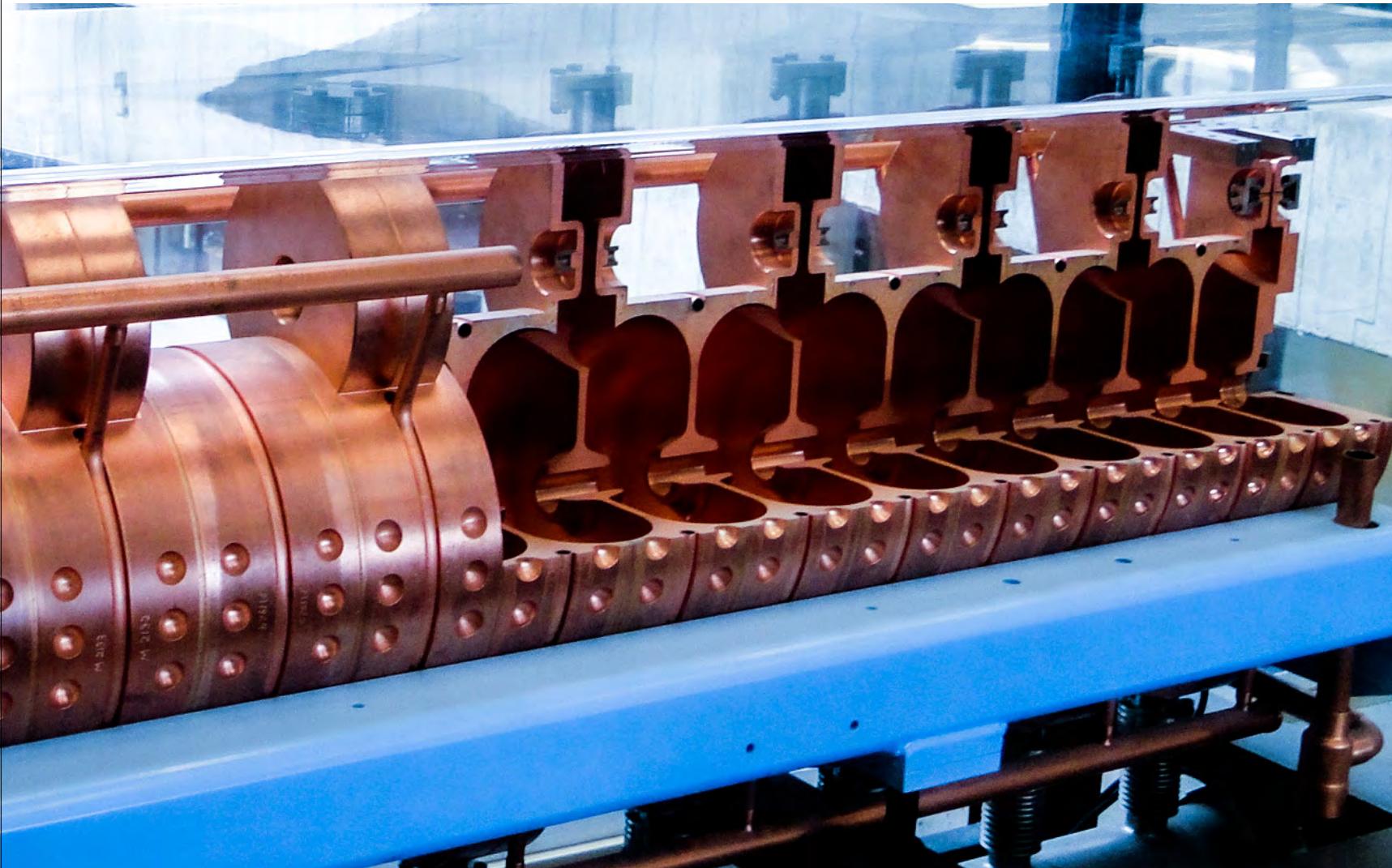


Fig. #. Radio Frequency Cavities, a beam of particles enter through the hole on the side and travels gaining speed and energy.

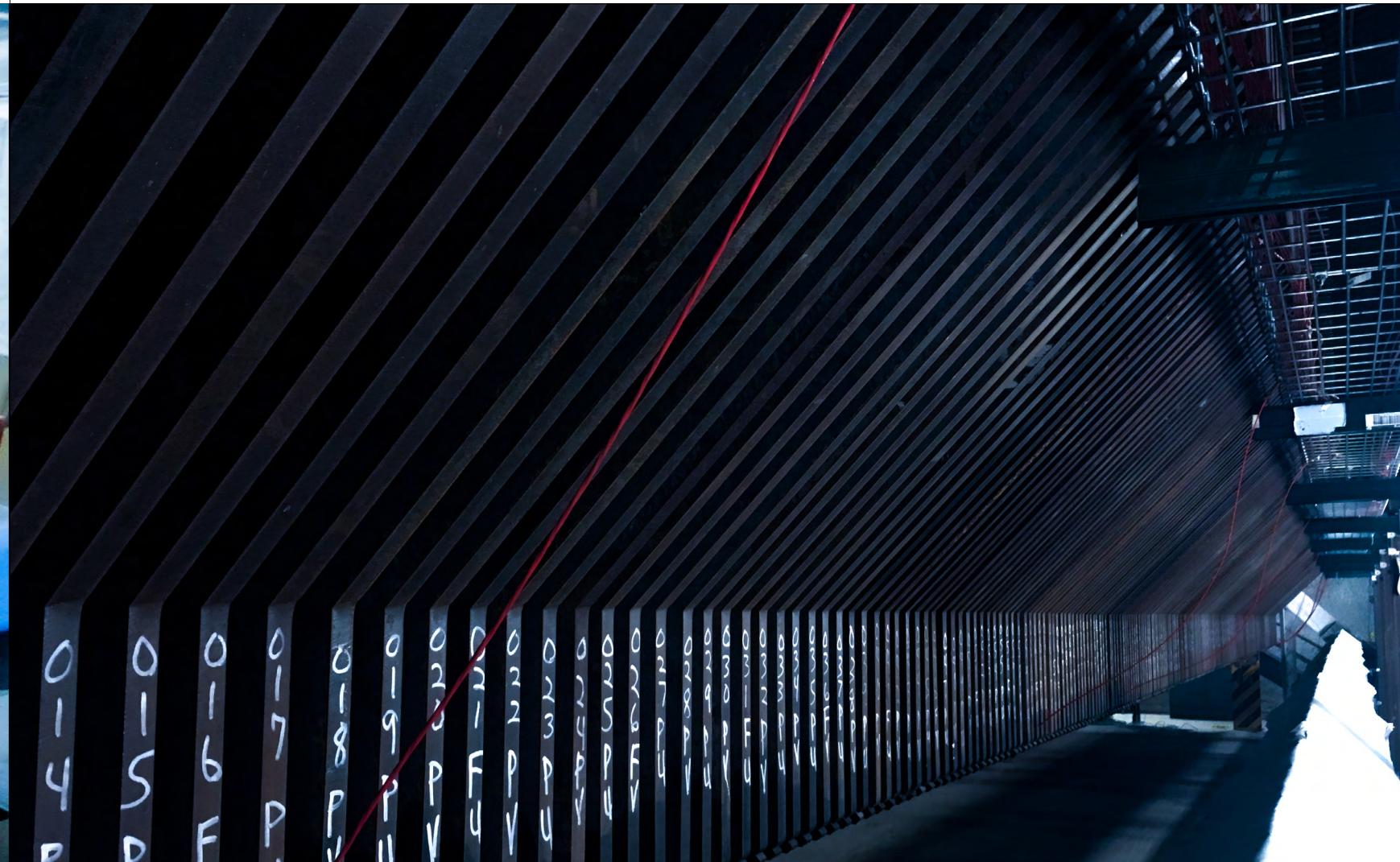
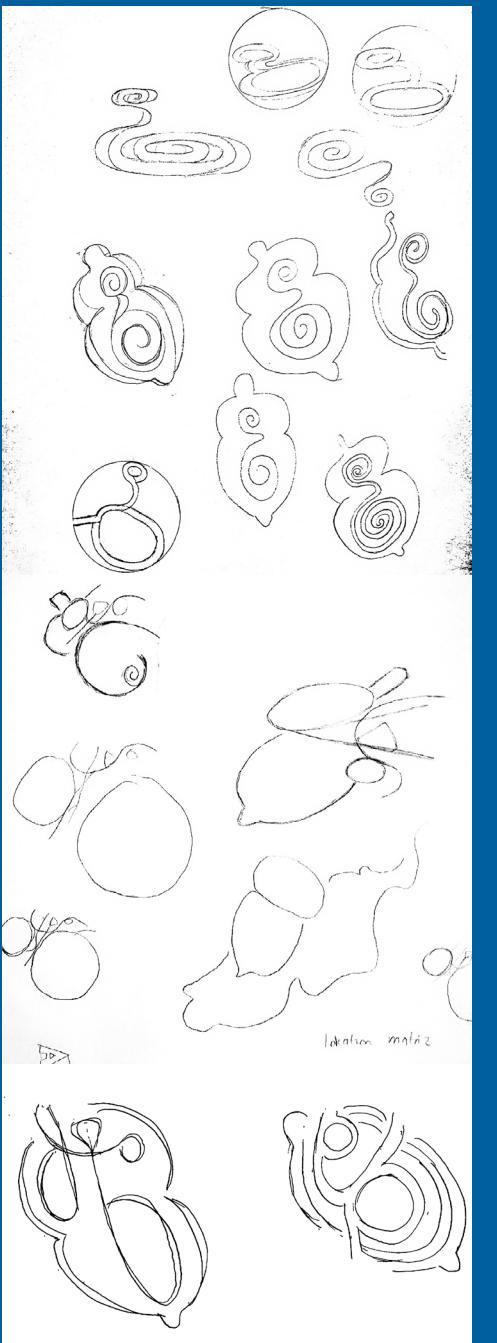


Fig. #. Detector Plates

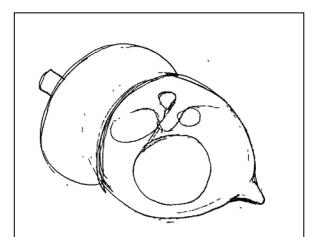
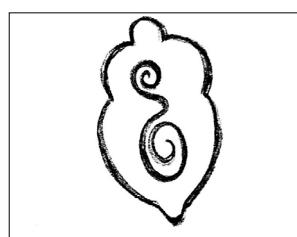
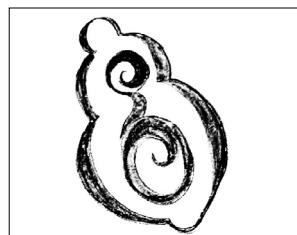
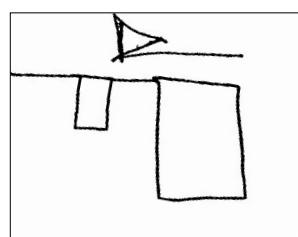
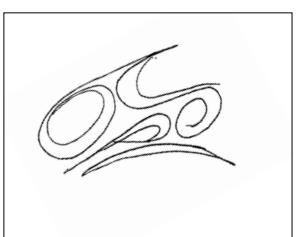
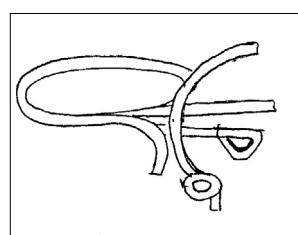
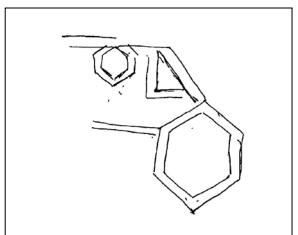
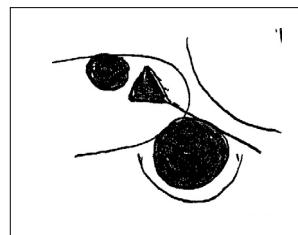
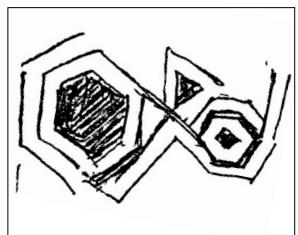
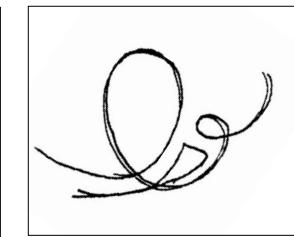
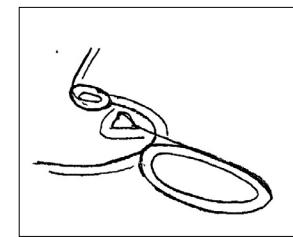
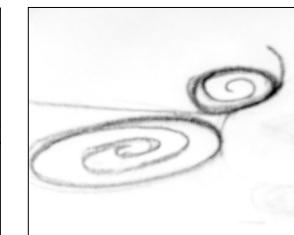
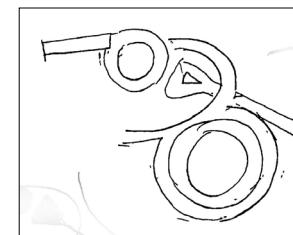
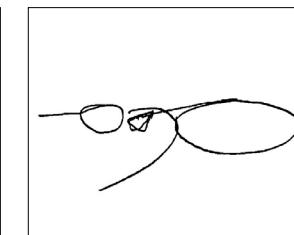
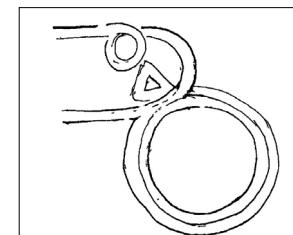
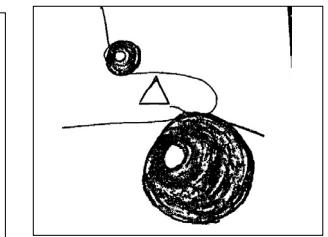
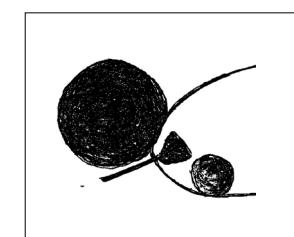
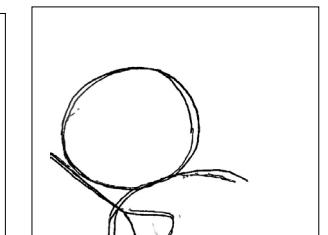
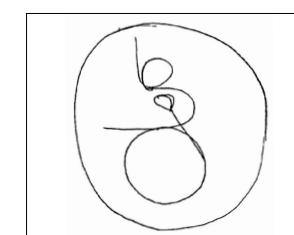
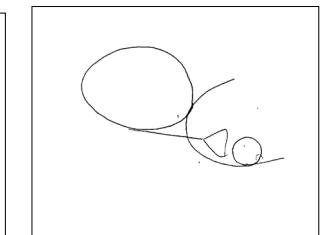
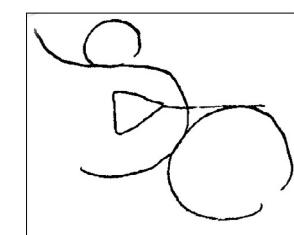
I D E A T I O N



A t t r i b u t e s m a t r i x

	ACORN	ACCELERATOR	FERMILAB
ACCELERATOR COMPLEX			
SCIENCE			
AVANT-GARDE			

In the first place, the ideation matrix relate attributes and project's concepts.

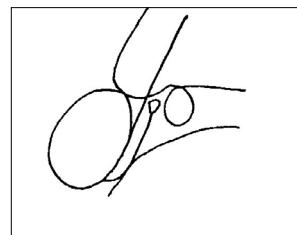
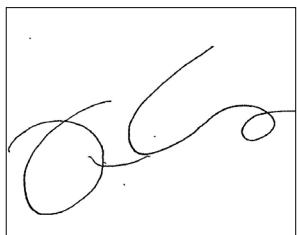
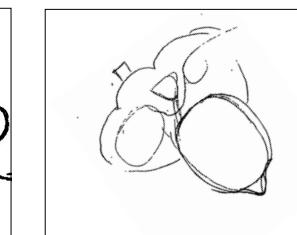
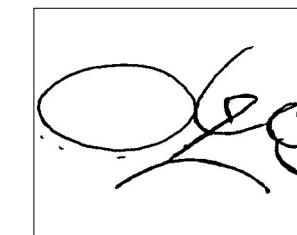
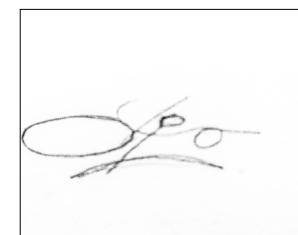
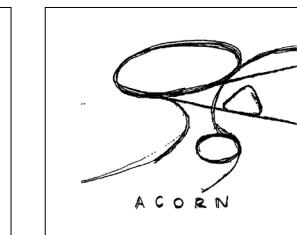
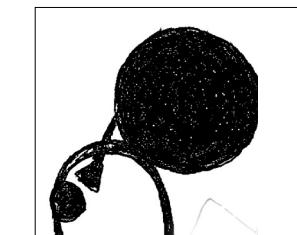
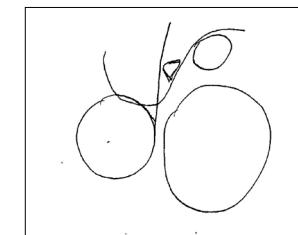
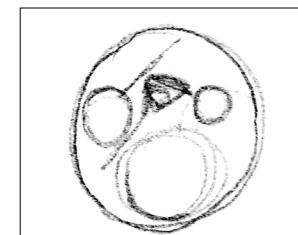
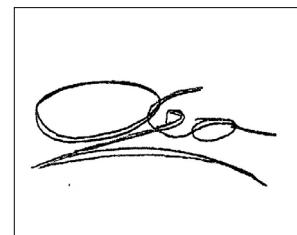
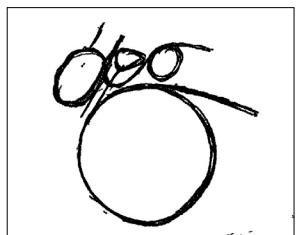
Combinations**Substitutions****Modifications****Adaptations**

Spirals suggesting the accelerator complex framed with acorn shape.

Geometric shapes exploration resembling the Accelerator Complex.

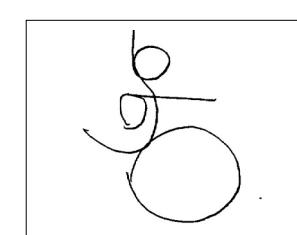
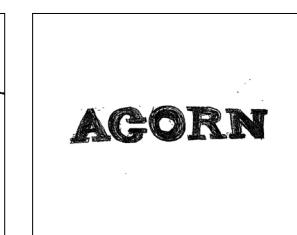
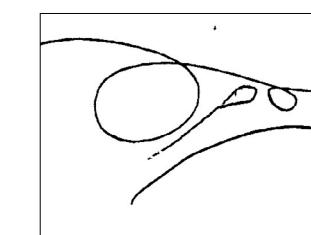
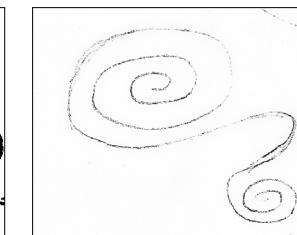
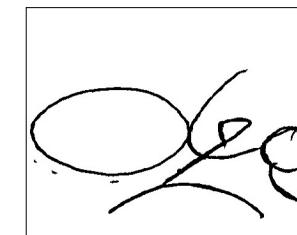
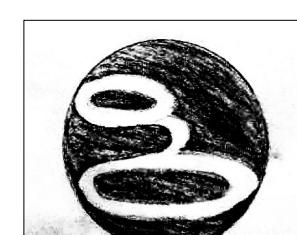
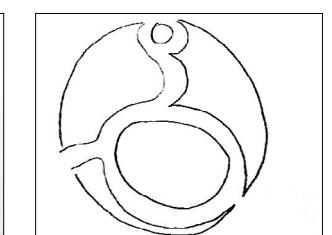
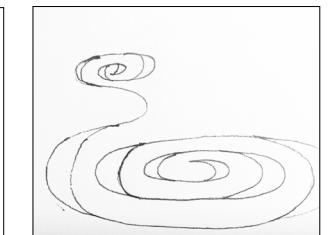
Line diverse treatment, spirals, and repetition.

Tensions and energies related to points, lines, and planes.

Rotation**Place**

Technology aesthetics, realistic, and dynamic.

Forces that influence the accelerator and push it in a particular direction.

Eliminate**Reverse**

GRAPHICS DEVELOP

Beginning with Vectors

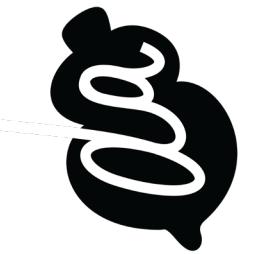
The most interesting concepts are presented to the team in a survey where options 3 and 5 obtained 40% of people in favor.



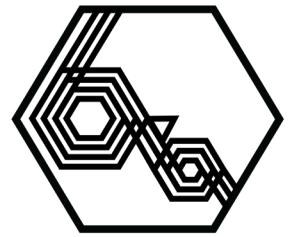
Observations

The first ideas are presented to the client; however, they were not a good fit considering the attributes and the sense of modern and technological aesthetics.

Survey Options



Option 1



Option 2



Option 3



Option 4



Option 5

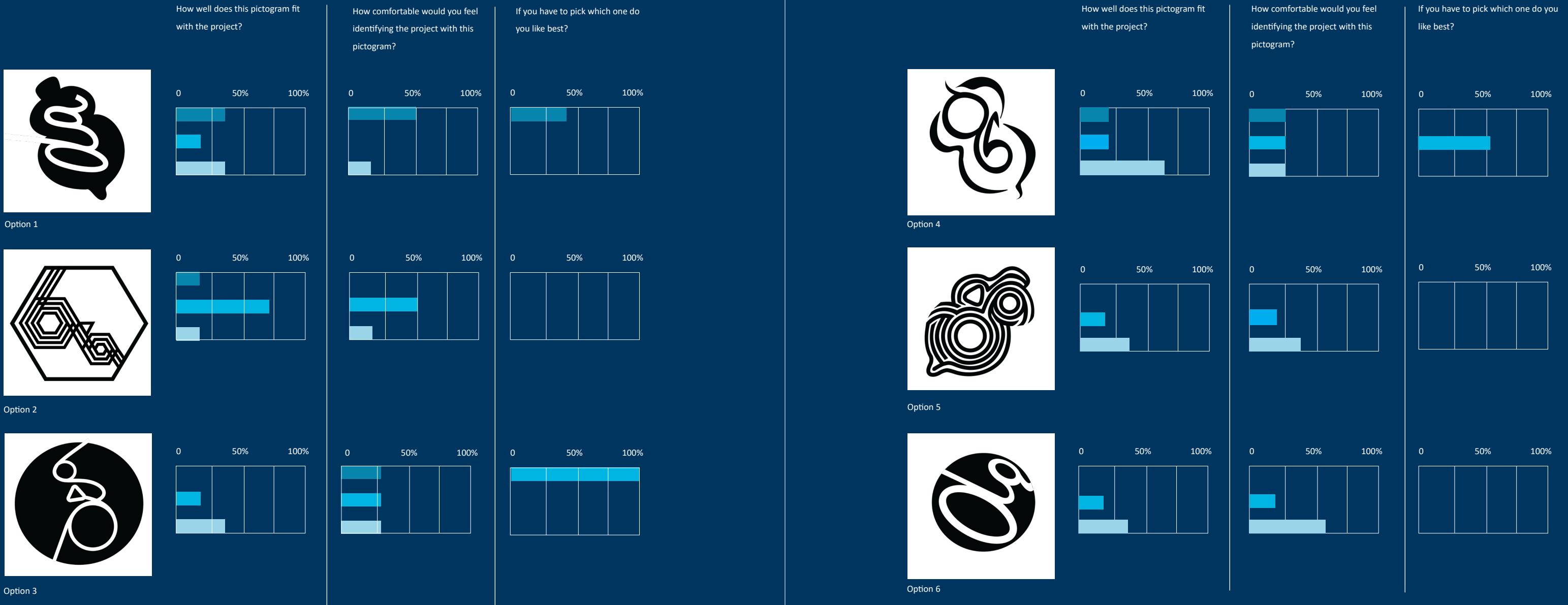


Option 6

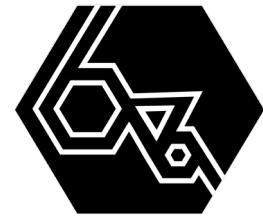
E V A L U A T I O N

The larger and darkest bars indicate majority in favor of the option. So, options 2, 3, and 4 were refined and went to a second survey.

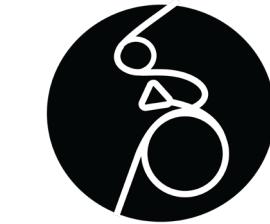
Total Participants 7.



Color Pallets



Option 2



Option 3



Option 4



Observations

The options 2, 3, and 4 are presented to team utilizing the Nav blue, tins, and shades.

Type Treatment



ACORN

ACORN



AC^{OR}N

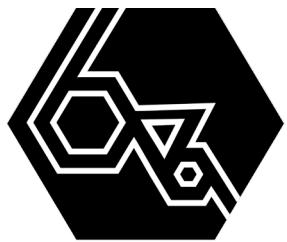
AC^{OR}N

Observations:

The pictograms is placed in combination with the acronym applying Helvetica and Eurostile.

FINAL EVALUATION

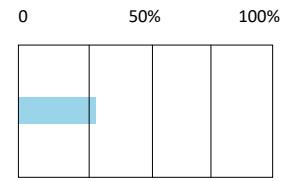
Which option does suit the project best?



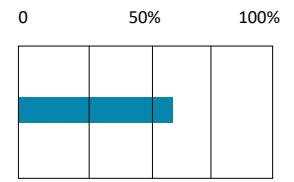
Option 1



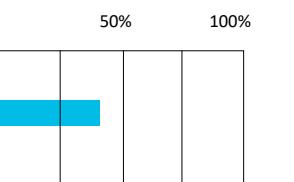
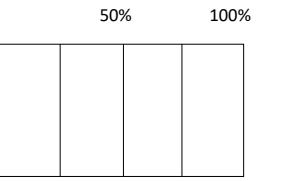
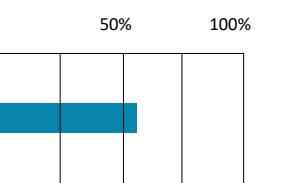
Option 2



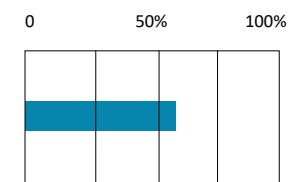
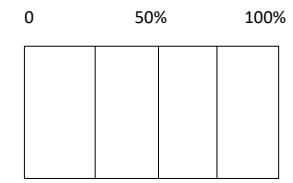
Option 3



If you pick option 1, which color pallet works best?

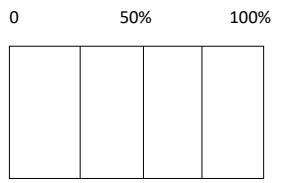


If you pick option 2, which color pallet works best?

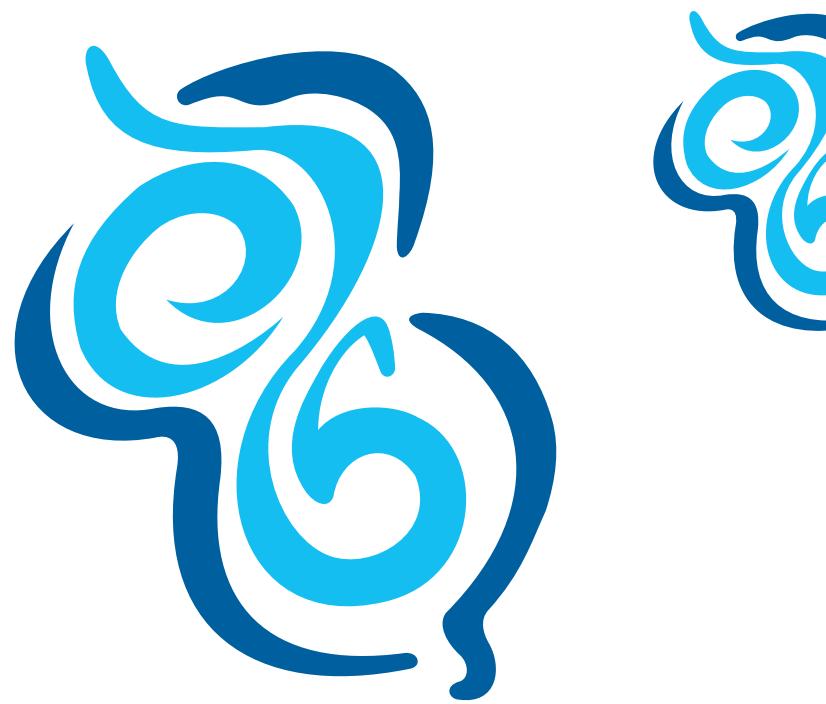


In a second survey the participants select among three options according to the selection they can also select the color version. Total Participants 9.

If you pick option 3, which color pallet works best?



Final



After the second survey, this pictogram is the favorite design; the winner in different sizes.

Inverted Colors



The inverted colors keep the same color for the shapes that resemble the particles pathways due to its importance.

Type Match



Colors

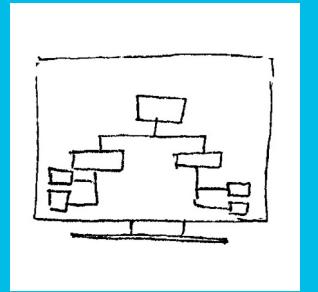
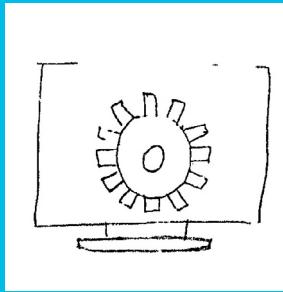
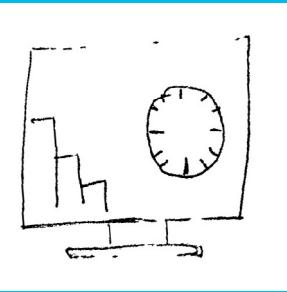
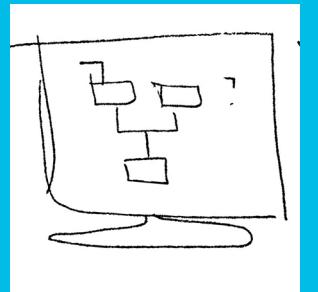
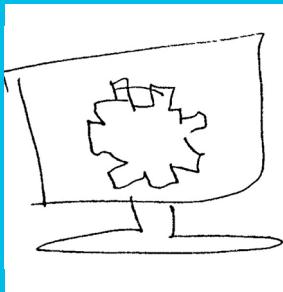
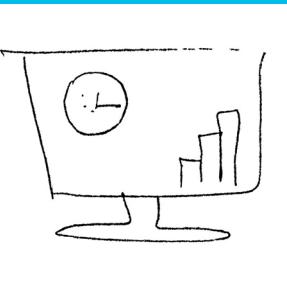




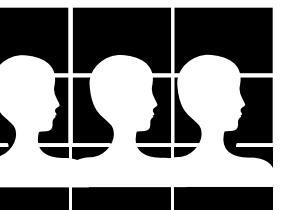
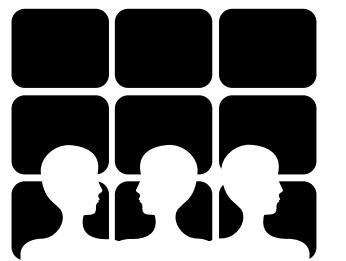
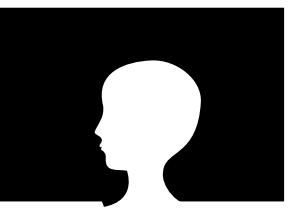
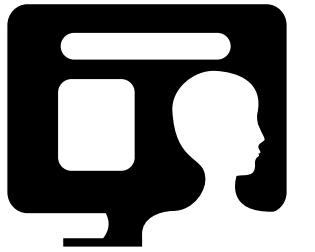
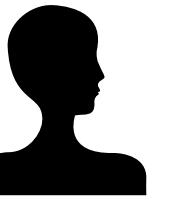
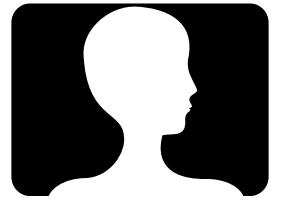
G R A P H I C S Y S T E M

The icons are created and customized by Fermilab's graphic standards. Besides, the appearance matches the curvilinear shape and colors of the ACORN's pictogram.

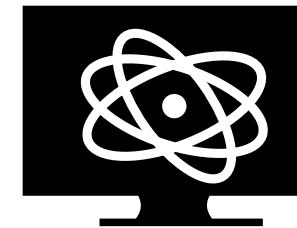
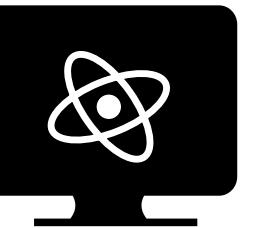
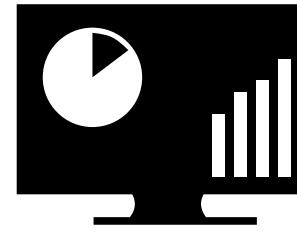
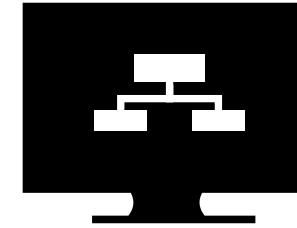
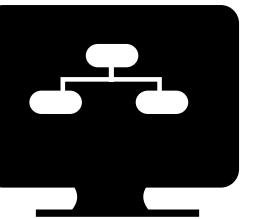
I d e a t i o n



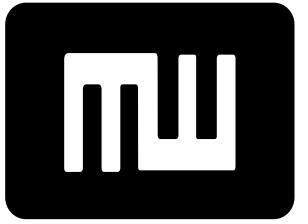
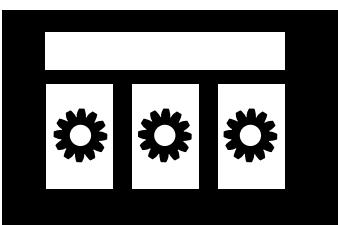
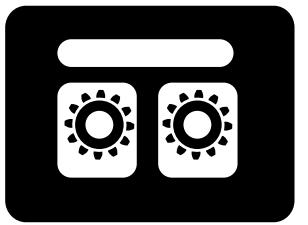
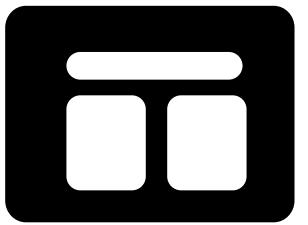
Human Users



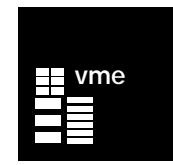
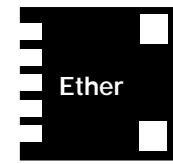
Applications



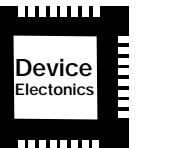
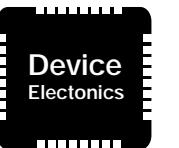
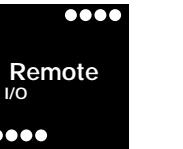
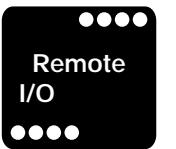
Facility Integration



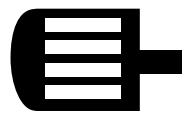
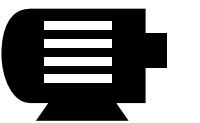
Logical System



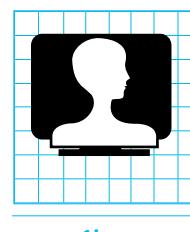
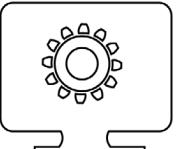
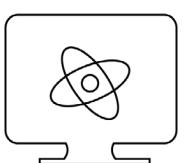
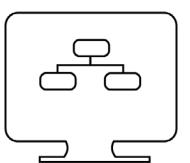
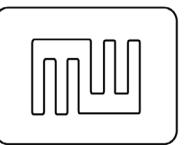
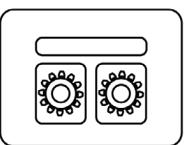
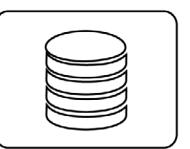
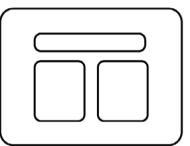
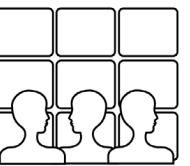
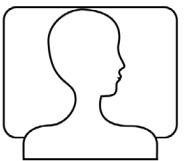
Signal Condition



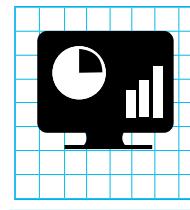
Physical Equipment



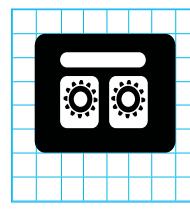
Refining



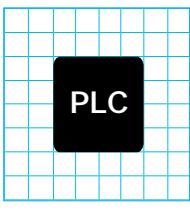
1in



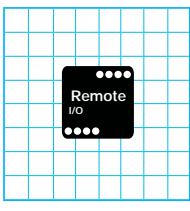
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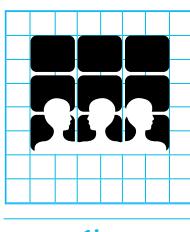
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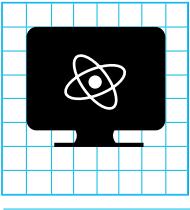
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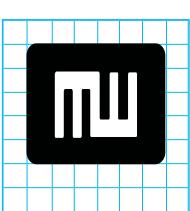
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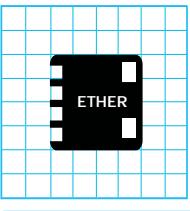
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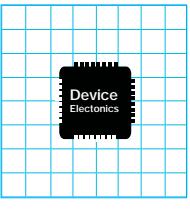
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1in



1in

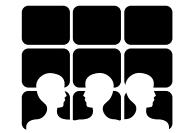


1in

Human Users



Human Interfaces



Control Room

Logical System



Process Local Control



ETHER



VME



LEPR



Remote



Controller



Device Electronics

Applications



System GUI's



Equipment GUI's



Physics App



Configuration App



EHS GUI's

Facility Integration



Virtual Front End



MOOC Front End



EPIC



Data Logger

Physical Equipment



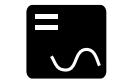
Sensor



Pump



Motor



Converter



Electricity



Magnetism



Water Flow



Water Flow

Human Users



Human Interfaces



Control Room

Logical System



Process Local Control



ETHER



VME



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Water Flow



Water Flow

Facility Integration



Virtual Front End



MOOC Front End



EPIC



Data Logger

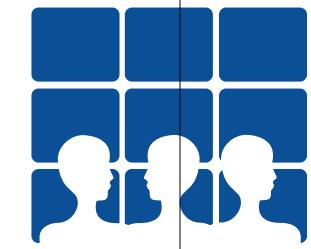
Control System layout

**Display ESS facility
data, task execution**

ESS facility data exchange

Data Network

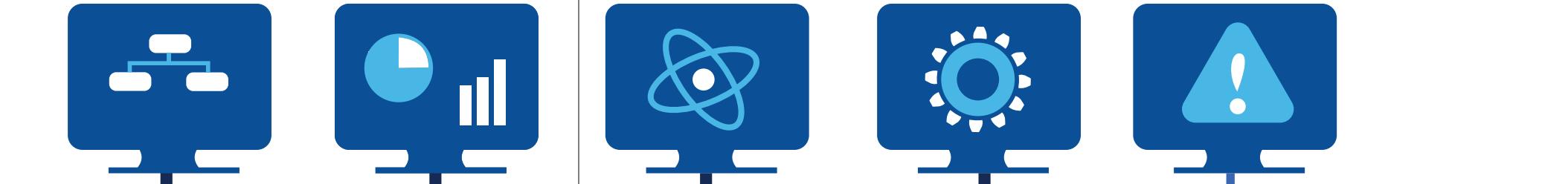
Event Generator



Control Room



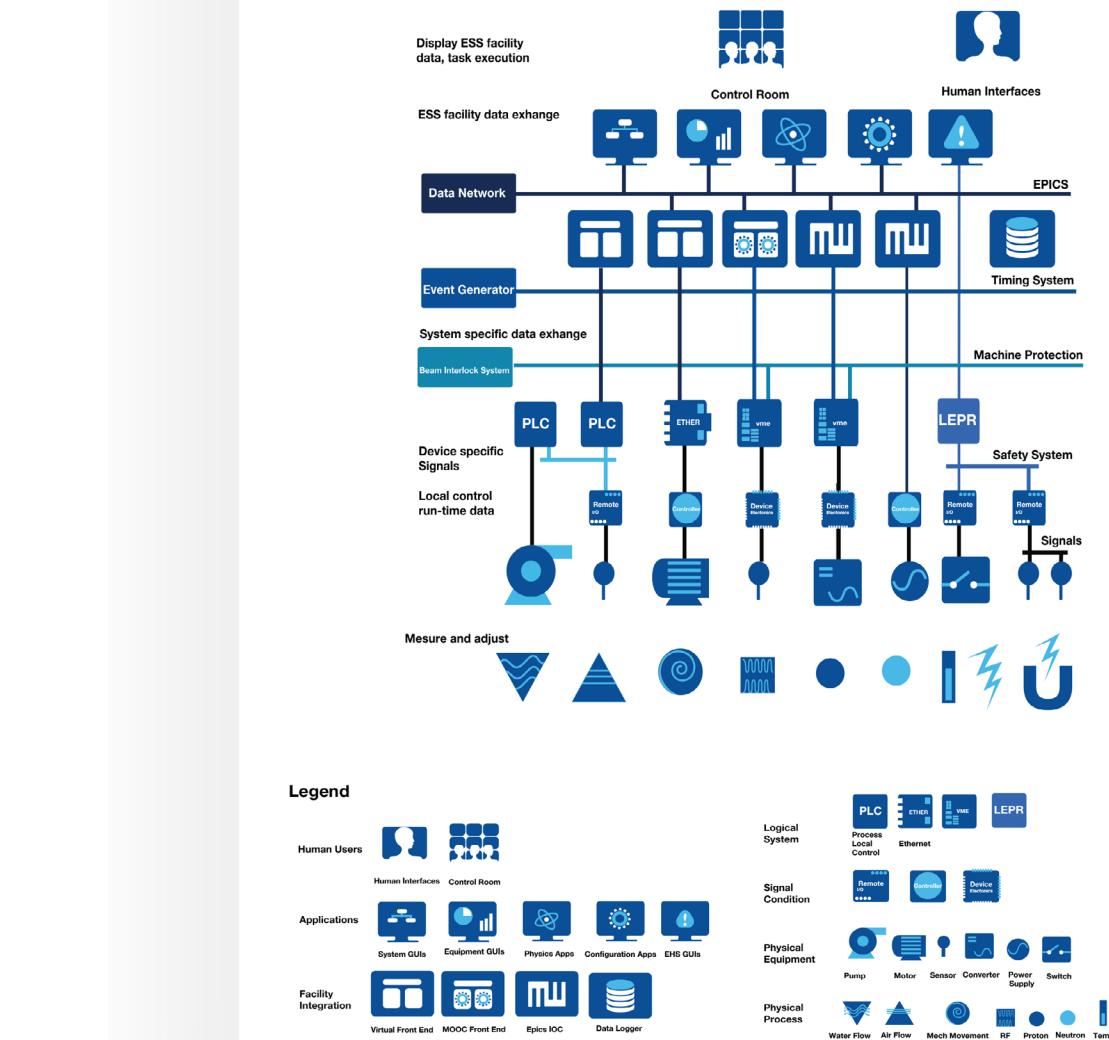
Human Interfaces



Timing System



Control System Layout



Accelerator Complex Conceptualization

