sme how tomorrow moves | BLUE SKY COMPETITION | NSF | ASME

NAMRC | 54th
NORTH AMERICAN MANUFACTURING RESEARCH CONFERENCE

PLANETARY MANUFACTURING FABRIC

(PMF)

From Factories to Programmable Matter

BEYOND BOUNDARIES | INTELLIGENT MANUFACTURING | SUSTAINABLE BY DESIGN | RESILIENT BY ARCHITECTURE

HAYDAR HAYDAR
Master's Student

HAIJUN GONG
Associate Professor

EVENT
54th SME NAMRC
Blue Sky Competition
David Dornfeld Vision Award

GEORGIA SOUTHERN UNIVERSITY

Manufacturing Engineering Department, Georgia Southern University

OUR JOURNEY

Reimagining Manufacturing for a Planetary Future

1 STRUCTURAL LIMITS

2 PMF CONCEPT

3 SCIENTIFIC FOUNDATIONS

4 TRANSFORMATIONAL IMPACT

5 ROADMAP TO REALITY

VISION › ENGINEERING › IMPACT › REALIZATION

WHY MANUFACTURING MUST EVOLVE

The factory-centric paradigm is reaching structural limits.

We built manufacturing for scale—
not resilience, locality, or circularity.

- SUPPLY FRAGILITY
- CARBON INTENSITY
- MATERIAL LOSS
- CENTRALIZED DEPENDENCY

PROGRESS IS NOT PARADIGM CHANGE.

MECHANIZATION

MASS PRODUCTION

AUTOMATION

DIGITALIZATION

AI

Better tools. Same manufacturing architecture.

MANUFACTURING
BECOMES
EMBEDDED
WITHIN
MATTER ITSELF.
From manufacturing products...
to orchestrating matter.
DISTRIBUTED
AUTONOMOUS
PROGRAMMABLE
CIRCULAR

PMF SYSTEM ARCHITECTURE

A continuous manufacturing ecosystem integrating intelligence, matter, and circularity.

DIGITAL DESIGN

AI • Modeling • Digital Twin

DISTRIBUTED INTELLIGENCE

Coordination • Optimization • Swarm Logic

AUTONOMOUS AGENTS

Assemble • Transport • Disassemble

PROGRAMMABLE MATTER

Adaptive • Responsive • Reconfigurable

PHYSICAL REALIZATION

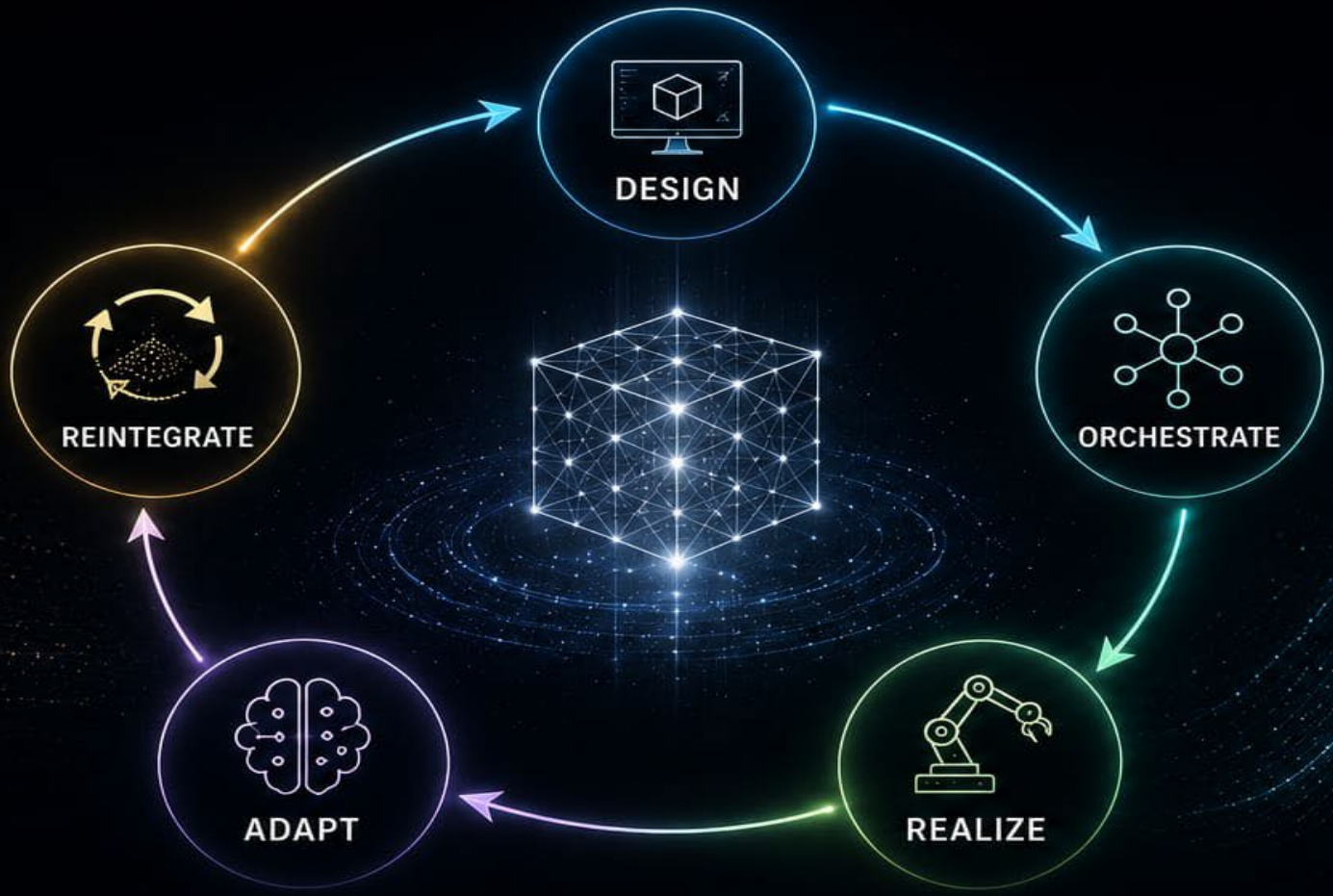
Products • Infrastructure • Systems

CLOSED-LOOP MATERIAL CYCLE

Recover • Reintegrate • Reuse

HOW PMF OPERATES

A continuous cycle of design, orchestration, realization, adaptation, and reintegration.

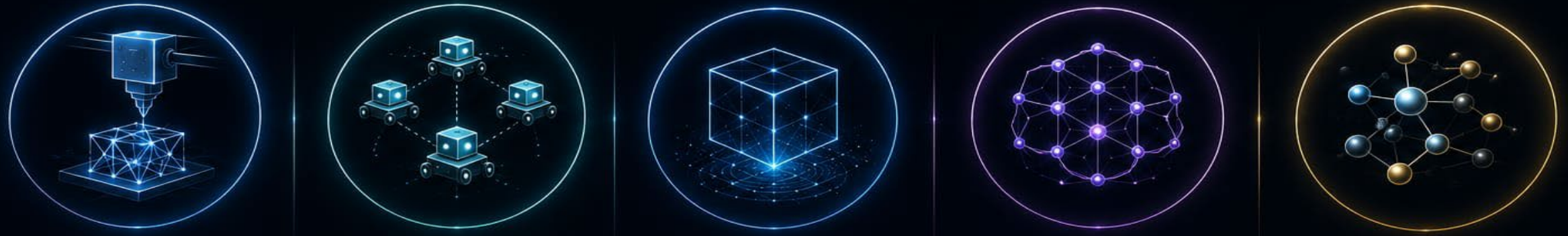


PRODUCTS BECOME TEMPORARY CONFIGURATIONS OF REUSABLE MATTER.

SCIENTIFIC FOUNDATIONS

THE ENABLING CONVERGENCE BEHIND PMF

PMF is a convergence—not a single invention.



ADDITIVE MANUFACTURING

SWARM ROBOTICS

DIGITAL TWIN

PROGRAMMABLE MATTER

AI • MATERIALS • NANO

TRANSFORMATIONAL IMPACT

PMF changes what manufacturing can be.

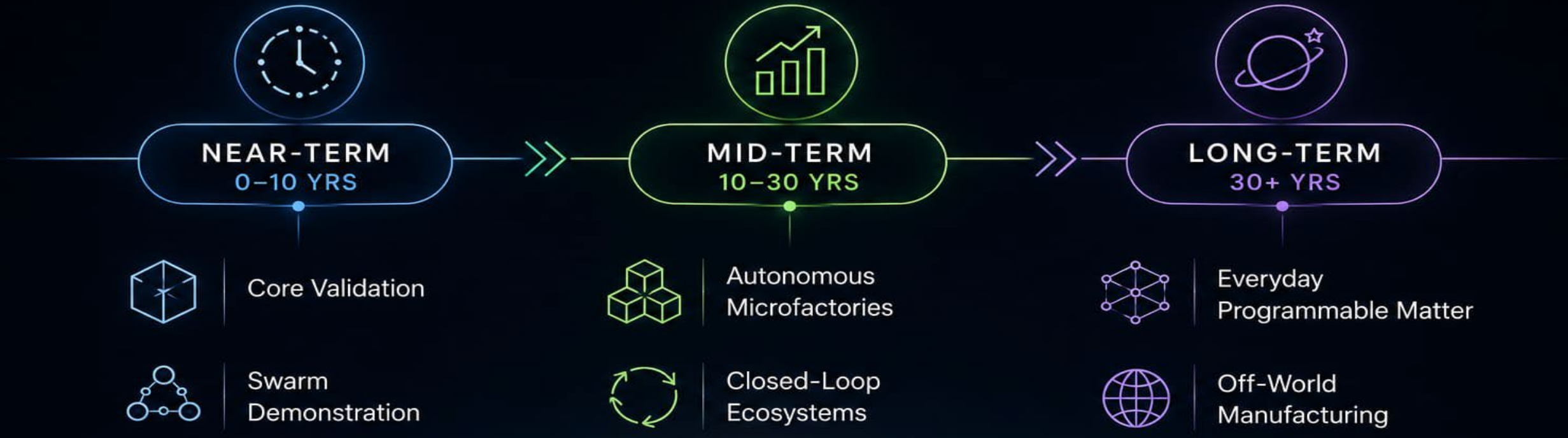
LOCALIZED PRODUCTION

CIRCULAR MATERIALITY

ADAPTIVE INFRASTRUCTURE

EXTRATERRESTRIAL MANUFACTURING

Vision demands a roadmap to reality.



WHY THIS MATTERS NOW

The foundations are emerging around us.

DISTRIBUTED FABRICATION

AUTONOMOUS SWARMS

DIGITAL TWINS

ADVANCED MATTER SYSTEMS

CLOSING VISION

The future of manufacturing may not be built— it may be programmed.

THANK YOU

QUESTIONS?

PMF

PROGRAMMABLE MATTER FABRICATION

PROGRAM THE FUTURE.