

THE HBCU SUSTAINABLE AGRICULTURE INNOVATION CONSORTIUM

FLORIDA A&M UNIVERSITY • ALABAMA A&M UNIVERSITY • TUSKEGEE UNIVERSITY
TENNESSEE STATE UNIVERSITY • NORTH CAROLINA A&T STATE UNIVERSITY

AGRI-TECH-TURE

FOR COLLABORATIVE RESEARCH & DEVELOPMENT
INNOVATING SUSTAINABLE AGRICULTURE TODAY

*Nature is my
laboratory.*

— G. Washington Carver



FOOD SECURITY



WATER CONSERVATION



CLEAN ENERGY



COMMUNITY
EMPOWERMENT

*To elevate
a people,
you must
elevate
agriculture."*

— Henry A. P. Blair.

DAVID BLACKWELL

THE GREAT MATHEMATICIAN

His equations shaped the future
of data, probability and
intelligence.



HSAIC

HBCU SUSTAINABLE AGRICULTURE
INNOVATION CONSORTIUM

GLADYS MAE WEST GPS MATHEMATICIAN

Her calculations help the world
navigate with precision,
including the future of farming.

FAITH. LAND. LEGACY.
THE KINGDOM HARVEST INITIATIVE

RESEARCH • INNOVATION • COLLABORATION • STEWARDSHIP • SUSTAINABILITY

BUILDING A SUSTAINABLE FUTURE. TOGETHER.
FOR GENERATIONS TO COME.

BY: B. HILL-GLENN

Engineering Concepts Phase 2 Student Guide

Conceptual Design and Facility Visioning

Agri-Tech-Ture Capstone Competition

Session presenters: Berry Glenn, III and Dr. Odell Glenn Jr.

Use your Phase 1 market research to propose a facility that can serve a defined customer need. By the end of this session, your team should be able to explain what it will build, who it will serve, what it will produce, how it will operate, and what major costs it expects.

What to submit for Phase 2

1. Facility concept narrative explaining what is being built, for whom, and why.
2. Production goals and proposed products.
3. Technology strategy and core operating concept.
4. Preliminary cost model with major cost categories.

The training also uses a simple facility block diagram to help explain the concept. Use the templates in this guide as preparation aids, then assemble the four submission items in the format requested by the organizers.

The 65 minute training session

Activity	Time	Your task
Phase 1 review	15 min	Identify evidence to carry forward and gaps to resolve.
Training module	20 min	Learn to connect customers, production, technology and costs.
Example walkthrough	10 min	Review the narrative, diagram and planning tables.
Team work session	15 min	Draft your concept and record research assignments.
Next steps	5 min	Confirm what to complete and submit.

Original schedule in the session document: training September 3, 2026; Phase 2 deliverable September 17, 2026. Confirm the current submission instructions with the competition organizers.

Team or company: _____

Current due date: _____ Submission destination: _____

Turn market research into facility requirements

Start with the Phase 1 submission: company identity, mission, leadership roles, target customers, market research and community impact. Review the claims your team can support, then identify the facility decisions each finding affects.

Connect each customer need to a design decision

Phase 1 finding	Facility decision	Evidence to record
Product and quality needs	Choose crops or fish and define handling requirements.	Buyer interview or a dated market source.
Purchase quantity and timing	Set a production target and harvest schedule.	Quantity, units, frequency and level of buyer commitment.
Delivery or pickup needs	Plan packaging, storage and distribution zones.	Delivery window, packaging and receiving needs.
Community or education goal	Define training activities and observation space.	Who participates and how you will measure the benefit.
Proposed location	Identify access, water, power and space needs.	Site information and questions that remain open.

Example: if interviews suggest that nearby restaurants need a consistent weekly lettuce delivery, your concept should explain the lettuce production target, harvest timing, packaging and delivery approach. Treat an expression of interest as interview evidence until a purchase commitment is documented.

The customer need our facility will address

Name a specific buyer group and the problem your research identifies.

[Enter your team response here]

Our strongest supporting evidence

Record the source or interview, date, finding and units.

[Enter your team response here]

The main gap we must resolve

State the unanswered question and name the team member who will research it.

[Enter your team response here]

Keep three labels clear throughout your submission: sourced fact, buyer self-report and team assumption. A planning assumption should include a way to test it.

Write the facility concept narrative

Prepare a one-page narrative that a reader can understand without a presenter. Connect the customer need to the proposed facility, products, operating approach and reasons the concept could work. Explain uncertainty where the evidence is incomplete.

Begin with three sentences

Sentence 1 describes the need

Our team proposes [facility type] in [proposed location] to serve [customers] who need [product or service].
[Enter your team response here]

Sentence 2 explains the operation

The facility will use [production system] to target [quantity and unit per period], supported by [main spaces and services].
[Enter your team response here]

Sentence 3 explains the basis

Our research suggests [supporting finding]. We still need to verify [key assumption] before developing the concept further.
[Enter your team response here]

Expand the draft into one page

Add the proposed products and production schedule, the likely site or site selection criteria, the main functional zones, the sales or delivery channel, and the community benefit. State why the chosen technology fits the customer need and which utility, staffing or capacity assumptions require research.

Illustrative example

CampusHarvest AgriTech proposes a hydroponic greenhouse near its campus to supply lettuce to nearby restaurants. The concept assumes five buyers each need 100 heads per week, creating a target of 500 marketable heads weekly. The facility would include growing, packaging, appropriate storage, distribution and student training zones. A recirculating nutrient system would support plant production, with monitoring and maintenance assigned to trained operators. The team would investigate buyer demand, crop performance, site utilities and equipment costs before refining the facility size and budget.

This company, demand and production target are fictional teaching examples. Replace them with your team's research; they are not recommended design values.

Set production goals with clear units

State what the facility will produce, who will buy it, and how much you intend to deliver. Distinguish customer demand from the facility's production capacity. A target becomes more credible when its assumptions and supporting sources are visible.

Complete your production goal table

Product	Target customer	Target output	Harvest or delivery timing	Sales channel
[Crop or fish]	[Buyer group]	[Quantity and unit]	[Per week, month or cycle]	[How it reaches the buyer]
[If applicable]	[Buyer group]	[Quantity and unit]	[Frequency]	[Channel]

The basis for our output target

Record buyer demand evidence and any crop or fish production assumptions. Cite sources and dates.

[Enter your team response here]

Check the logic behind the target

In the fictional example, five buyers ordering 100 heads each per week would require 500 marketable heads weekly. That demand does not establish how many growing positions or how much floor area the facility needs.

For a calculation exercise only, assume a 90 percent marketable rate and a six-week seed-to-harvest cycle with weekly cohorts. Dividing 500 by 0.90 and rounding up gives 556 plants started per week. Six weekly cohorts would represent 3,336 occupied plant positions if every plant occupies one position for the full cycle. Actual nursery stages, spacing, losses and harvest timing can change that requirement.

Do not convert this example into building area without researching the growing system, spacing, aisles, nursery and support zones. For fish, state species, harvest weight and harvest period separately; plant harvest timing does not establish fish output.

Our capacity assumptions

List the crop cycle or fish growth period, expected losses, growing positions or tank basis, and operating schedule.

[Enter your team response here]

The source we will use to verify capacity

Name the university extension resource, technical adviser, trial result or system supplier, and assign an owner.

[Enter your team response here]

Select the technology and explain its operation

Describe both the production method and the facility enclosure. Hydroponics and aquaponics describe production systems; a greenhouse or converted container describes a place those systems may operate. Compare options against your products, available space, utilities and team skills.

Option	Core concept	Question your team should resolve
Hydroponics	Plants receive nutrients through water without soil, with roots in solution or soilless media. [1]	Which system fits the crop, and how will water quality and nutrient delivery be monitored?
Aquaponics	Combines fish culture and hydroponic plants. Microbes help convert fish wastes into plant nutrients. [2]	How will the team manage the fish, plants, filtration and water quality together?
Greenhouse	An enclosure that uses natural light and may need environmental controls or supplemental lighting. [1]	What production method will it contain, and what seasonal control needs must be researched?
Container farming	Growing inside a converted container or similar enclosed module.	What space, lighting, ventilation and service assumptions does the proposed module require?
Mixed production	Combines more than one product or production approach.	What customer need justifies the added systems, space and operating tasks?

Our proposed method and enclosure

For example, a hydroponic system inside a greenhouse. State the product and why this combination fits your market.

[Enter your team response here]

Describe the core operating concept

- Explain how inputs such as seed, nutrients or fish feed enter the production system and how products are harvested.
- Identify the water, electrical service, lighting and environmental controls your concept will need.
- Describe what operators will monitor, who will do it, and how maintenance or interruptions will be addressed.
- Explain how products move into packaging, storage and delivery, and what students will learn through the operation.

The main tradeoff and our next research task

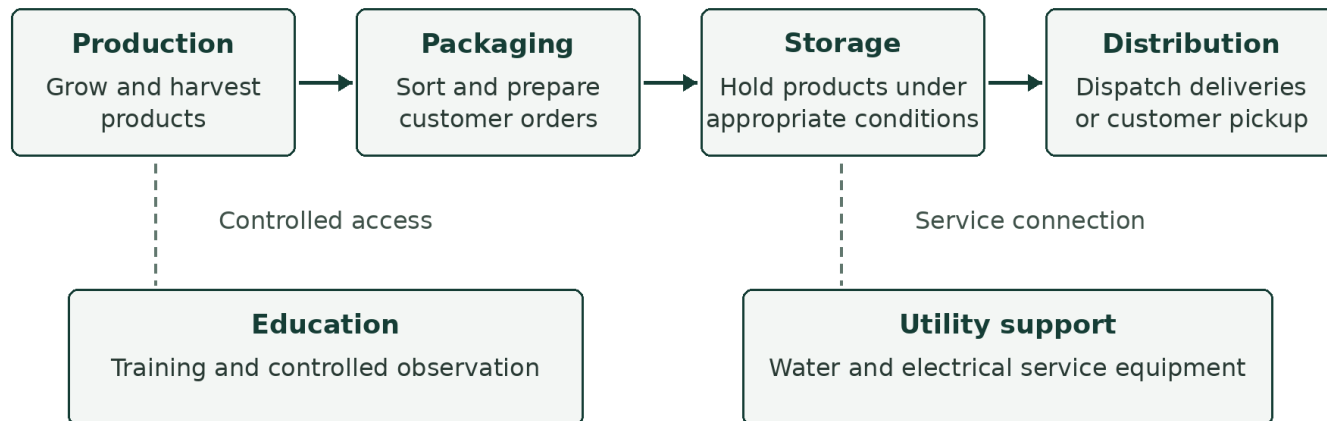
Name one limitation of your selected approach and the evidence needed to evaluate it.

[Enter your team response here]

Technical reading links for [1] and [2] appear on page 9. The system descriptions are an introduction; use crop- and system-specific research when refining your concept.

Map the facility zones and product flow

Use a simple block diagram to show the spaces your concept needs and how products move between them. Label the zones and arrows. At this stage, the diagram explains functions and relationships; dimensions can remain assumptions to research.



Illustrative functional diagram. Solid arrows show product flow; dashed connections show controlled access and utility service. This is not a scaled floor plan.

Describe the zones your team proposes

Zone	Purpose in our concept	Space or operating assumption
Production	[Growing or fish culture activities]	[System, capacity or access assumption]
Packaging	[Harvest preparation and order packing]	[Work areas or equipment to research]
Storage	[Product or supply holding needs]	[Conditions, quantity and holding time]
Education	[Training or observation activity]	[Participants and controlled access]
Sales and distribution	[Pickup, delivery or on-site sales]	[Receiving and dispatch needs]

Include supporting spaces where the concept needs them, such as equipment service, staff support or waste handling. Show connections to water and electricity. If you propose aquaponics, show the fish, filtration and plant production components in your operating diagram.

The facility relationship we need to check

Identify a movement, access or service requirement that could change your layout.

[Enter your team response here]

Build the preliminary cost model

Estimate the likely scale of the project using broad categories. An order-of-magnitude model is an early estimate based on a developing scope. Record what each amount includes, the source and date, and which assumptions could change it.

Separate one time and recurring costs

One-time costs cover facility establishment and startup. Recurring costs cover operation over a stated period. Use dollars consistently, identify the location and price date, and label ranges or allowances. Leave an unknown as “to research” until you have a defensible basis.

Category	What to investigate	One time USD	Monthly USD	Basis and source
Site	Land or lease setup, site preparation and access.	[Estimate]	[Rent if any]	[Ref / date]
Structure	Greenhouse, building, container or retrofit.	[Estimate]	[If any]	[Ref / date]
Equipment	Growing systems, tanks, controls, packing and storage.	[Estimate]	[If any]	[Ref / date]
Utilities	Water and power connections; service use.	[Estimate]	[Estimate]	[Ref / date]
Labor	Construction or installation; operating staff.	[Estimate]	[Estimate]	[Ref / date]
Startup	Initial inputs, training and commissioning.	[Estimate]	[If any]	[Ref / date]
Operations	Recurring inputs, maintenance, packaging and delivery.	[If any]	[Estimate]	[Ref / date]

Avoid double counting. If a supplier’s structure price includes installation, do not add that same labor again. If a monthly total includes staff or electricity, do not repeat those amounts under operations. Explain the treatment of recurring expenses during startup.

One-time facility and startup subtotal USD: _____

Monthly operating subtotal USD: _____

Operating period used for planning: _____

Our largest cost uncertainty

State the amount or range, what it includes, and the research needed to improve it.

[Enter your team response here]

If you include contingency or a startup cash reserve, show it separately and state its basis. A monthly operating estimate can be extended over a stated period, but the budget should explain startup timing and seasonal changes.

Use the team work session to start the deliverable

The 15-minute team work session is for producing a first draft and assigning the unanswered questions. The sequence below is a suggested way to use that time.

Minutes	Team activity	Draft output
0 to 3	Write the three-sentence facility concept.	A shared description of the proposal.
3 to 6	Choose the main product and preliminary system.	Product, customer, output target and technology.
6 to 10	Sketch the facility zones and flow.	A labeled block diagram.
10 to 13	List broad cost categories and major unknowns.	A first cost model with research gaps.
13 to 15	Assign research and editing responsibilities.	Owners and target completion dates.

Record the assumptions your team must verify

Assumption or question	How we will verify it	Owner	Target date
[Customer demand or commitment]	[Interview, source or follow-up]	[Name]	[Date]
[Production capacity]	[Trial, adviser or system data]	[Name]	[Date]
[Site, water or power]	[Site information or service inquiry]	[Name]	[Date]
[Cost or operating requirement]	[Quote, budget reference or adviser]	[Name]	[Date]

The most important decision before our next meeting

Name the decision, the evidence required and the person responsible.

[Enter your team response here]

Review the draft as a team

- ☐ The customer and market need are specific and supported.
- ☐ The narrative explains the facility, proposed location and purpose.
- ☐ Production targets include products, quantities, units and timing.
- ☐ The technology strategy explains the operating concept and key tradeoffs.
- ☐ The diagram shows zones and the flow of products or services.
- ☐ The budget separates one-time costs from recurring costs.
- ☐ Important assumptions have sources or assigned research tasks.

Assemble and submit your Phase 2 concept

Combine the team's work into a clear, consistent submission. The production target, technology, diagram and cost model should describe the same facility. Resolve conflicting quantities or scope assumptions before the final team review.

Submission item	What the reader should be able to understand
Facility concept narrative	What is proposed, who it serves, why it is needed, where it may be located and what makes it plausible.
Production goals and products	Products, buyers, output quantities, harvest timing, sales channel and the basis for the targets.
Technology strategy	The production method, enclosure, core operating process, support systems and assumptions to verify.
Preliminary cost model	Major categories, estimating basis, one-time subtotal, recurring cost period and key uncertainties.

Include the concept diagram used in the training to help explain the narrative and operating approach. Confirm the required format, filename and submission destination with the organizers.

Final reviewer: _____ Team review date: _____

Terms used in this session

Market demand is the quantity customers need over a stated period. Production capacity is the output a proposed system can support under defined operating assumptions. Harvest frequency is how often a crop or fish batch is ready for sale.

An order-of-magnitude estimate shows the broad scale of cost while the scope is still developing. Capital costs establish long-lived facility assets. Operating costs recur as the facility produces, maintains equipment and delivers products.

Session source and technical reading

Session source: Session 2 Conceptual Design and Facility Visioning, supplied training document. It identifies the four Phase 2 submission items and the narrative, block diagram, production table and cost model exercises.

[1] University of Missouri Extension. [Controlled Environment Agriculture Hydroponic Farming](#)

[2] Oklahoma State University Extension. [Principles of Small Scale Aquaponics](#)

Technical resources accessed September 30, 2026. Research the product, system, site and price assumptions relevant to your own proposal.

Phase 2 should make the concept understandable before detailed drawings, engineering and business modeling begin. Keep the remaining questions visible so later work can test and refine the proposal.