# Lean Systems Design

## University of Michigan

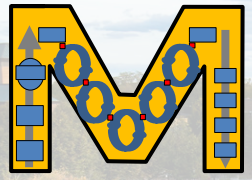
Art Hyde

Adjunct Professor

Integrative Systems + Design

ahyde@umich.edu

# Lean Systems Design



- Describe why & how we are developing a new Product Creation Process (NPC) framework
- Share key points of interest within the framework
- Discuss the path forward for Lean Systems Design within the University of Michigan & INCOSE

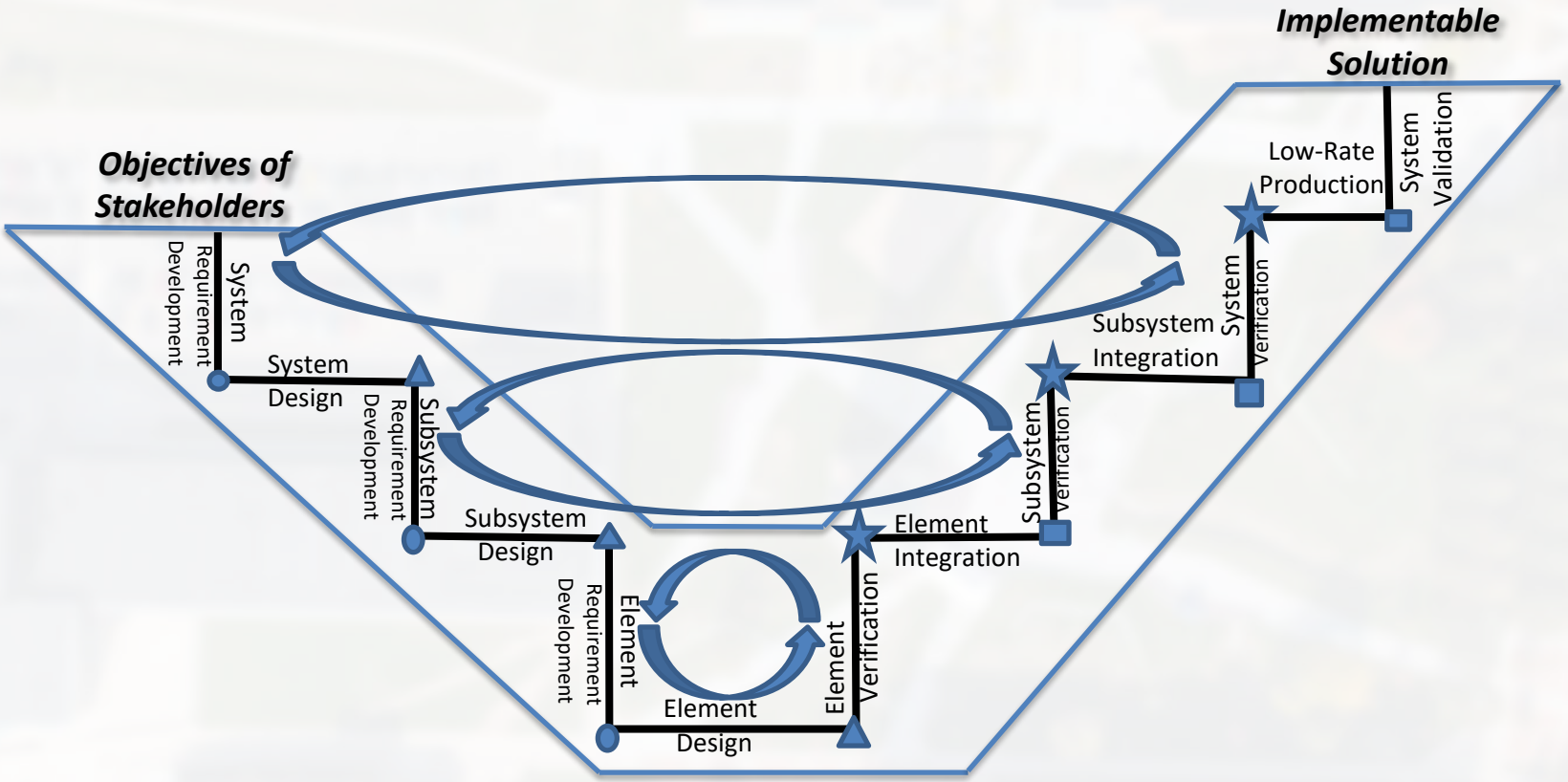
# Art Hyde

- University of Michigan
- Ford Motor Company
- INCOSE

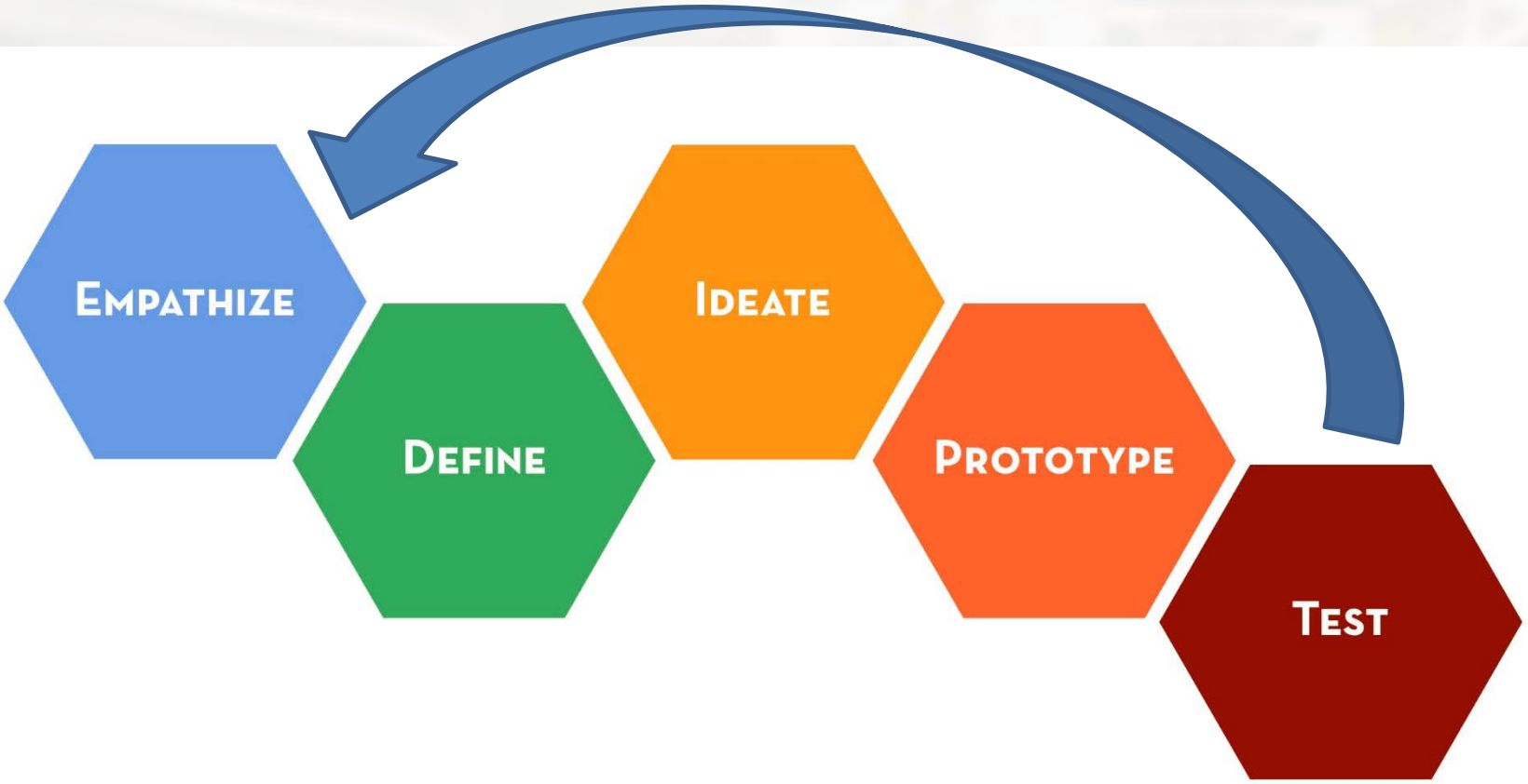
# Why Develop Lean Systems Design Framework?

1. University of Michigan needs an integrated NPC process
2. Address execution issues in Systems Engineering, Design Thinking, Agile and Lean Product Creation
3. Provide a tailorable framework that Enterprises could employ to structure & manage a range of NPC projects for competitive advantage

# Traditional Systems 'V' Process Framework



# Traditional Design Thinking Process Framework

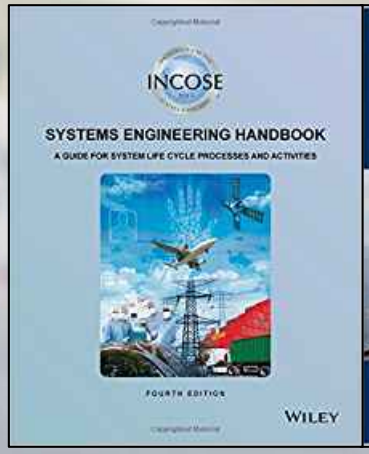


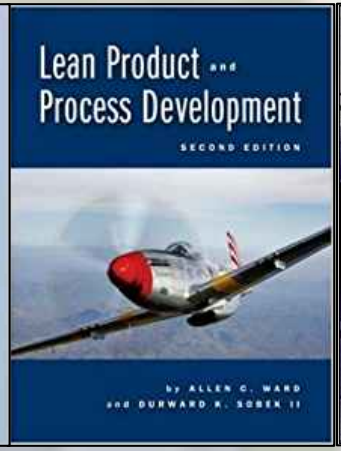
# Traditional Agile Development Process Framework

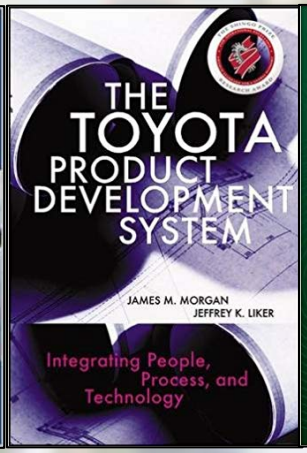
# How Are We Developing Lean Systems Design?

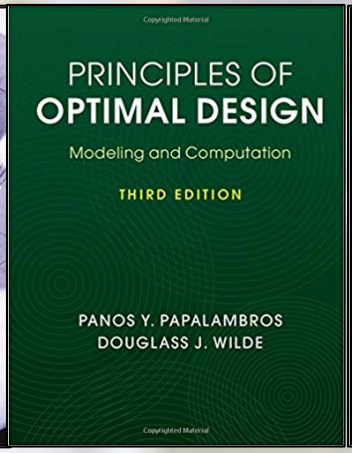
- Leverage expertise within University of Michigan
- Reflect learnings from work on Human Centered Innovation
- Build on NPC experience from Ford, GM & Others

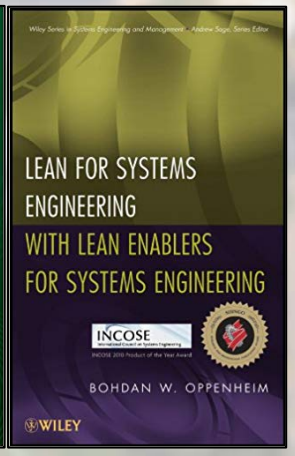
# Reference Sources

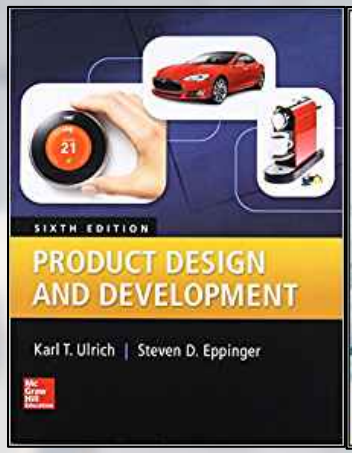


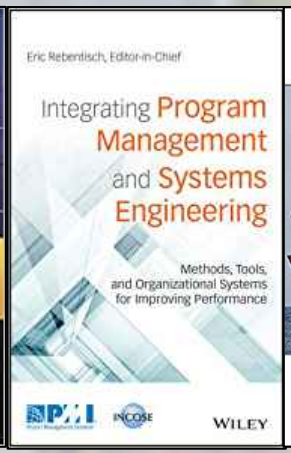



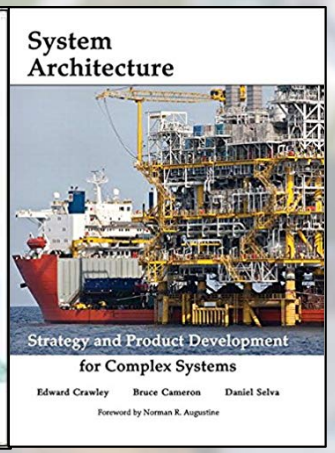



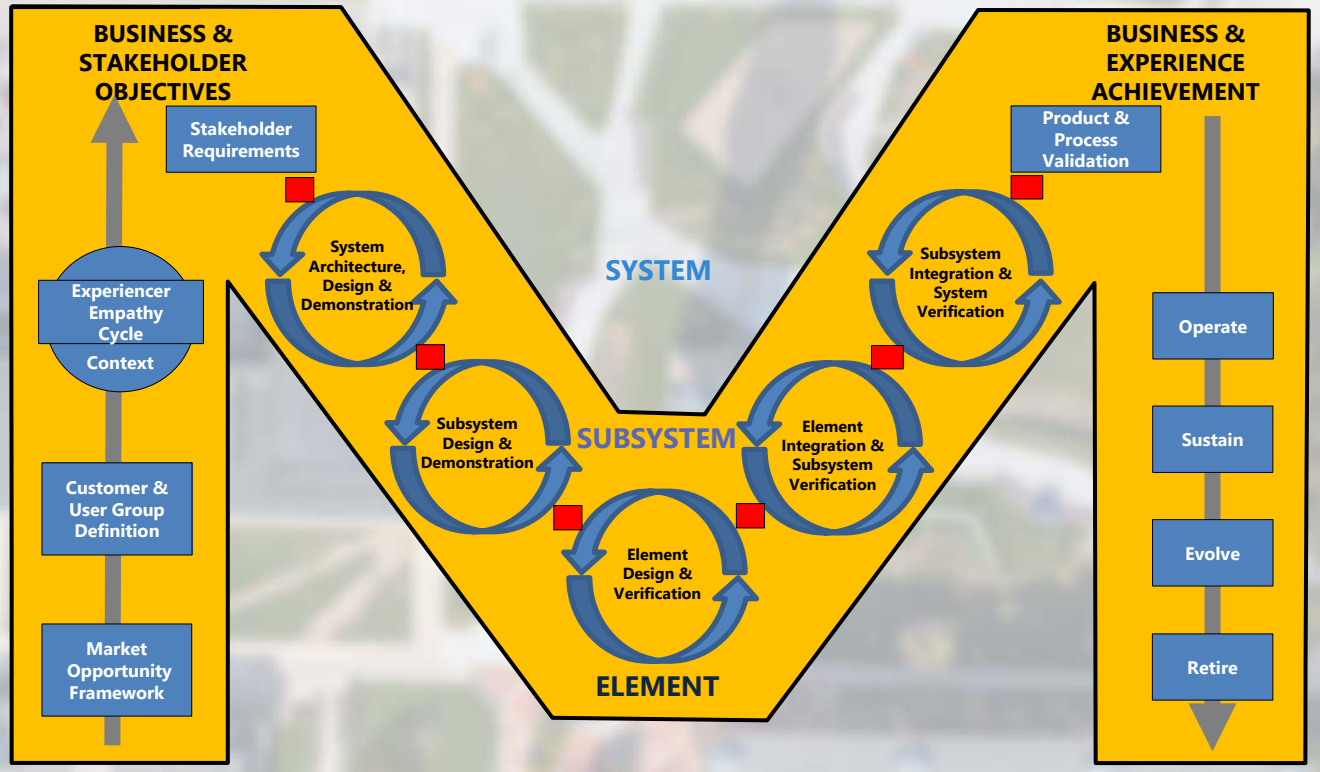




# Lean Systems Design High Level Process Framework




**Human-Centered Innovation**

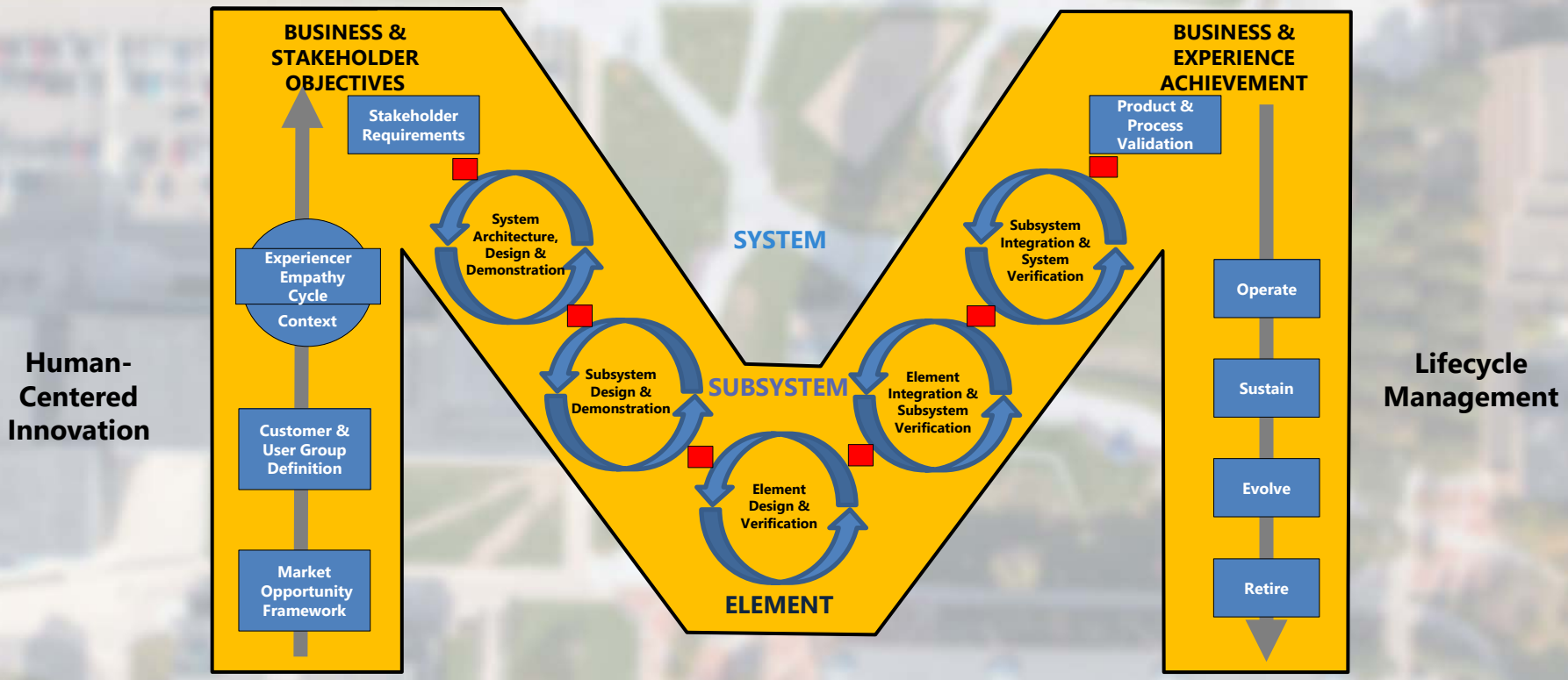
**Lifecycle Management**

**Legend:**

Plan-Do-Check-Act (PDCA) Lean Cycle

New Product Creation (NPC) project decision point

# Engineering Great Products Is a People Business




**Legend:** Plan-Do-Check-Act (PDCA) Lean Cycle

New Product Creation (NPC) project decision point

# Engineering Great Products Is a People Business


Empathizers


Experiencers

Human-Centered Innovation


Big Data Analysts


Business Planners

Stakeholders

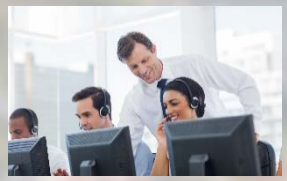
Designers

Project Leaders


Manufacturing & Logistics Operators


Quality Engineers

Lifecycle Management


Product Line Team


Recycling Operators

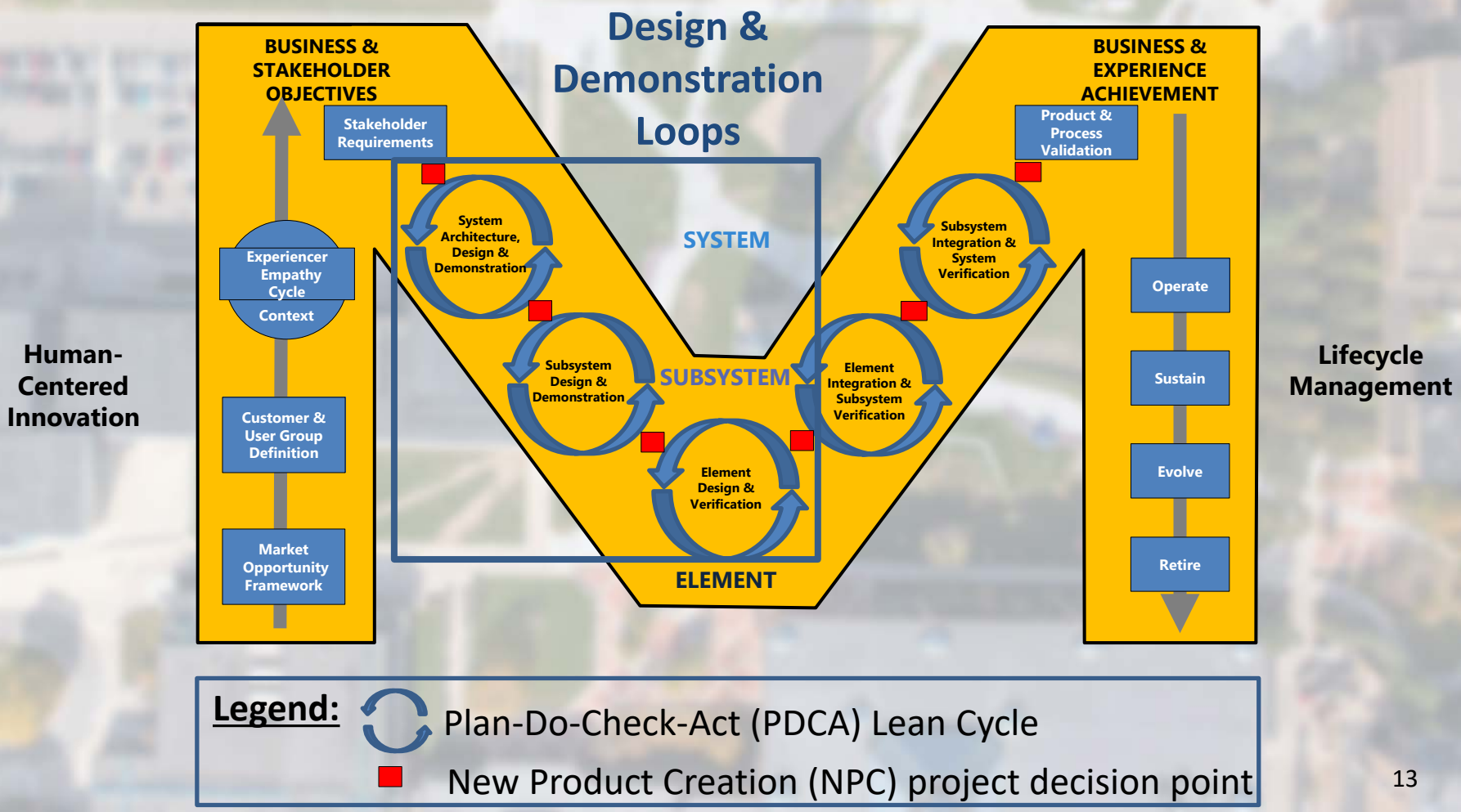



**Legend:**

Plan-Do-Check-Act (PDCA) Lean Cycle

New Product Creation (NPC) project decision point

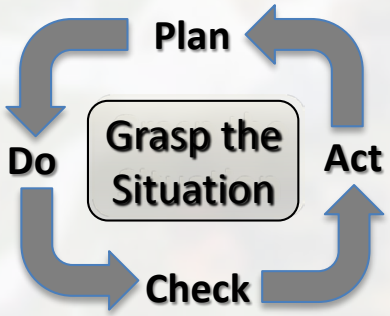
# PDCA Loops Achieving Efficiency and Effectiveness

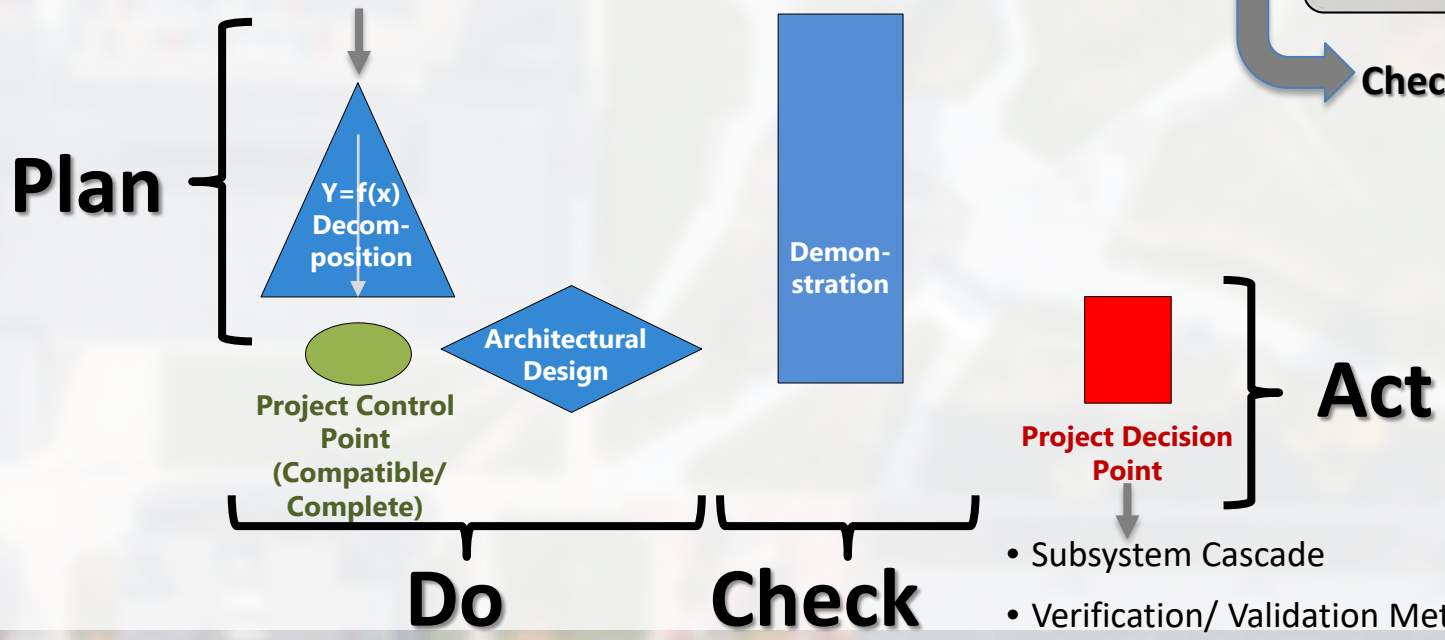


# Make Cascades Into PDCA Creation Loops

## Example: *System Architectural Design Stage*

- Stakeholder Requirements
  - Experiencer Empathy Insights
  - Business Plan & Portfolio Prioritization
  - Life Cycle Plan

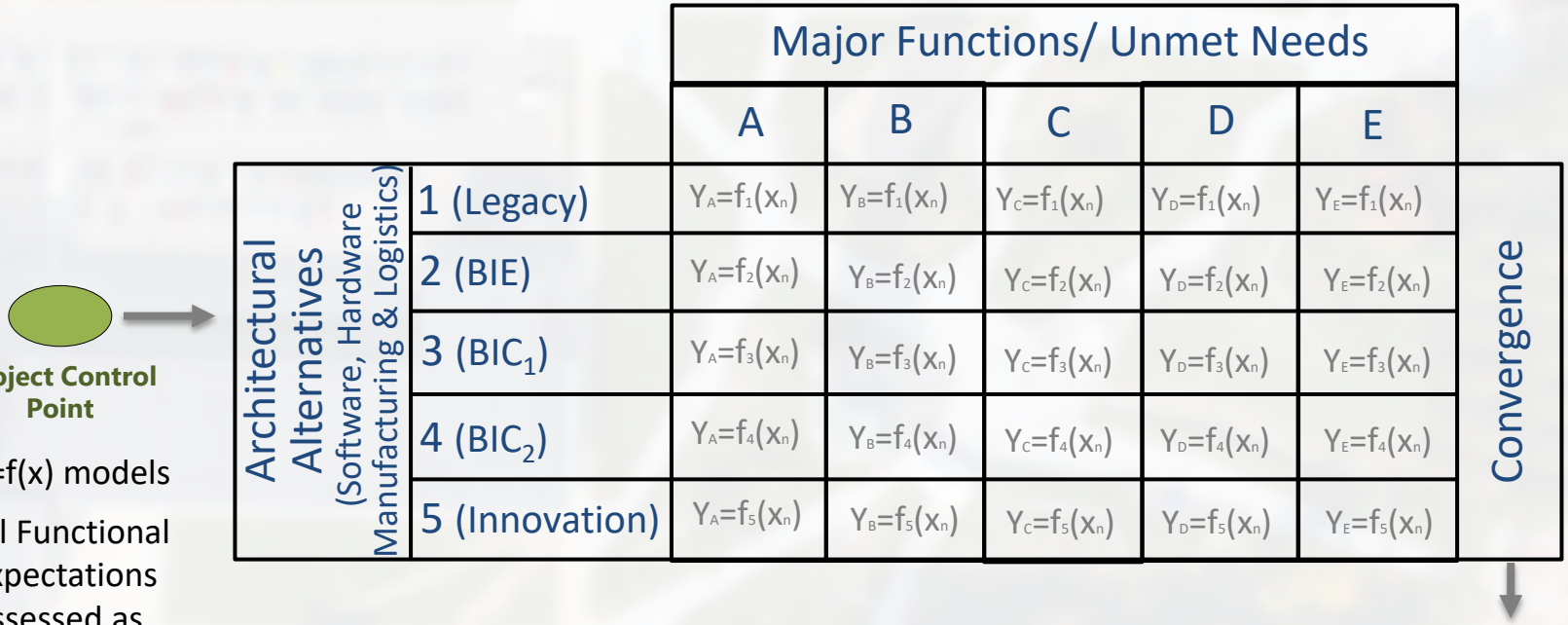



- Subsystem Cascade
- Verification/ Validation Methods

# Set-Based Decision-Making

## Example: *System Architectural Design Stage*

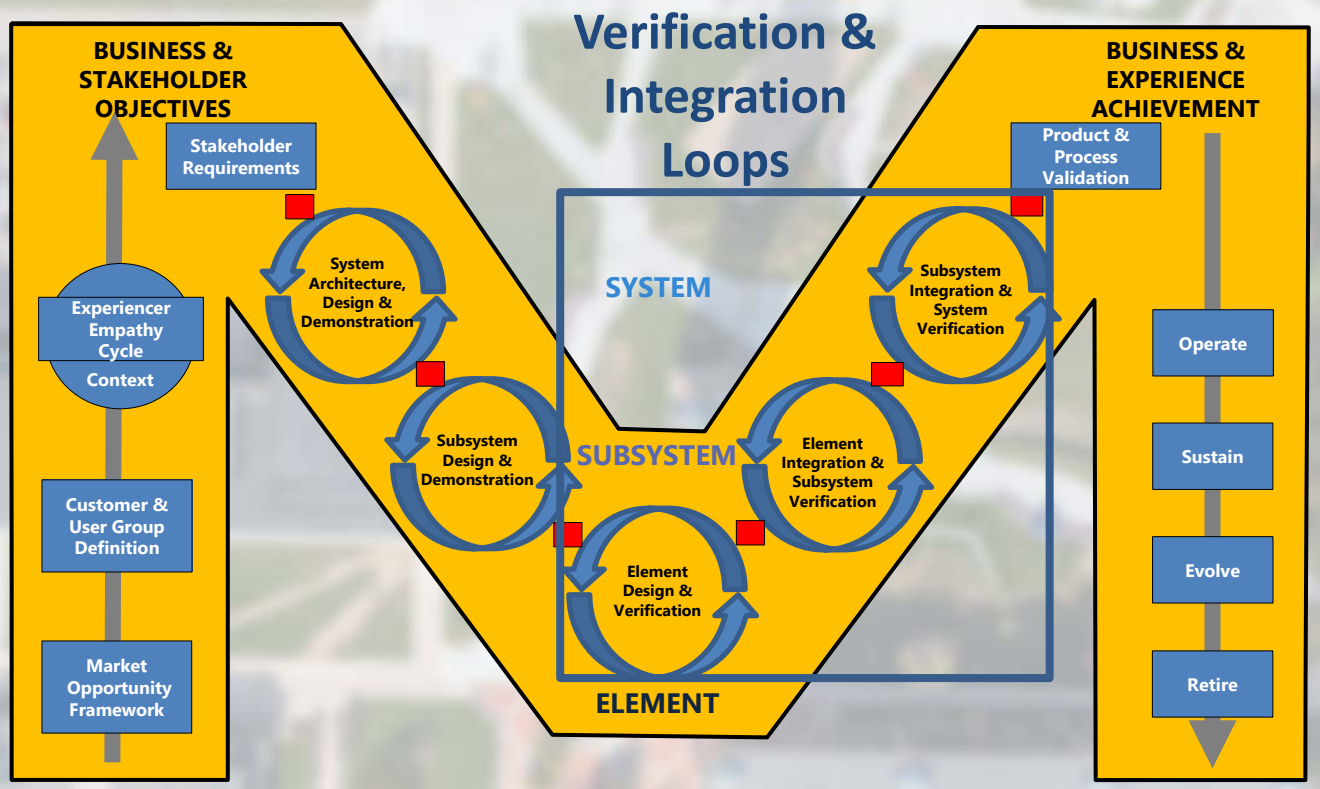



**Project Control Point**

- Y=f(x) models
- All Functional Expectations Assessed as Compatible & Complete

- Surviving (Composite) Alternative
- Subsystem Boundaries & Technologies
- Sourcing & Partner Plans

# PDCA Loops Achieving Efficiency and Effectiveness

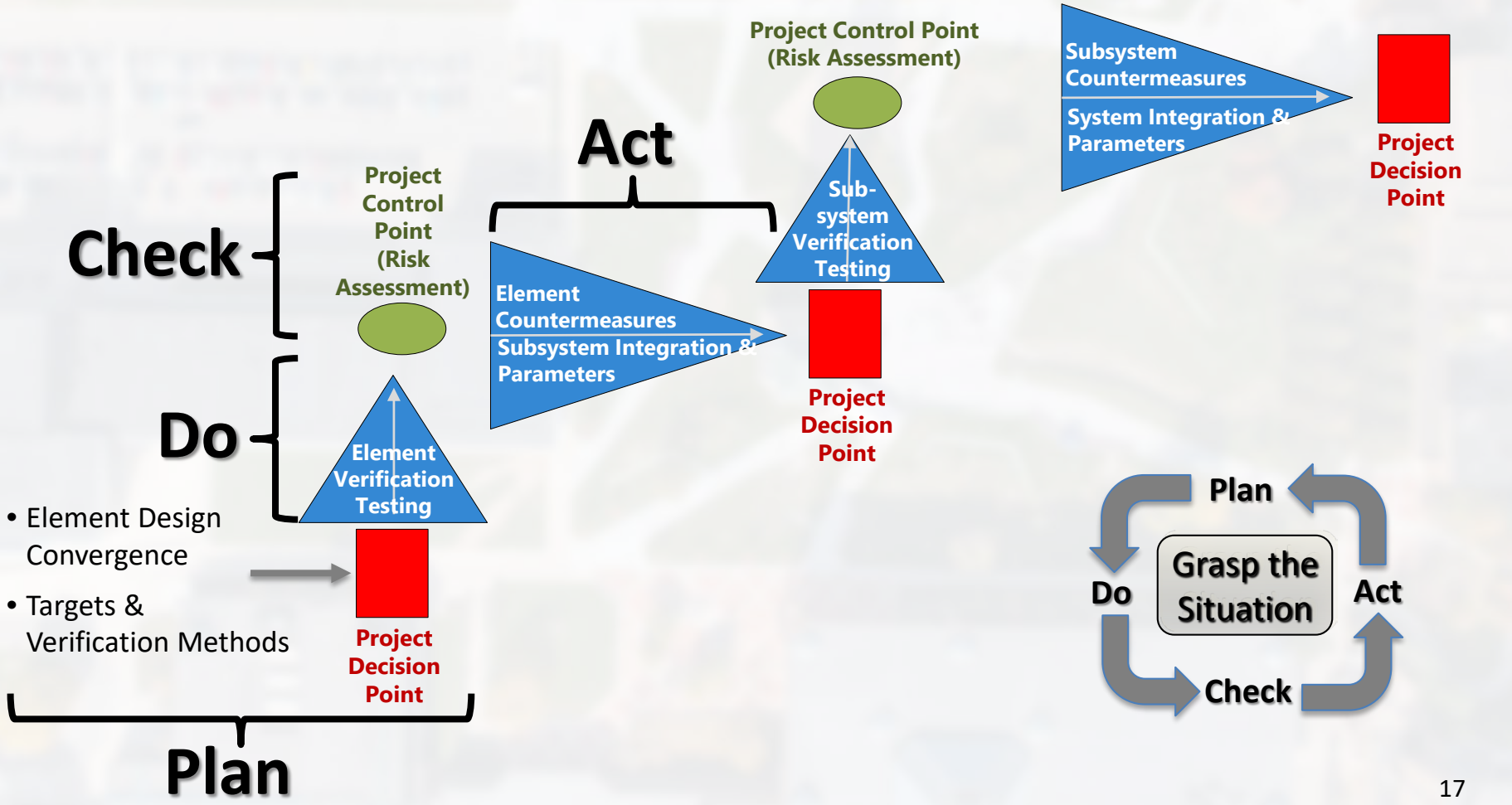



**Legend:** Plan-Do-Check-Act (PDCA) Lean Cycle

New Product Creation (NPC) project decision point

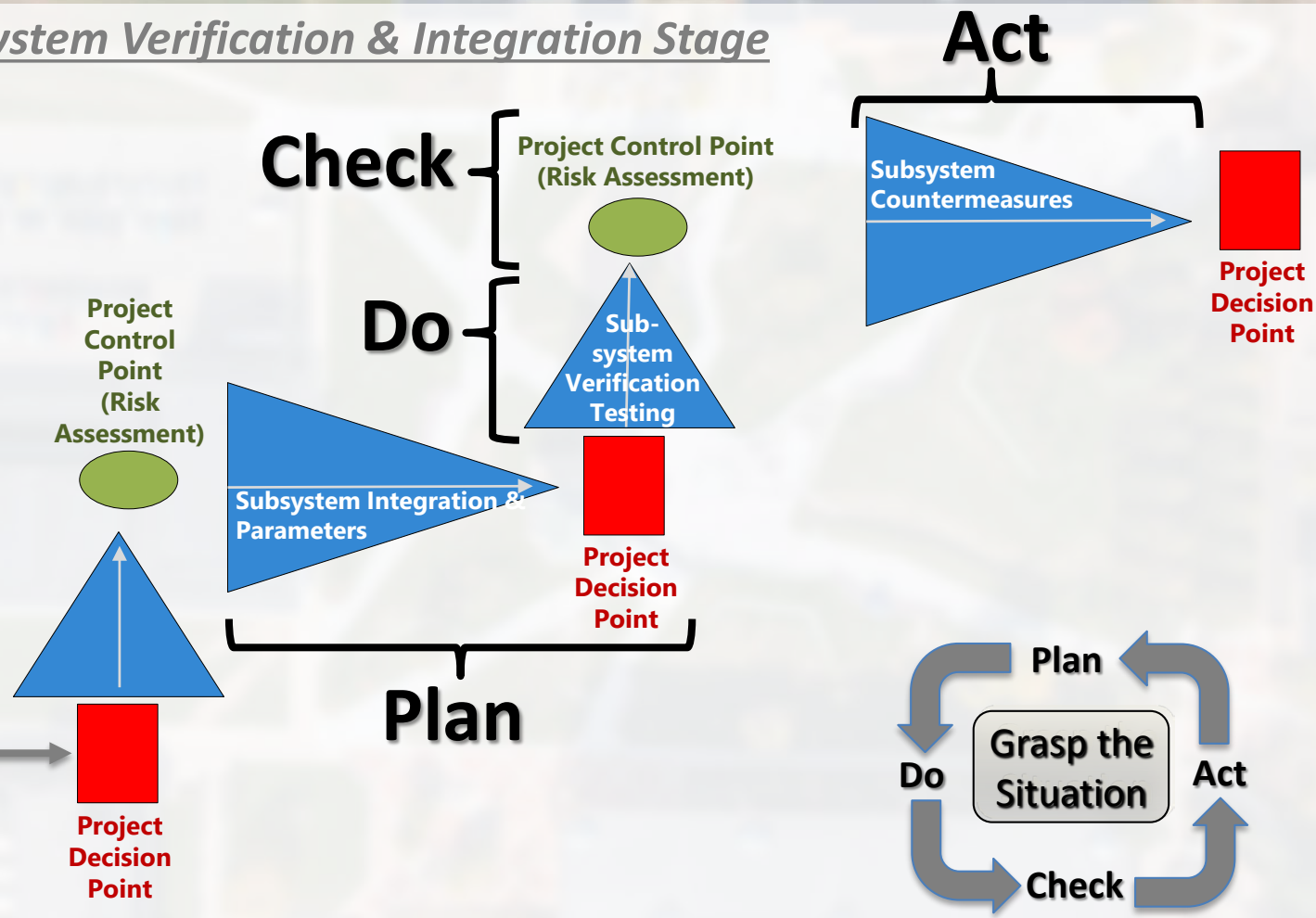
# Make Verification Into PDCA Improvement Loops

## Example: Element *Verification & Integration Stage*



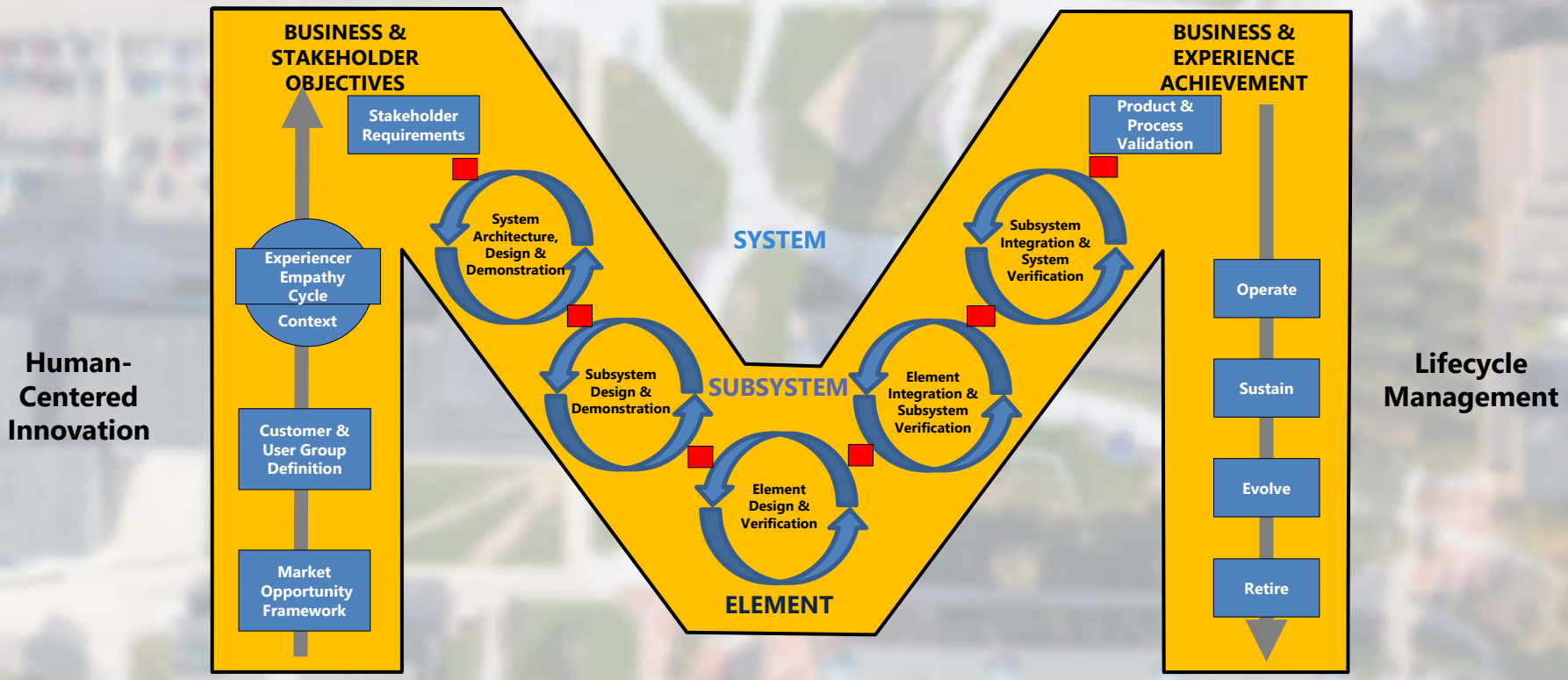
# Make Verification Into PDCA Improvement Loops

## Example: *Subsystem Verification & Integration Stage*




- Element Design Convergence
- Element/ System/ Subsystem Targets & Verification Methods

# Increase Clock Time of the Process Execution




**Legend:** Plan-Do-Check-Act (PDCA) Lean Cycle

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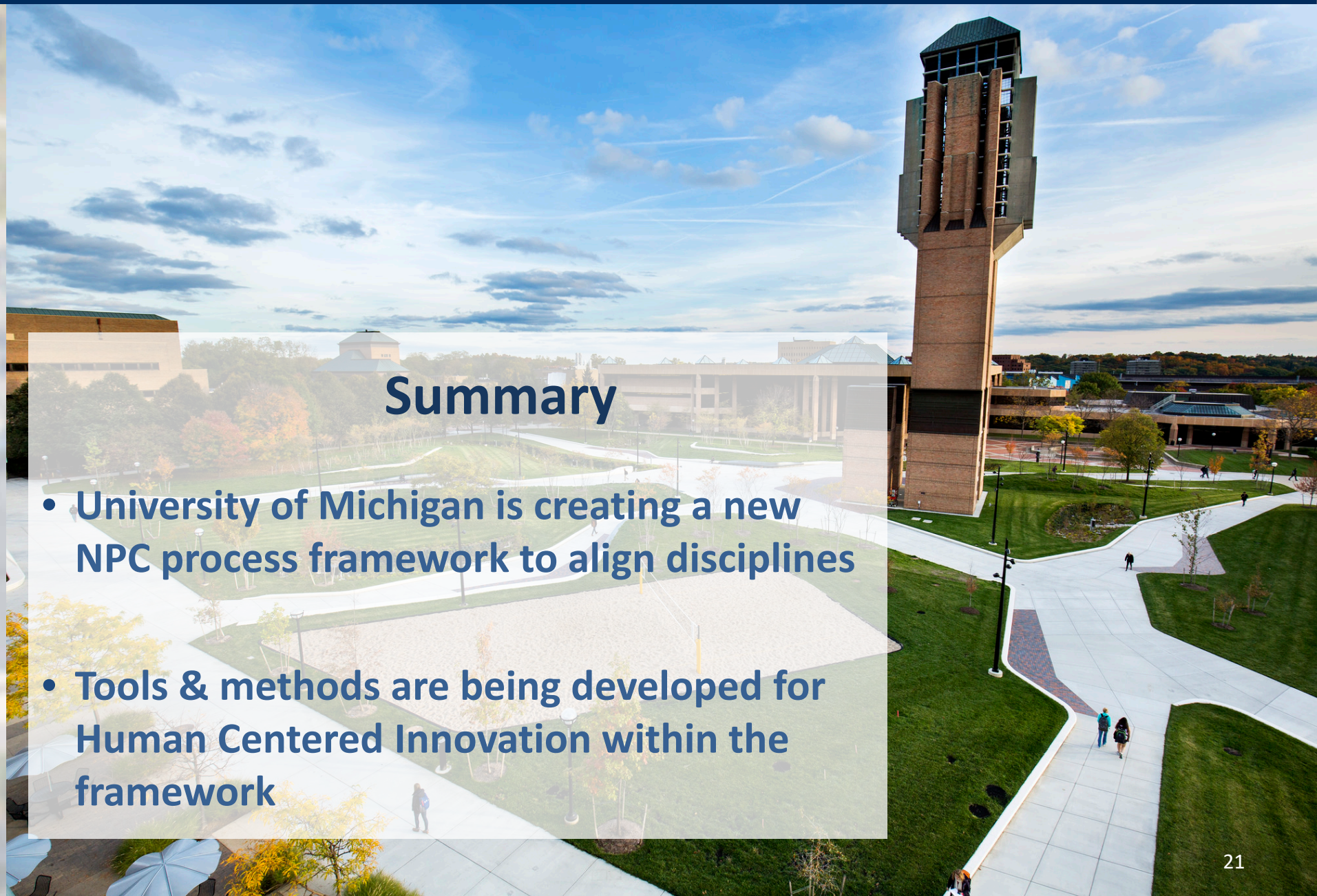
# Increase Clock Time of the Process Execution

- Scale the process to the project scope
- Use standards, checklists & models to guide the project team, focus decision making and build a learning organization
- Cadence & plan the work to reduce perceived risk
- Positively confirm expectations & alignment across Stakeholders and Experiencers (as practical) as part of each SE cascade



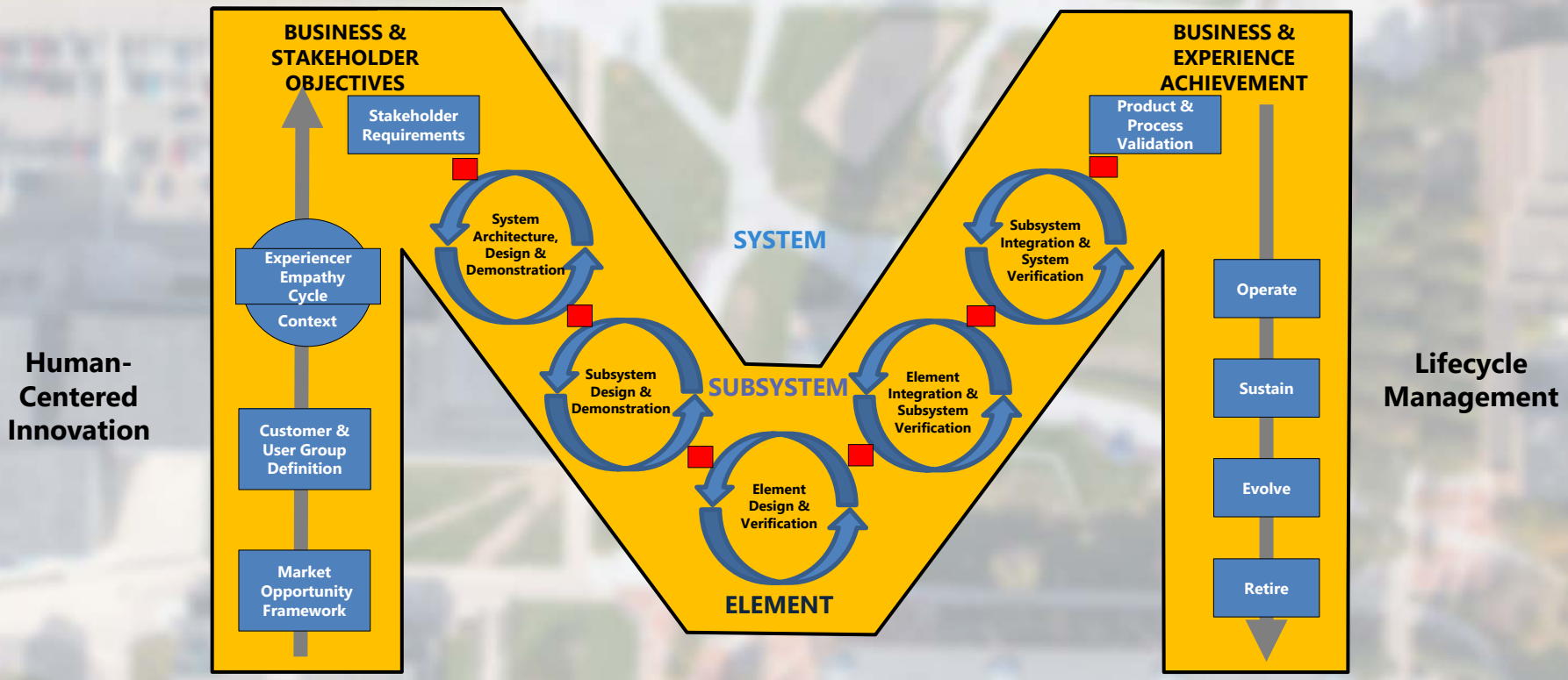
# Summary

- University of Michigan is creating a new NPC process framework to align disciplines
- Tools & methods are being developed for Human Centered Innovation within the framework

# Path Forward

- Complete development of process, methods & tools
- Develop new & modify existing courses

# Lean Systems Design High Level Process Framework




**Legend:** Plan-Do-Check-Act (PDCA) Lean Cycle

New Product Creation (NPC) project decision point

# Supporting Information

# Integrative Systems + Design Curriculum

## IS+D Core Courses (MS)

- Introduction to Systems Engineering
- Systems Engineering Requirements
- Systems Engineering Architecture & Design
- Design Science Analytic Product Design
- Design Science Process Models
- Design Science Colloquium

## IS+D Elective Courses

- Software Systems Engineering
- Risk Management
- Design for Six Sigma
- Design Science Practicum

## IS+D Professional Programs

- Design for Six Sigma
- Lean Product Development
- Lean Systems Design (Fall 2018)

## IS+D PhD Programs

- Design Science
- Systems Engineering

**Memo: Supporting Curriculums:**

### College of Engineering

- Application courses in all major Engineering disciplines

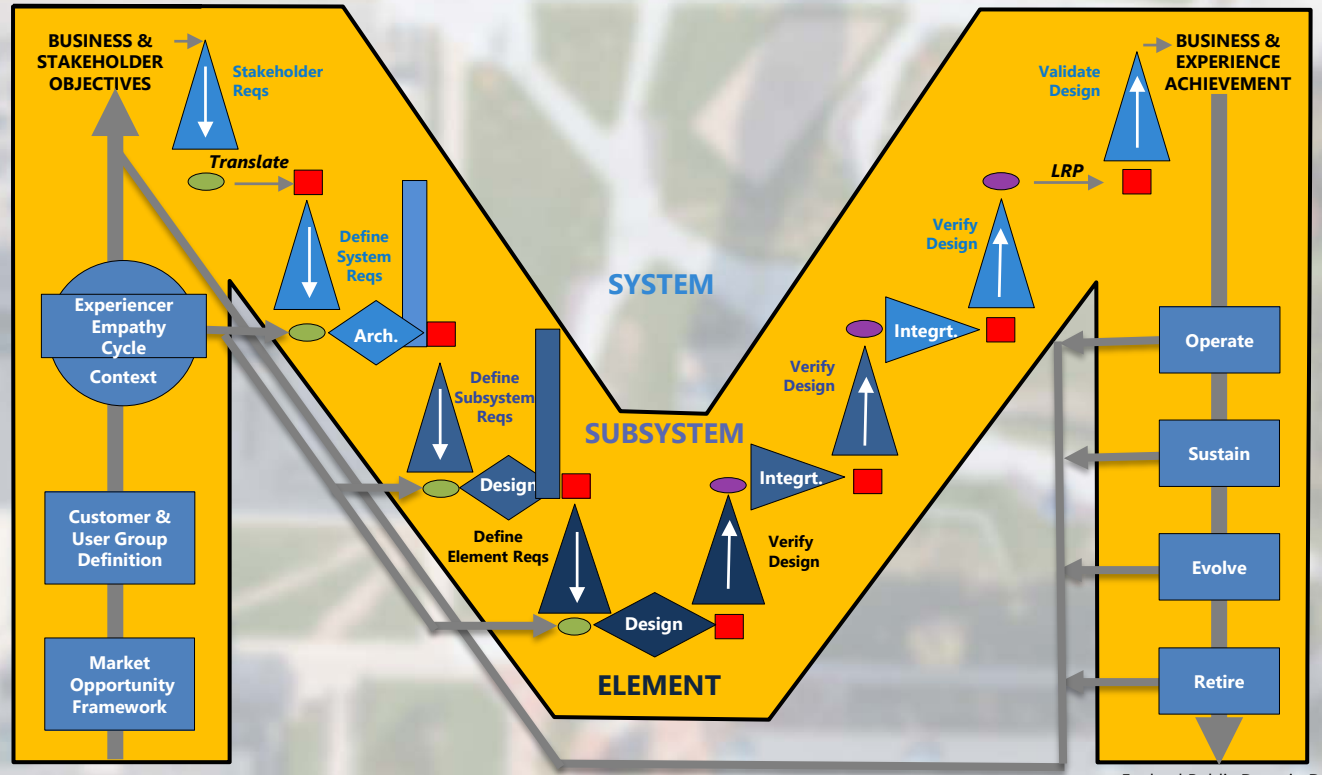
### Ross School of Business

- Marketing and Entrepreneurial courses

# Lean Systems Design Process Model

## *CLOSER LOOK*

**Human-Centered Innovation**




- Public Domain Data
- Proprietary Data & Resources
- Legacy Resources & Values

**Lifecycle Management**

- Evolved Public Domain Data
- Evolved Proprietary Data & Resources
- Evolved Legacy Resources & Values