

# Isn't It Great When We Iterate: Rapid Innovation for Additive Manufacturing

**Orrin Bourne**

Manufacturing Technical Specialist

**Justin Janelli**

Manufacturing Technical Specialist





# Orrin Bourne

## Manufacturing Technical Specialist

I have a background in mechanical engineering and software engineering and have been using Autodesk technologies for more than 20 years. Prior to joining Autodesk I built technologies used to improve workflows for engineering and manufacturing. Fusion Lifecycle is one of my areas of expertise having been a user/developer for nearly 8 years.





# Justin Janelli

## Manufacturing Technical Specialist

Justin has a background in Mechanical Engineering and Materials Science, and industry experience in Aerospace with General Atomics Aeronautical Systems. He's been with Autodesk for 4 years, streamlining workflows and delivering valuable automation and insight to customers' collaboration, design, and manufacturing processes.



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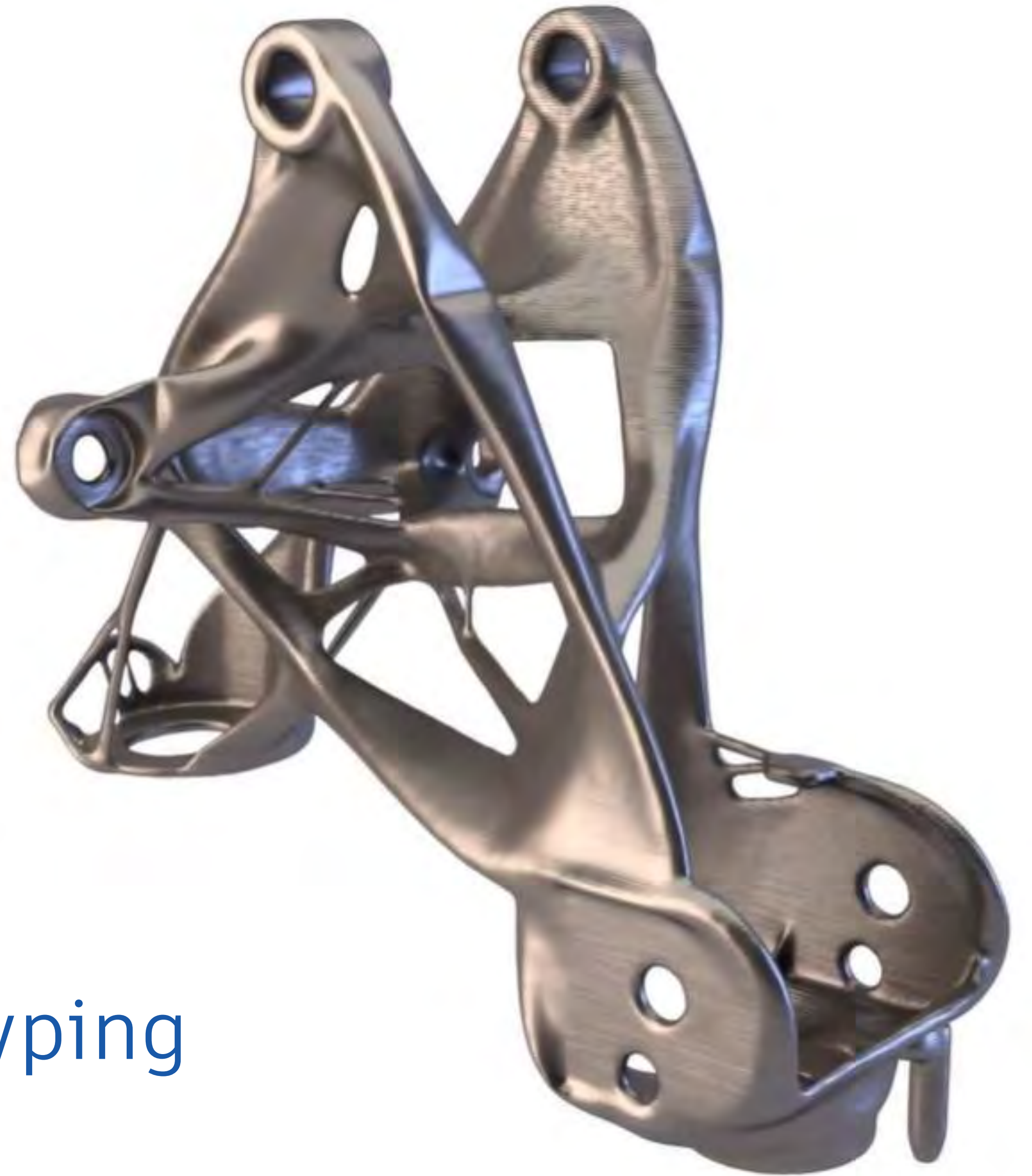


# Industrialization of Additive Manufacturing

Growing Confidence

Demonstrated Value

Transitioning from Prototyping to Production





# Can Conventional DFMA Be Applied?

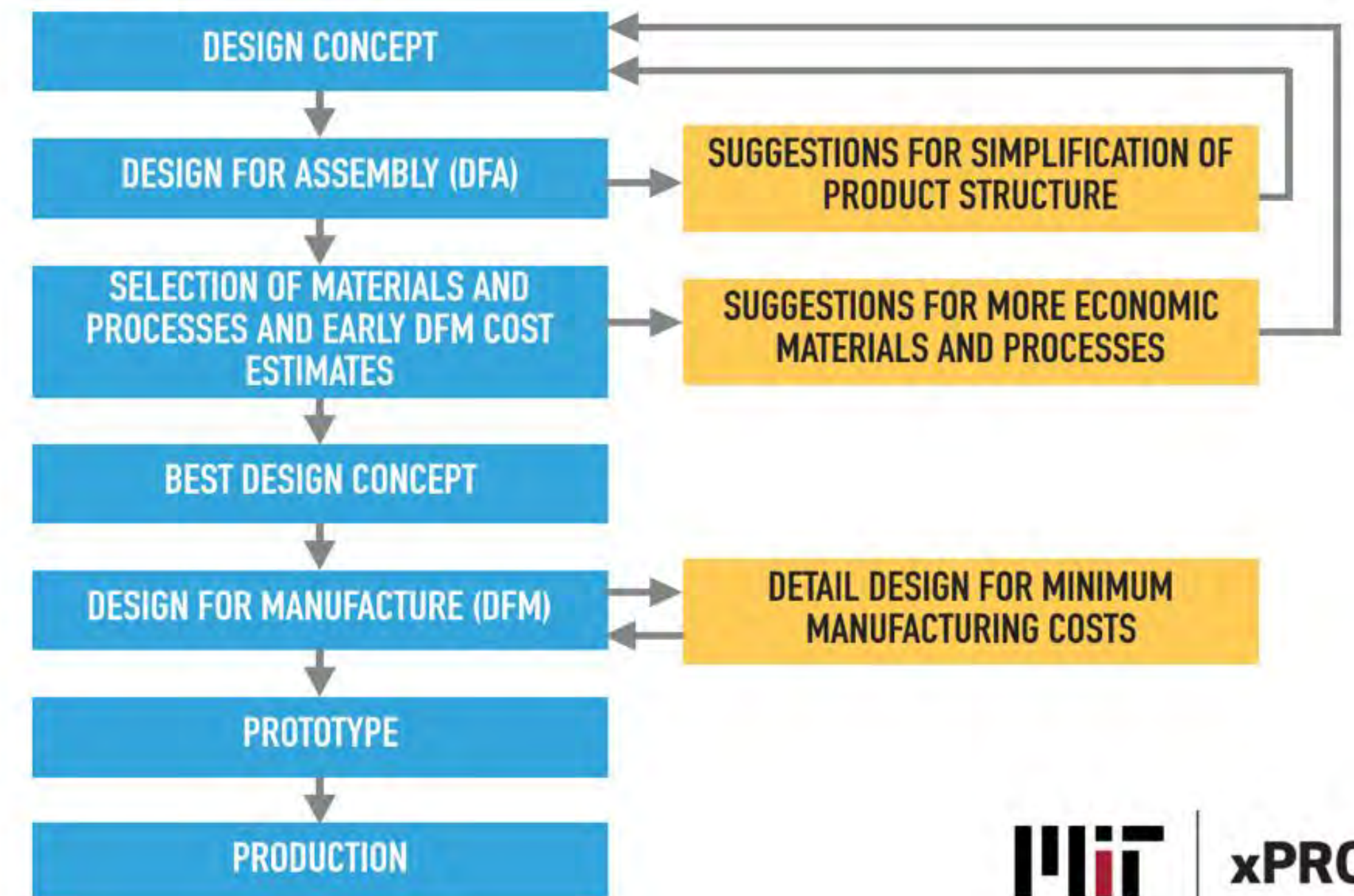
LINEAR PROCESS FOCUSED ON DESIGN  
SELECTION

COST STRONGLY CORRELATED TO ASSEMBLY  
TIMES

MANUFACTURABILITY RELEGATED TO LATER  
IN THE PROCESS

BOOTHROYD & DEWHURST - DESIGN FOR MANUFACTURING AND ASSEMBLY

## TYPICAL DFMA PROCESS





**“While past knowledge and expertise has often been the value we add in our work, it may ... become one of the biggest inhibitors to generating new AM innovations.”**

**– Professor John Hart, MIT**



# Additive Manufacturing Is Just Different

## HIGHLY COMPLEX DESIGN PROCESS

- Consider materials, design constraints, AM machines, process parameters, part properties, and quality
- There are few hard and fast rules

## AM CAN HAPPEN ANYWHERE IN THE PRODUCT LIFECYCLE

- Conceptualization, Prototyping, Ramp Up, Maturity, Decline, End-of-Life

## UNIQUE VALUE PROPOSITION AND CHALLENGES

- Must fully explore AM space to find that “break out” design or product
- Balance between very high design freedom and stringent manufacturing constraints



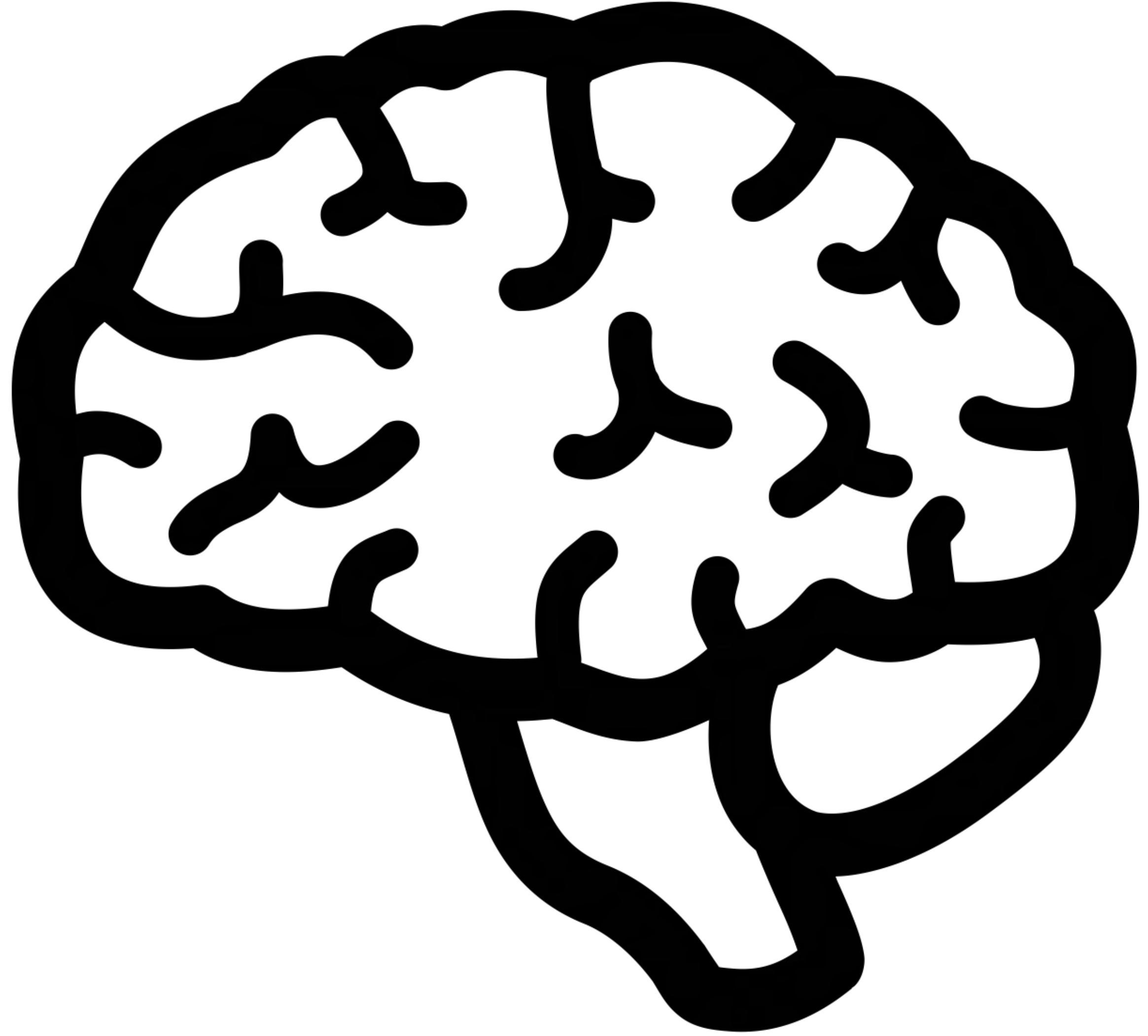
# RETHINK

Designing

Production

Delivery

Servicing

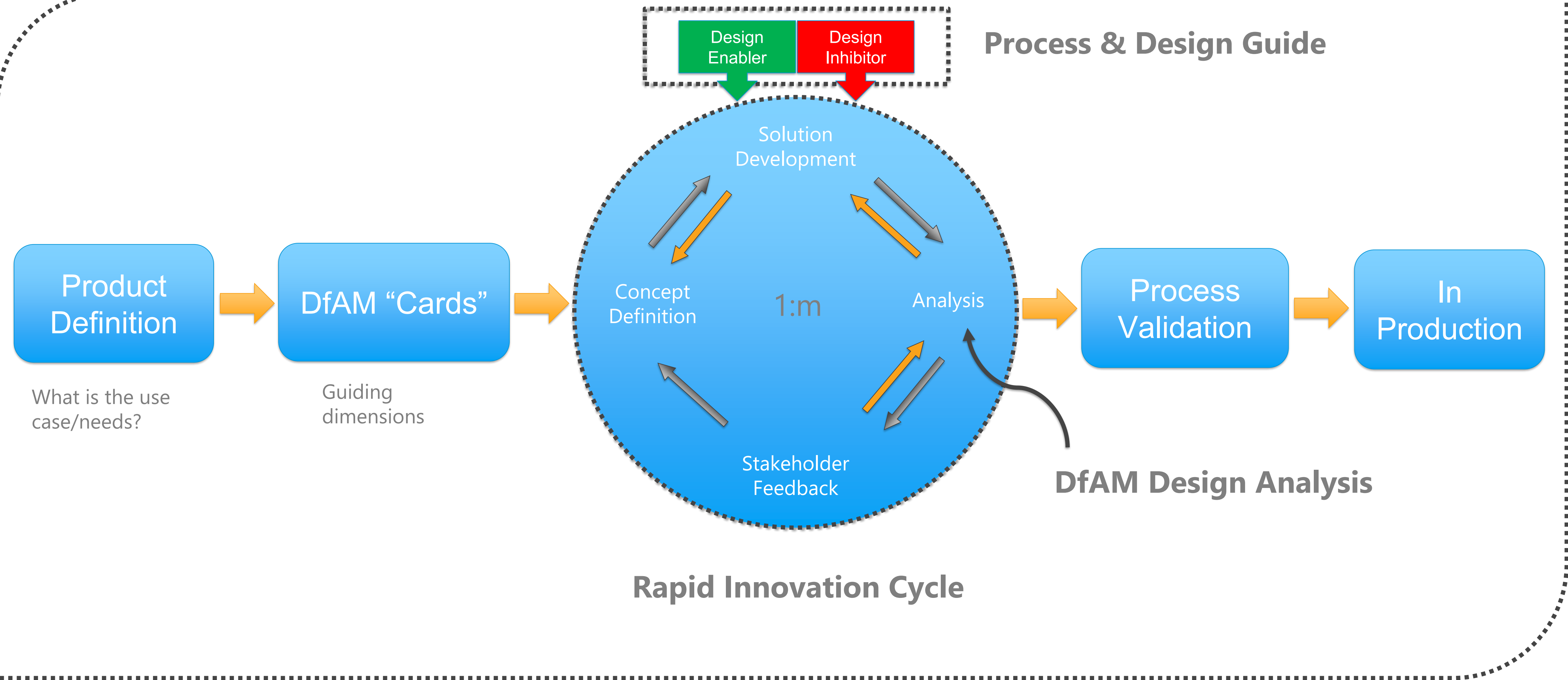




# How Do We Pursue Innovation Across the AM Product Lifecycle?



# Agile Product Development



Inspired by the MIT course "Additive Manufacturing for Innovative Design and Production"

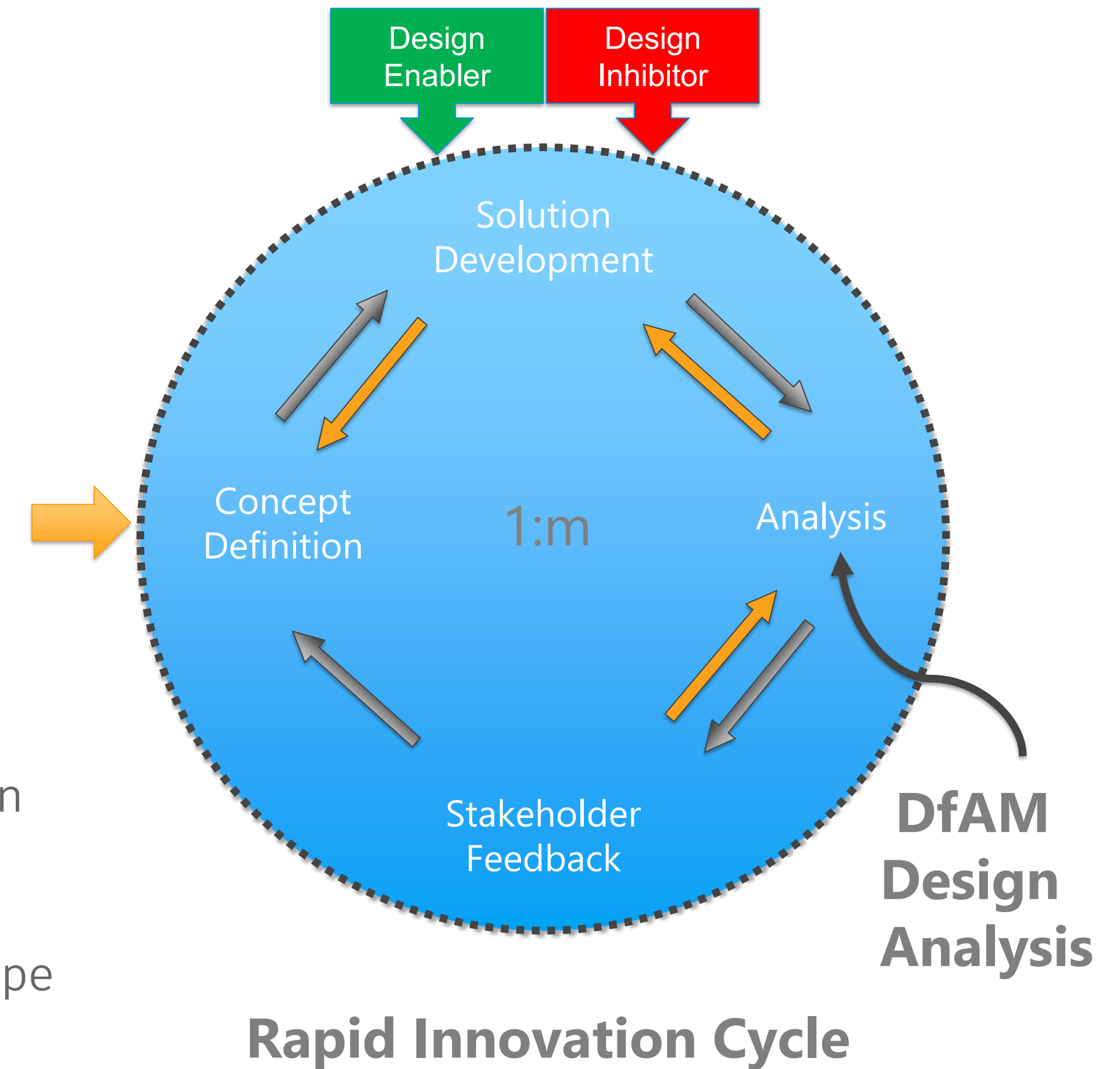


# Rapid Innovation Cycle

Agile product development as applied to manufacturing

Has four main steps:

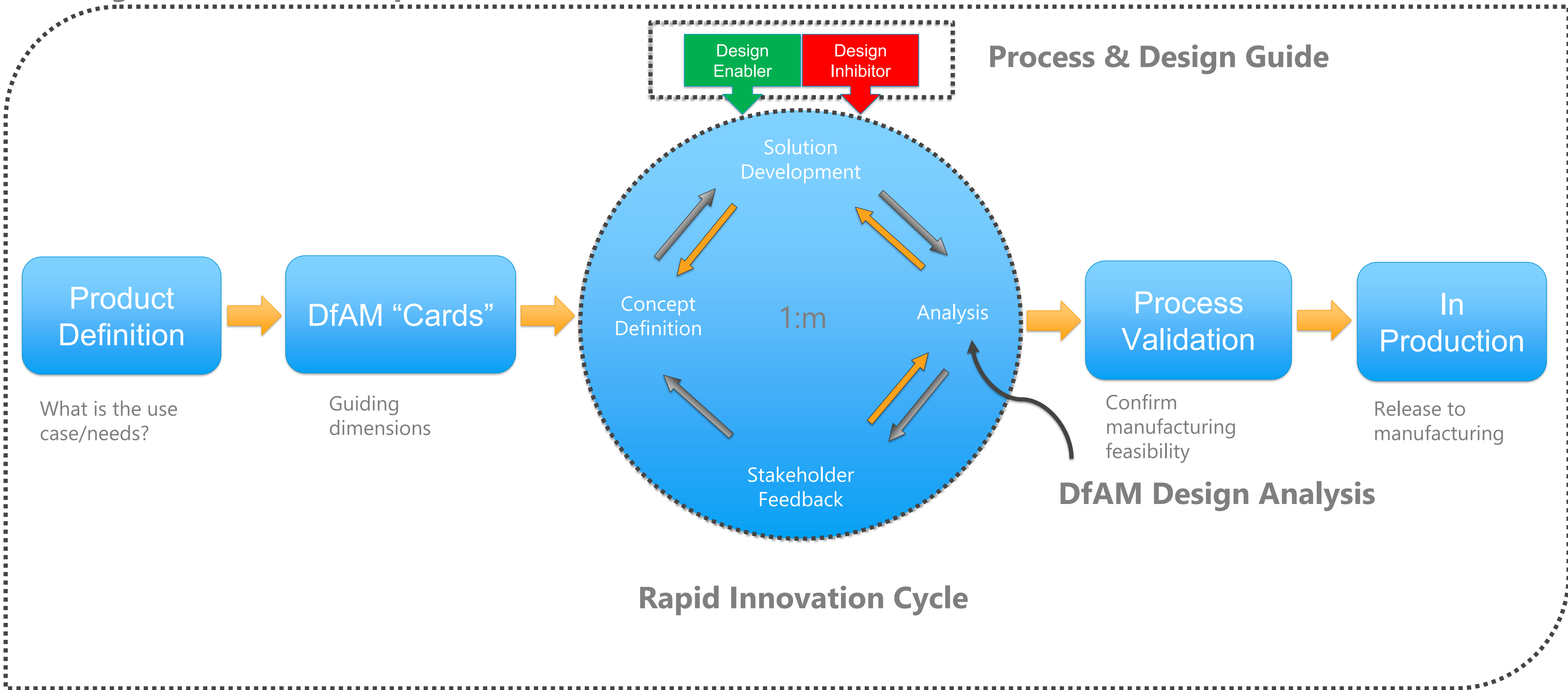
- **Concept Definition**
  - Refine the “solution” concept that satisfies the use case
- **Solution Development**
  - Consider process that will likely bring the concept to fruition
  - Evaluate design inhibitors and enablers – incorporate into design
- **Analysis**
  - Short first order analysis, thought experiments, physical prototype
  - Maximize insights while minimizing costs
- **Stakeholder Feedback**
  - Gather feedback from target group (internal and external)
  - Re-iterate as needed



**Characterized By Collaboration and Feedback At All Steps Along The Way**



# Agile Product Development



Inspired by the MIT course "Additive Manufacturing for Innovative Design and Production"



***DEMO***





# Home Dashboard

Charts

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▼

My Outstanding Work

Last updated: 10/19/2020 05:35 PM 

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<div></div>	<div></div>	<div></div>	Due Date	Item Name	Workspace	State	State Set On	State Set By
				AU2020 Mounting Bracket   APD-000008	Agile Product Development	Definition	10/19/2020	Justin Janelli
				INNOVATION CYCLE   RIC-000013	Rapid Innovation Cycle	Concept Definition	10/13/2020	Justin Janelli
				Justin Test 10.13.2020   APD-000003	Agile Product Development	Innovation Cycles	10/13/2020	Justin Janelli
				INNOVATION CYCLE   RIC-000009	Rapid Innovation Cycle	Stakeholder Feedback	10/11/2020	Orrin Bourne

My Bookmarks

^

<div>★</div>	Item Name	Workspace	Comment
<div>★</div>	INNOVATION CYCLE   RIC-000013	Rapid Innovation Cycle	

My Recently Viewed Items

^

Item Name	Workspace
INNOVATION CYCLE   RIC-000013	Rapid Innovation Cycle
AU2020 Mounting Bracket   APD-000008	Agile Product Development
INNOVATION CYCLE   RIC-000009	Rapid Innovation Cycle
Justin Test 10.13.2020   APD-000003	Agile Product Development
INNOVATION CYCLE   RIC-000012	Rapid Innovation Cycle
DfAM Analysis   DA-000016	DfAM Design Analysis



# Home Dashboard

AUTODESK® FUSION LIFECYCLE

Dashboard

Workspaces

Advanced Tools

Workspaces

Digital Manufacturing

Digital Manufacturing

Agile Product Development

Rapid Innovation Cycle

DfAM Design Analysis

Process and Design Guide

Last updated: 10/19/2020 05:35 PM

	State	State Set On	State Set By
Product Development	Definition	10/19/2020	Justin Janelli
Innovation Cycle	Concept Definition	10/13/2020	Justin Janelli
Product Development	Innovation Cycles	10/13/2020	Justin Janelli
Innovation Cycle	Stakeholder Feedback	10/11/2020	Orrin Bourne

My Bookmarks

Item Name

Comment

INNOVATION CYCLE | RIC-000013

Rapid Innovation Cycle

My Recently Viewed Items

Item Name	Workspace
INNOVATION CYCLE   RIC-000013	Rapid Innovation Cycle
AU2020 Mounting Bracket   APD-000008	Agile Product Development
INNOVATION CYCLE   RIC-000009	Rapid Innovation Cycle
Justin Test 10.13.2020   APD-000003	Agile Product Development
INNOVATION CYCLE   RIC-000012	Rapid Innovation Cycle
DfAM Analysis   DA-000016	DfAM Design Analysis

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# Create New Agile Product Development (APD)

Home > Agile Product Development



Compact View ☐

My Default View (7) ▾



Item Descriptor ▾	Current State
TEST   APD-000001	In Production
TEST 2   APD-000002	Innovation Cycles
Justin Test 10.13.2020   APD-000003	Innovation Cycles
Demo for Michelle   APD-000006	Process Validation
AU Prep with AM Shop Managers   APD-000007	In Production
APD-000005	Definition
APD-000004	Definition

7 out of 7 total records in this view being displayed.



# APD | Populate Item Details

AUTODESK FUSION LIFECYCLE

Home

Agile Product Development

AM Fixturing / Workholding for CNC Machining | APD-000008

Definition

Workflow actions

Item Details

Workflow Actions

Concept Whiteboard (0)

RICs (0)

Attachments (0)

Save

Cancel

Product Definition (1 of 3)

Title

AM Fixturing / Workholding for CNC Machining

ID

APD-000008

Definition of Need

Rapid generation of complex, high mix, short-run workholdings used for CNC machining.

Find the right blend of performance, cost, sustainability.

Decision Drivers

Design Objectives

Applications

Processes

Industry

Material

Creative Dimensions

Select

Select

Select

Select

Select

Select

Size (LxWxH mm)

Surface Finish (µm)

Target Cost (\$)

Production Qty

Matr'l Properties

Mech Properties

Feature Res. (mm)

Additive Manufacturing Dimensions

Solution (2 of 3)

Points Of Contact (3 of 3)

\* Product Owner

Select

Product Owner

×

Innovation Manager

×

Process Validator

×

Stakeholder

×

Innovation Manager

Select

Responsible for Definition state and oversight while in Innovation Cycles

Responsible for creating White Board Concepts and generating RIC while in Innovation Cycles state

Responsible for manufacturing while in Process Validation state

Informational purposes. Will provide feedback for RICs.

Process Validator

Select

Stakeholder

Select

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# DfAM Cards

DECISION DRIVERS	COST	TIME TO MARKET	FLEXIBILITY	PERFORMANCE	QUALITY	INDUSTRY	APPLICATION	PROCESS	DESIGN	
DESIGN OBJECTIVES	HIGH-STRENGTH	LOW/HIGH VOLUME	LIGHTWEIGHT	MODULARIZED	INDUSTRIALLY DESIGNED	GENERATIVELY DESIGNED	PARAMETRICALLY DESIGNED	COMPLIANT DESIGN	REVERSE ENGINEERED	
AM APPLICATIONS	PROTOTYPING / PRODUCT DEVELOPMENT	TOOLING & MANUFACTURING PRODUCTIVITY	CUSTOMIZATION & PERSONALIZATION	PRODUCTION	ART, DESIGN, ARCHITECTURE	PERFORMANCE OPTIMIZATION	SPARE PARTS / MRO	PROCESS	SUSTAINABILITY	
AM PROCESSES	FFF / FDM	SLA	SLS	SLM	BINDER JETTING	MATERIAL JETTING	DED	LOM	HYBRID	
INDUSTRY	AEROSPACE	AUTOMOTIVE	INDUSTRIAL	CONSUMER ELECTRONICS	CONSUMER	TEXTILES	MANUFACTURING	MEDICAL	ARCHITECTURE	
MATERIAL	POLYMERS	METALS	COMPOSITES	ORGANICS	MULTIMATERIALS	FOODS	CERAMICS	GLASS		

Source: MIT



xPRO



# APD | Review Item Details

Home &gt; Agile Product Development

AM Fixturing / Workholding for CNC Machining | APD-000008

Definition

Workflow actions

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Item Details

Workflow Actions

Concept Whiteboard (0)

RICs (0)

Attachments (0)

Edit

Product Definition (1 of 3)

^

Title	AM Fixturing / Workholding for CNC Machining						
ID	APD-000008						
Definition of Need	Rapid generation of complex, high mix, short-run workholdings used for CNC machining.						
	Find the right blend of performance, cost, sustainability.						
	Decision Drivers	Design Objectives	Applications	Processes	Industry	Material	
Creative Dimensions	Application Design	Gernatively Designed High-Strength	Performance Optimization Process	Binder Jetting Hybrid	Industrial	Metals	
	Performance Time to Market	Industrially Designed Low/High Volume	Sustainability Tooling & Manufacturing	SLA SLM SLS		Polymer	
	Size (LxWxH mm)	Surface Finish (µm)	Target Cost (\$)	Production Qty	Matr'l Properties	Mech Properties	Feature Res. (mm)
Additive Manufacturing Dimensions	300x300x300	400.00	100.00	100	Corrosion-resistant	Thermoplastic	1.00

Solution (2 of 3)

▼

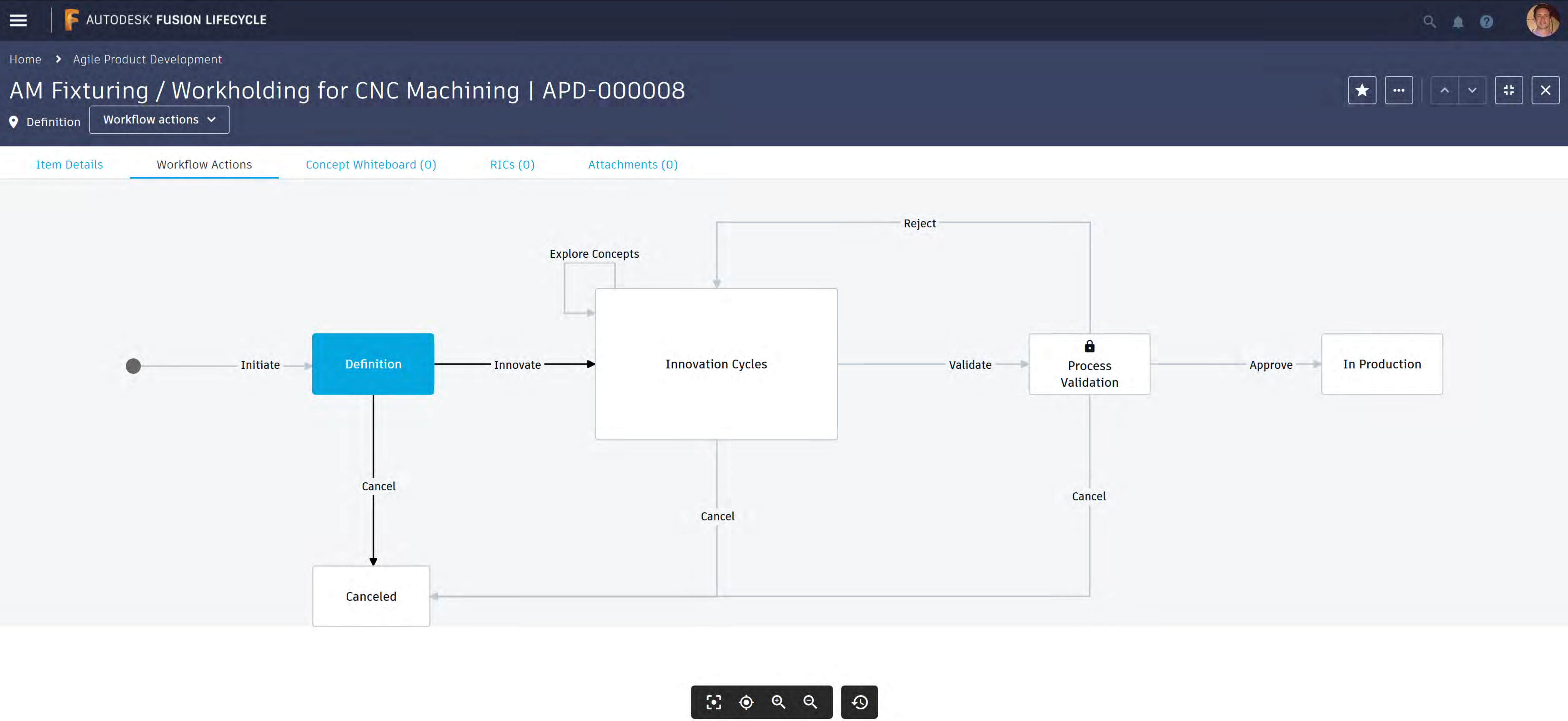
Points Of Contact (3 of 3)

^

Product Owner	Janelli, Justin
Innovation Manager	Janelli, Justin
Process Validator	Janelli, Justin
Stakeholder	Janelli, Justin

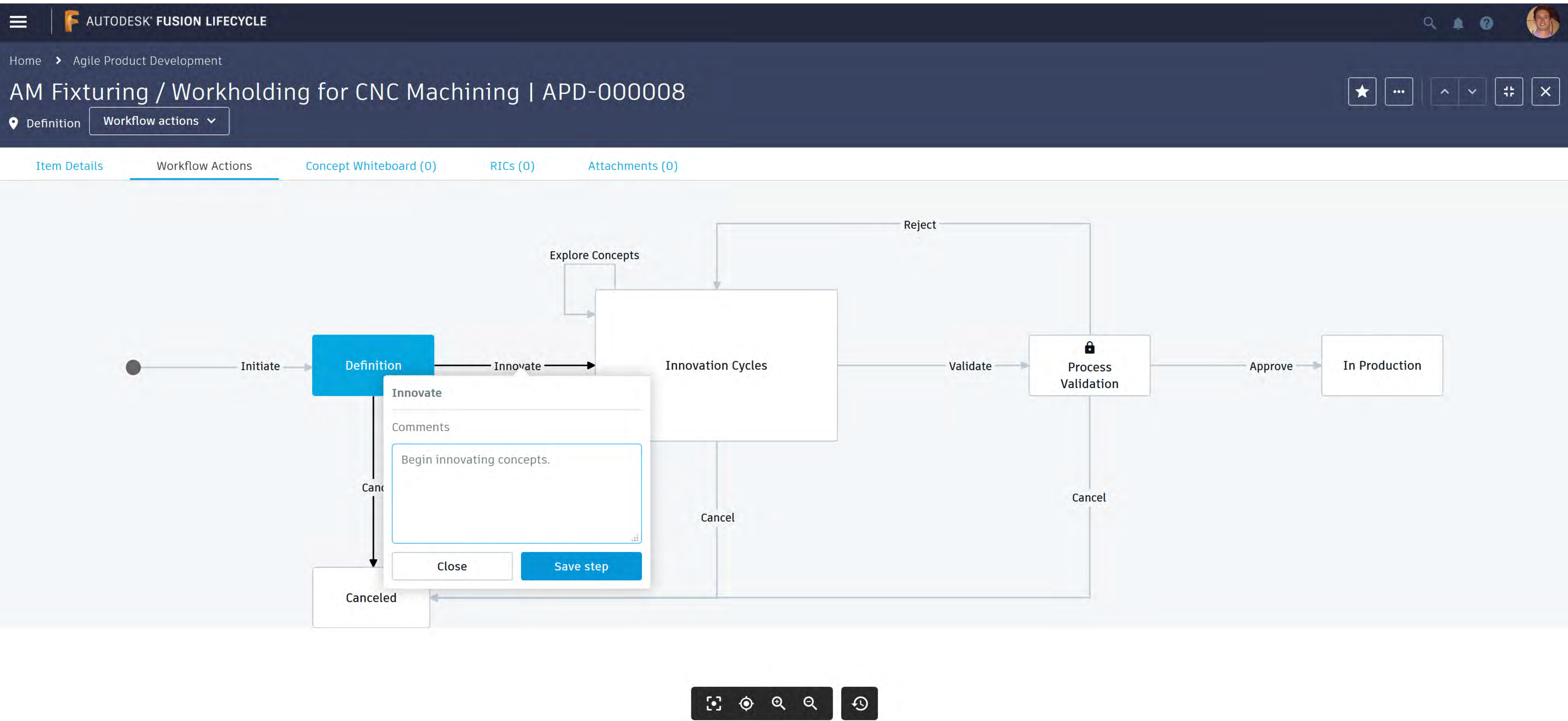


# APD | Product Owner Hand-Off to Innovation Manager



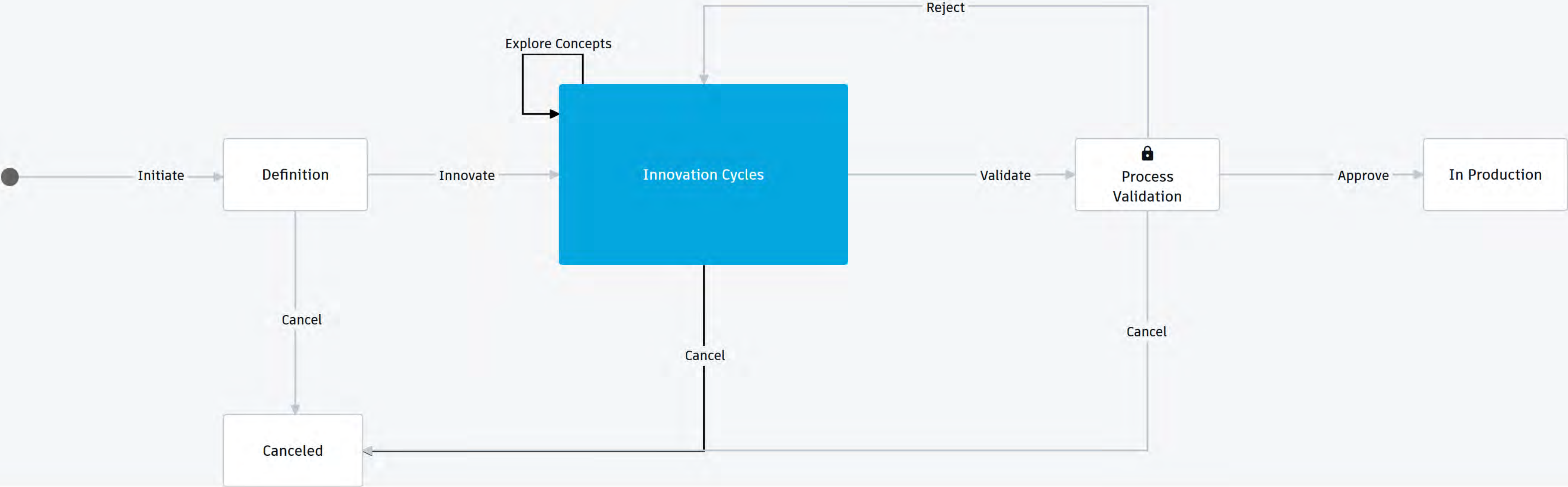


# APD | Product Owner Hand-Off to Innovation Manager





# APD | Ready to Innovate





# APD | Innovate Concepts to Explore

Home > Agile Product Development

## AM Fixturing / Workholding for CNC Machining | APD-000008

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📍 Innovation Cycles

Workflow actions ▾

Item Details

Workflow Actions

Concept Whiteboard (3)




RICs (0)

Attachments (0)

Edit

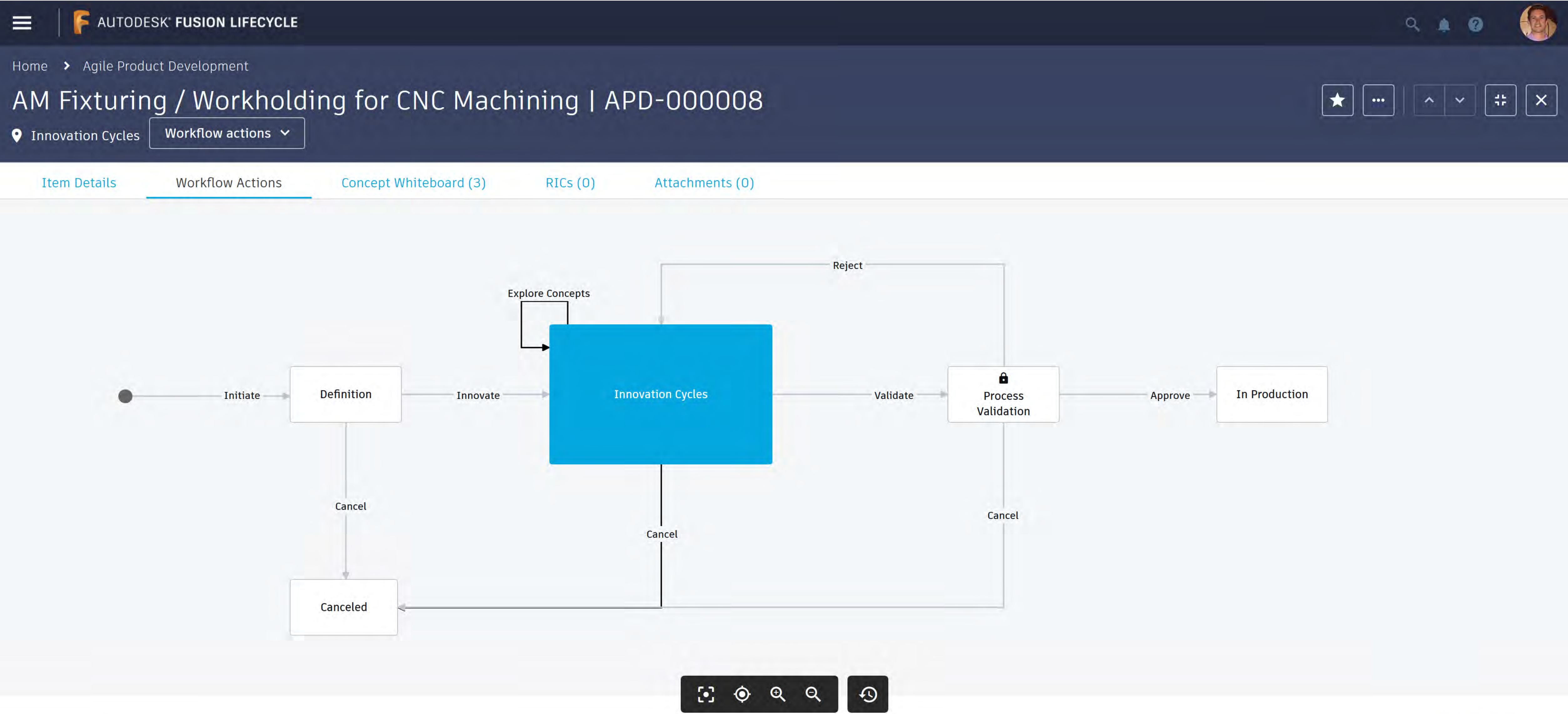
Add

Remove

Explore	Concept ↑	Notes	Supporting Data Link (URL)
<input type="checkbox"/> 	Enable reuse / recycling for sustainability.	Concept whiteboard sketch with material ideas in supporting link.	<a href="https://a360.co/31pxiza">https://a360.co/31pxiza</a>
<input type="checkbox"/> 	Generatively designed.	Inspired by Matsuura. See supporting AU Class link.	<a href="https://www.autodesk.com/autodesk-university/class/Automated-Fixture-Creation-CNC-Milling-Using-Generative-Design-Approach-2019#video">https://www.autodesk.com/autodesk-university/class/Automated-Fixture-Creation-CNC-Milling-Using-Generative-Design-Approach-2019#video</a>
<input type="checkbox"/> 	Parts are user-configurable via web, cloud-based interface.	Inspired by internal project around AM jigs and drilling templates.	<a href="https://a360.co/34f4fjB">https://a360.co/34f4fjB</a>



# APD | Innovation Manager Must Choose Which to Explore





# APD | Group & Explore Concepts

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# ADP | Creates New Rapid Innovation Cycle (RIC)

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Home > Agile Product Development

AM Fixturing / Workholding for CNC Machining | APD-000008

Innovation Cycles

Workflow actions

Item Details

Workflow Actions

Concept Whiteboard (3)

RICs (1)

Attachments (0)

Item	Workspace	Current State	Direction Type	Description
INNOVATION CYCLE   RIC-000024	Rapid Innovation Cycle	Concept Definition	↔ Bi-Directional	Rapid Innovation

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# APD | Group & Explore Remaining Concepts

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Home > Agile Product Development

AM Fixturing / Workholding for CNC Machining | APD-000008

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📍 Innovation Cycles

Workflow actions ^

Cancel >

Explore Concepts >

Item Details

Edit

Explore

Concept ↑

Enable reuse / recycling for s

Generatively designed.

✓

Parts are user-configurable v  
interface.

Concept Whiteboard (3)

RICs (1)

Attachments (0)

< Back

Explore Concepts

Comments

Explore user defined / web-  
configurable.

Close

Save step

Supporting Data Link (URL)

Sketch with material ideas in <https://a360.co/31pxiza>

See supporting AU Class link. <https://www.autodesk.com/autodesk-university/class/Automated-Fixture-Creation-CNC-Milling-Using-Generative-Design-Approach-2019#video>

Project around AM jigs and <https://a360.co/34f4fjB>

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# APD | Creates New Rapid Innovation Cycle (RIC)

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Home > Agile Product Development

AM Fixturing / Workholding for CNC Machining | APD-000008

Innovation Cycles

Workflow actions

Item Details

Workflow Actions

Concept Whiteboard (3)

RICs (2)

Attachments (0)

Item	Workspace	Current State	Direction Type	Description
INNOVATION CYCLE   RIC-000024	Rapid Innovation Cycle	Concept Definition	↔ Bi-Directional	Rapid Innovation
INNOVATION CYCLE   RIC-000025	Rapid Innovation Cycle	Concept Definition	↔ Bi-Directional	Rapid Innovation

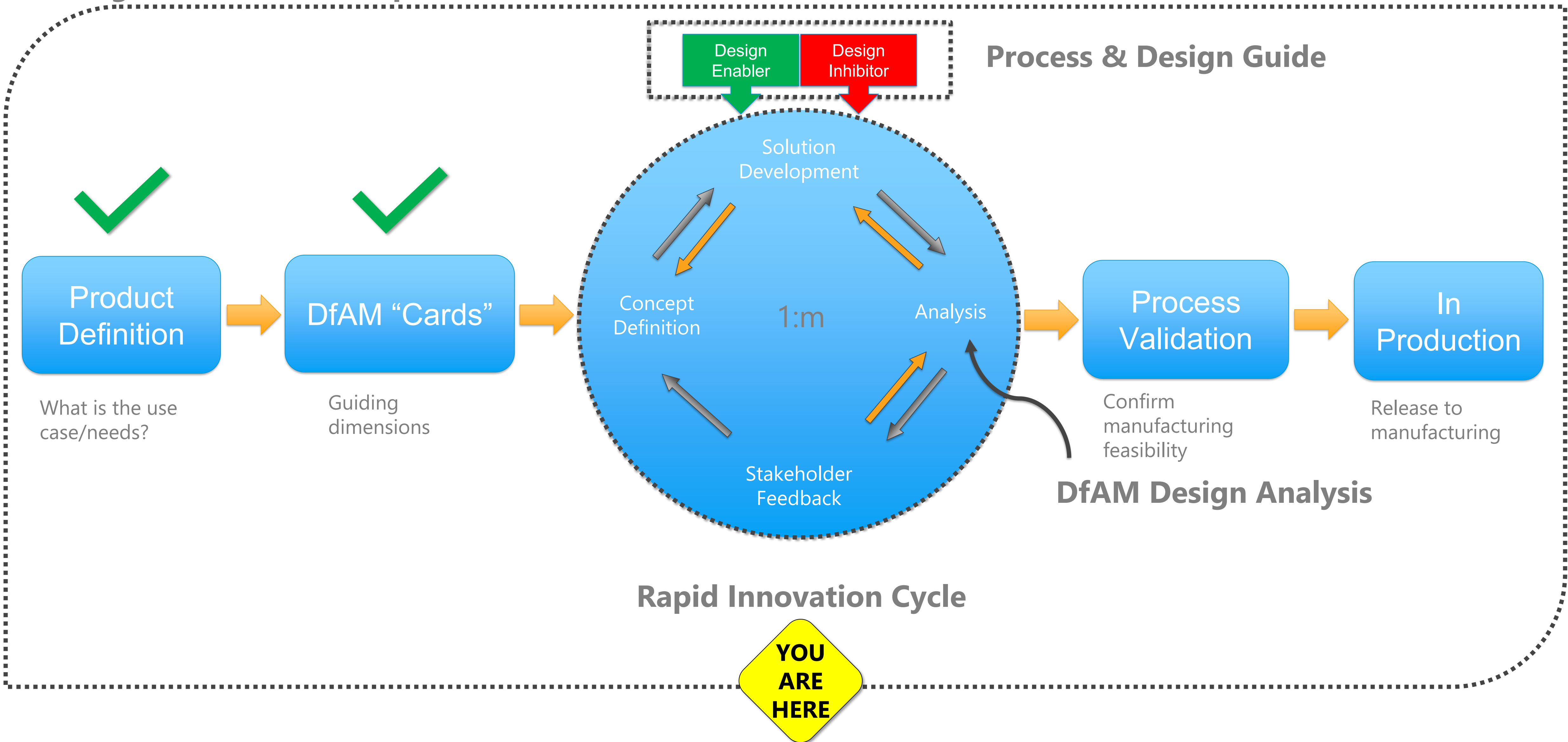
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# Agile Product Development



Inspired by the MIT course "Additive Manufacturing for Innovative Design and Production"



# RIC | Review Rapid Innovation Cycle (RIC)

Home > Rapid Innovation Cycle

## INNOVATION CYCLE | RIC-000024

Concept Definition

Workflow actions

Item Details

Workflow Actions

DfAM Solutions (0)

Change Log

Edit

Details (1 of 2)

Title	INNOVATION CYCLE		
ID	RIC-000024		
	Design Concept	Parent Link	
	Enable reuse / recycling for sustainability.	<a href="#">AM Fixturing / Workholding for CNC Machining   APD-000008</a>	
	Generatively designed.		

Points Of Contact (2 of 2)

RIC Manager	Janelli, Justin
Solution Manager	
Lead Analyst	
Stakeholder	Janelli, Justin

RIC Manager

×

Responsible for Concept Definition and Stakeholder Review

Solution Manager

×

Responsible for Solution Development state

Lead Analyst

×

Responsible for Analyzing state

Stakeholder

×

Derived from Parent Link item



# RIC | Update Rapid Innovation Cycle (RIC)

Home > Rapid Innovation Cycle

## AM Fixturing | Reuse & Generative Design | RIC-000024

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📍 Concept Definition

Workflow actions ▾

- Item Details
- Workflow Actions
- DfAM Solutions (0)
- Change Log

Edit

Details (1 of 2)

⬆

Title	AM Fixturing   Reuse & Generative Design		
ID	RIC-000024		
	Design Concept	Parent Link	
	Enable reuse / recycling for sustainability.	<a href="#">AM Fixturing / Workholding for CNC Machining   APD-000008</a>	
	Generatively designed.		

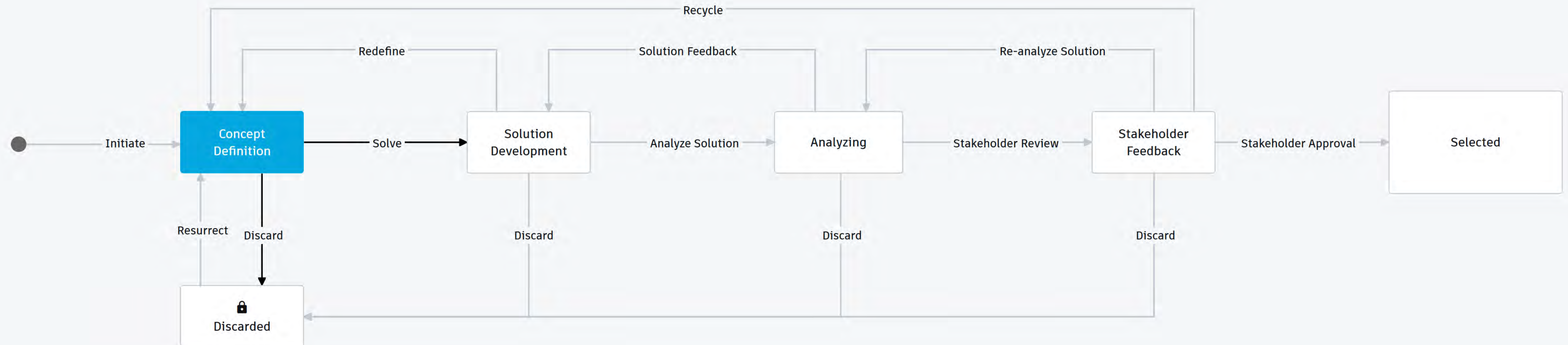
Points Of Contact (2 of 2)

⬆

RIC Manager	Janelli, Justin
Solution Manager	Janelli, Justin
Lead Analyst	Janelli, Justin
Stakeholder	Janelli, Justin



# RIC | RIC Manager





# RIC | Hand-off to Solution Manager

AUTODESK FUSION LIFECYCLE

Home

Rapid Innovation Cycle

AM Fixturing | Reuse & Generative Design | RIC-000024

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📍 Concept Definition

Workflow actions ▾

Item Details

Workflow Actions

DfAM Solutions (0)

Change Log

●

Initiate

Concept Definition

Solve

Solution Development

Analyze Solution

Analyzing

Stakeholder Review

Stakeholder Feedback

Stakeholder Approval

Selected

Recycle

Redefine

Solution Feedback

Re-analyze Solution

Discard

Discard

Resurrect

Solve

Comments

Begin solution development.

Close

Save step

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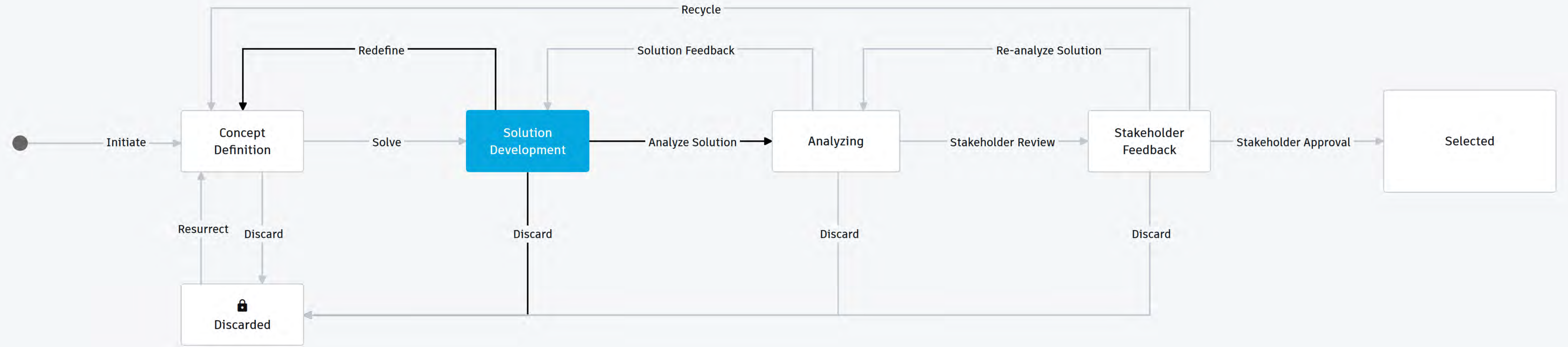
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# RIC | Ready for Solution Development





# RIC | Add Designs and MFG Processes to Explore

AUTODESK FUSION LIFECYCLE

Home > Rapid Innovation Cycle

AM Fixturing | Reuse & Generative Design | RIC-000024

Solution Development

Workflow actions

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Item Details

Workflow Actions

DfAM Solutions (4)

Change Log

Edit

Add

Remove

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# RIC | Build Out Your Available MFG Processes

Home > Process and Design Guide

## SLA | 3D Systems ProX 950







Item Details

Attachments (0)

Change Log

Edit

Info. (1 of 1)

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Process	SLA
Machine	3D Systems ProX 950
Build Volume	1500 x 750 x 550 mm
Design Enablers	Compliant Materials, Durable Materials, Easy to Use, Isotropic Materials, Large Scale Parts, Simple Post-Processing (No Machining), Smooth Surface, Soluble Material
Design Inhibitors	Requires Support Material & Post-Processing



# Design Enablers & Inhibitors

## Design Enablers

*process attributes that expand the design space, and enable new solutions*

- Compliant materials
- Durable materials
- Easy to use
- Efficient build utilization
- Electrically conductive
- Full color
- High build rate
- High detail
- Isotropic mechanics
- Large-scale parts
- Low feedstock cost
- Simple post-processing
- Smooth surface
- Soluble material
- Thermally conductive
- Uses well-known materials
- Other (your suggestions)

## Design Inhibitors

*process attributes that challenge the feasibility of new solutions*

- Anisotropic mechanics
- Complicated post-processing
- Expensive equipment
- Expensive materials
- Low resolution
- Poor material durability
- Residual stress
- Safety precautions
- Other (your suggestions)



# RIC | Attach Supporting Documentation

Item Details

Attachments (1)

Change Log

Upload

Download (0)

Bulk Download ▾

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Display folders at the top ☐

Direct Attachments

File Name ↑

Title

Ver.

Type

Size

Last Updated

Description

☐

3d-systems-3dsprint-sla-en-letter-flyer-web-2017-04-26.pdf

3d-systems-3dsprint-sla-en-letter-flyer-web-2017-04-26

1

Adobe PDF

295.6 KB

10/21/2020

3D Systems ProX 950 Spec Sheet

Related Attachments



No related attachments to this item.



# RIC | Tag Solutions to Analyze

Home > Rapid Innovation Cycle

## AM Fixturing | Reuse & Generative Design | RIC-000024

Solution Development

Workflow actions ▾

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Additional Actions

Item Details

Workflow Actions

DfAM Solutions (4)

Change Log

Edit

Add

Remove

	Additional Actions	Design Data (URL)	Mfg. Process	Status ↓	Design Analysis	Stakeholder Feedback
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<a href="https://a360.co/2TezPYn">https://a360.co/2TezPYn</a>	SLM   EOSm400-4	Under Consideration		
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<a href="https://a360.co/3dOgas0">https://a360.co/3dOgas0</a>	Binder Jetting   HP Metal Jet	Under Consideration		
<input type="checkbox"/>	<input type="checkbox"/>	<a href="https://a360.co/34g6aEG">https://a360.co/34g6aEG</a>	SLA   3D Systems ProX 950	Under Consideration		
<input type="checkbox"/>	<input type="checkbox"/>	<a href="https://a360.co/31pR5P1">https://a360.co/31pR5P1</a>	Generative Design   Reference	Reference		



# RIC | Create New DfAM Analysis

AUTODESK FUSION LIFECYCLE

Home

Rapid Innovation Cycle

AM Fixturing | Reuse & Generative De

Solution Development

Workflow actions

Item Details

Workflow Actions

DfAM Solutions (4)

Edit

Add

Remove

	Additional Actions	Design Data (URL)	Mfg. Process
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<a href="https://a360.co/2TezPYn">https://a360.co/2TezPYn</a>	SLM   EOSr
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<a href="https://a360.co/3dOgas0">https://a360.co/3dOgas0</a>	Binder Jett
<input type="checkbox"/>	<input type="checkbox"/>	<a href="https://a360.co/34g6aEG">https://a360.co/34g6aEG</a>	SLA   3D Sy
<input type="checkbox"/>	<input type="checkbox"/>	<a href="https://a360.co/31pR5P1">https://a360.co/31pR5P1</a>	Generative

Additional Actions - Create DfAM Analysis\_RIC

Select an action to perform.

☒ Create DfAM Analysis\_RIC

☐ Duplicate Selected DfAM Solution

☐ Split Selected DfAM Solutions

Cancel

OK

Star

More

Up

Down

Fullscreen

Close

Additional Actions

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# RIC | DfAM Analyses Created

Home > Rapid Innovation Cycle

## AM Fixturing | Reuse & Generative Design | RIC-000024

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📍 Solution Development

Workflow actions ▾

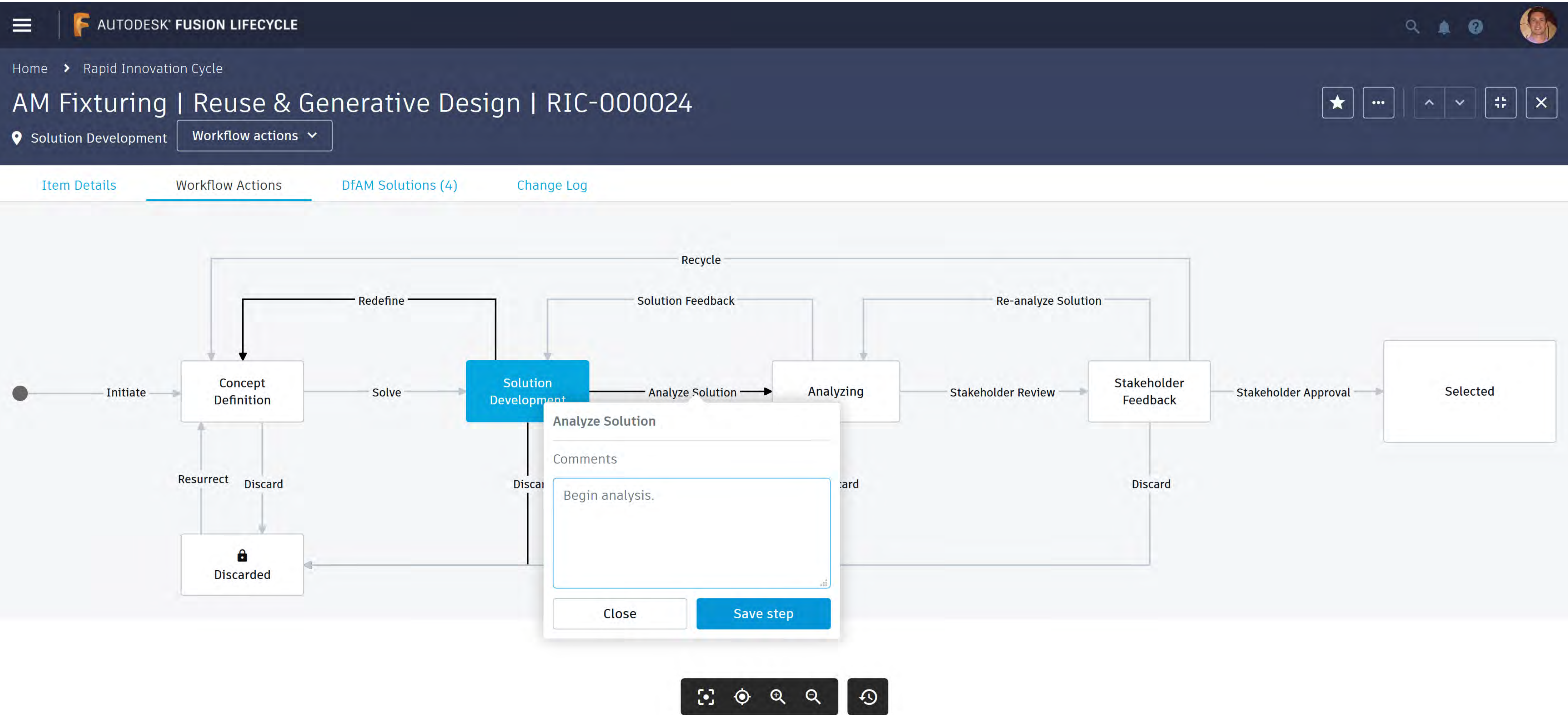
Item DetailsWorkflow ActionsDfAM Solutions (4)Change Log

EditAddRemove

Additional Actions		Design Data (URL)	Mfg. Process	Status ↓	Design Analysis	Stakeholder Feedback
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/2TezPYn	SLM   EOSm400-4	Under Consideration	DfAM Analysis   DA-000029	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/3dOgas0	Binder Jetting   HP Metal Jet	Under Consideration	DfAM Analysis   DA-000028	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/34g6aEG	SLA   3D Systems ProX 950	Under Consideration		
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/31pR5P1	Generative Design   Reference	Reference		

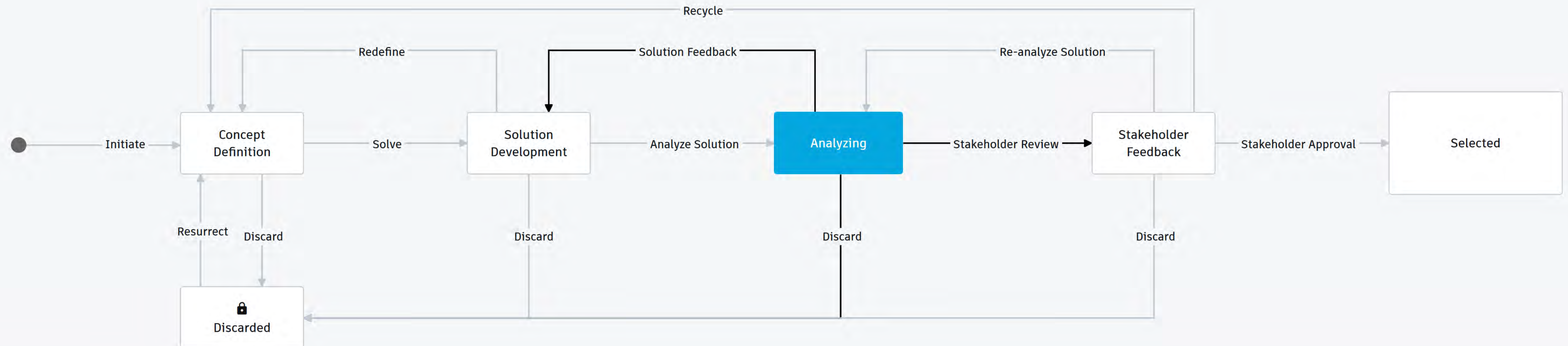


# RIC | Hand-off to Lead Analyst





# RIC | Ready for Analysis





# RIC | Remaining DfAM Analyses Auto Created

Home > Rapid Innovation Cycle

## AM Fixturing | Reuse & Generative Design | RIC-000024

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📍 Analyzing 

Workflow actions ▾

Item Details

Workflow Actions

DfAM Solutions (4)

Change Log

Edit

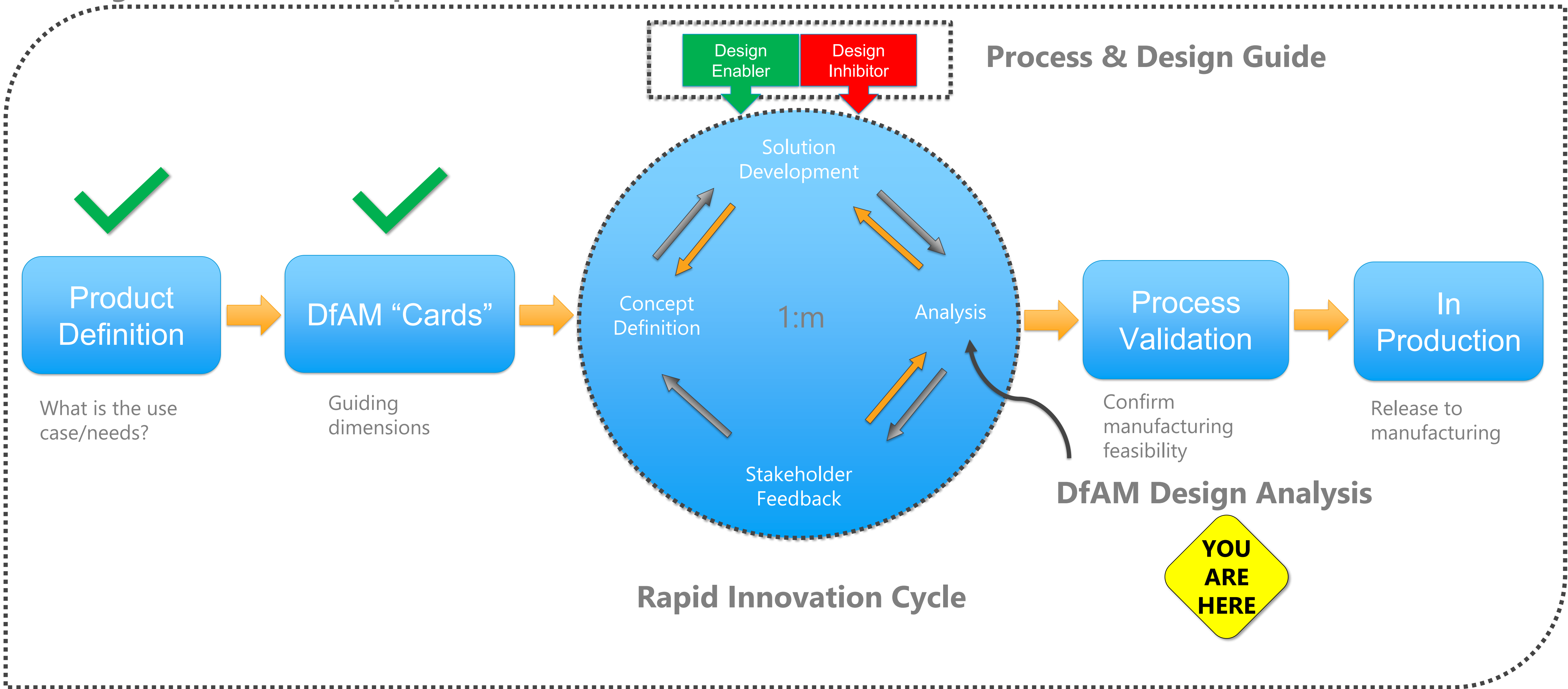
Add

Remove

Additional Actions		Design Data (URL)	Mfg. Process	Status	Design Analysis ↑	Stakeholder Feedback
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/3dOgas0	Binder Jetting   HP Metal Jet	Under Consideration	DfAM Analysis   DA-000028	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/2TezPYn	SLM   EOSm400-4	Under Consideration	DfAM Analysis   DA-000029	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/34g6aEG	SLA   3D Systems ProX 950	Under Consideration	DfAM Analysis   DA-000030	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/31pR5P1	Generative Design   Reference	Reference		



# Agile Product Development



Inspired by the MIT course "Additive Manufacturing for Innovative Design and Production"



# Analysis | Populate with All Relevant Analysis Info

Home > DfAM Design Analysis

## DfAM Analysis | DA-000028

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- Item Details
- Supporting Documents (0)
- Change Log

Edit

Details (1 of 4)		⬆
Title	DfAM Analysis	
ID	DA-000028	
Associated RIC	AM Fixturing   Reuse & Generative Design   RIC-000024	
Simulation (2 of 4)		⬇
Lifecycle Analysis (3 of 4)		⬇
Costing (4 of 4)		⬇



# Analysis | Attach Supporting Documentation



## DfAM Analysis | DA-000028



Item Details

Supporting Documents (3)

Change Log

Upload

Download (0)

Bulk Download



Display folders at the top ☐

### Direct Attachments



	File Name ↑	Title	Ver.	Type	Size	Last Updated	Description
▼	Costing						
<input type="checkbox"/>	Cost Analysis.xlsx	Cost Analysis	1	Microsoft Excel	294.9 KB	10/21/2020	
▼	FEA (Nastran)						
<input type="checkbox"/>	FEA Analysis - Nastran.pdf	FEA Analysis - Nastran	1	Adobe PDF	615.8 KB	10/21/2020	
▼	Manufacturability (Netfabb)						
<input type="checkbox"/>	Manufacturability Analysis - Netfabb.pdf	Manufacturability Analysis - Netfabb	1	Adobe PDF	615.8 KB	10/21/2020	

### Related Attachments





# RIC | Option to Split Solution into Own RIC

AUTODESK FUSION LIFECYCLE

Home > Rapid Innovation Cycle

AM Fixturing | Reuse & Generative Design | RIC-000024

Analyzing

Workflow actions

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Item Details   Workflow Actions <u>DfAM Solutions (4)</u> Change Log						
<div>EditAddRemove</div>						
Additional Actions		Design Data (URL)	Mfg. Process	Status	Design Analysis ↑	Stakeholder Feedback
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/3dOgas0	Binder Jetting   HP Metal Jet	Viable	DfAM Analysis   DA-000028	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/2TezPYn	SLM   EOSm400-4	Viable	DfAM Analysis   DA-000029	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	https://a360.co/34g6aEG	SLA   3D Systems ProX 950	Under Consideration	DfAM Analysis   DA-000030	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/31pR5P1	Generative Design   Reference	Reference		



# RIC | Tag Solution and Split into New RIC



Home > Rapid Innovation Cycle

AM Fixturing | Reuse & Generative Design | RIC-000024



📍 Analyzing Workflow actions ▾

Additional Actions - Split Selected DfAM Solutions ✕

Select an action to perform.

- ☐ Create DfAM Analysis\_RIC
- ☐ Duplicate Selected DfAM Solution
- ☒ **Split Selected DfAM Solutions**

## eholder Feedback

Cancel

OK



# RIC | Review DfAM Solutions Post-Split

Home > Rapid Innovation Cycle

## AM Fixturing | Reuse & Generative Design | RIC-000024

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📍 Analyzing

Workflow actions ▾

Item Details

Workflow Actions

DfAM Solutions (3)

Change Log

Edit

Add

Remove

Additional Actions		Design Data (URL)	Mfg. Process	Status	Design Analysis ↑	Stakeholder Feedback
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/3dOgas0	Binder Jetting   HP Metal Jet	Viable	DfAM Analysis   DA-000028	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/2TezPYn	SLM   EOSm400-4	Viable	DfAM Analysis   DA-000029	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/31pR5P1	Generative Design   Reference	Reference		



# APD | Review, Track, Manage Newly Split RIC from APD

AUTODESK® FUSION LIFECYCLE

Home

Agile Product Development

AM Fixturing / Workholding for CNC Machining | APD-000008

Innovation Cycles

Workflow actions

Item Details

Workflow Actions

Concept Whiteboard (3)

RICs (3)

Attachments (0)

	Item	Workspace	Current State	Direction Type	Description
	AM Fixturing   Reuse & Generative Design (SPLIT)   RIC-000026	Rapid Innovation Cycle	Concept Definition	↔ Bi-Directional	Rapid Innovation Cycle
	AM Fixturing   Reuse & Generative Design   RIC-000024	Rapid Innovation Cycle	Stakeholder Feedback	↔ Bi-Directional	Rapid Innovation
	INNOVATION CYCLE   RIC-000025	Rapid Innovation Cycle	Concept Definition	↔ Bi-Directional	Rapid Innovation

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FUSION LIFECYCLE



# RIC | Hand-off to RIC Manager

AUTODESK FUSION LIFECYCLE

Home > Rapid Innovation Cycle

AM Fixturing | Reuse & Generative Design | RIC-000024

Analyzing

Workflow actions

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Item Details

Workflow Actions

DfAM Solutions (4)

Change Log

Initiate

Concept Definition

Solve

Solution Development

Analyze Solution

Analyzing

Stakeholder Review

Stakeholder Feedback

Stakeholder Approval

Selected

Discarded

Resurrect

Discard

Discard

Discard

Recycle

Redefine

Solution Feedback

Re-analyze Solution

Stakeholder Review

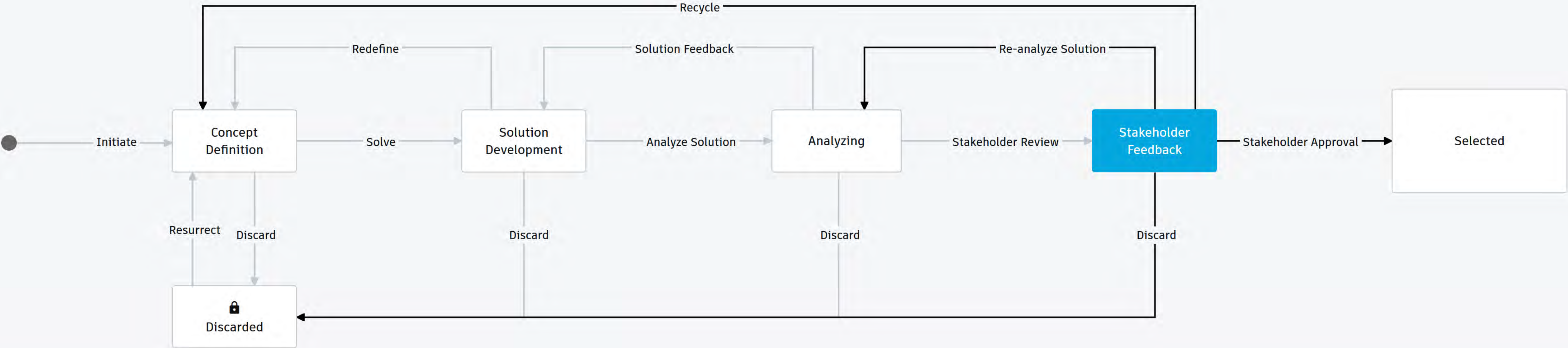
Comments

Close

Save step



# RIC | Ready to Gather Stakeholder Feedback





# RIC | RIC Manager Reviews & Presents to Stakeholder

AUTODESK FUSION LIFECYCLE

Home > Rapid Innovation Cycle

AM Fixturing | Reuse & Generative Design | RIC-000024

Stakeholder Feedback

Workflow actions

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Item Details   Workflow Actions <u>DfAM Solutions (3)</u> Change Log						
<div>EditAddRemove</div>						
Additional Actions		Design Data (URL)	Mfg. Process	Status	Design Analysis ↑	Stakeholder Feedback
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/3dOgas0	Binder Jetting   HP Metal Jet	Viable	DfAM Analysis   DA-000028	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/2TezPYn	SLM   EOSm400-4	Viable	DfAM Analysis   DA-000029	
<input type="checkbox"/>	<input type="checkbox"/>	https://a360.co/31pR5P1	Generative Design   Reference	Reference		



# RIC | Stakeholder Selects Solution

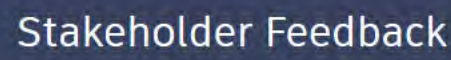


**F** AUTODESK® FUSION LIFECYCLE



Home > Rapid Innovation Cycle

AM Fixturing | Reuse & Generative Design | RIC-000024



Workflow actions ▾



### Item Details

## Workflow Actions

### DfAM Solutions (3)

## Change Log

Edit

Add

Remove

	Additional Actions	Design Data (URL)	Mfg. Process	Status	Design Analysis ↑	Stakeholder Feedback
<input type="checkbox"/>		<a href="https://a360.co/3dOgas0">https://a360.co/3dOgas0</a>	Binder Jetting   HP Metal Jet	Selected	DfAM Analysis   DA-000028	Selected for reasons XYZ.
<input type="checkbox"/>		<a href="https://a360.co/2TezPYn">https://a360.co/2TezPYn</a>	SLM   EOSm400-4	Viable	DfAM Analysis   DA-000029	Not selected for reasons XYZ.
<input type="checkbox"/>		<a href="https://a360.co/31pR5P1">https://a360.co/31pR5P1</a>	Generative Design   Reference	Reference		

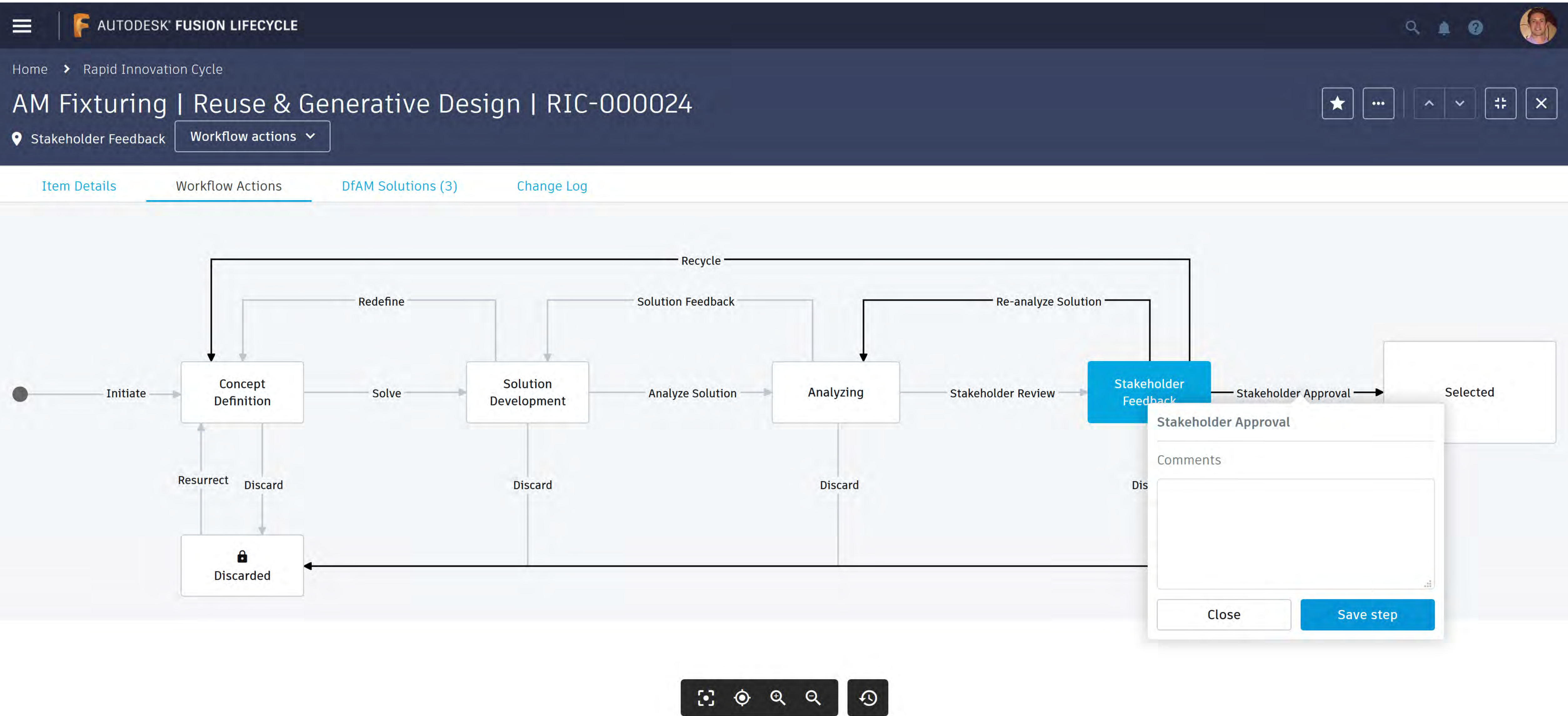


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# RIC | Hand-off to Process Validator





# RIC | Ready for Process Validation

Home > Rapid Innovation Cycle

## AM Fixturing | Reuse & Generative Design | RIC-000024

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📍 Selected 

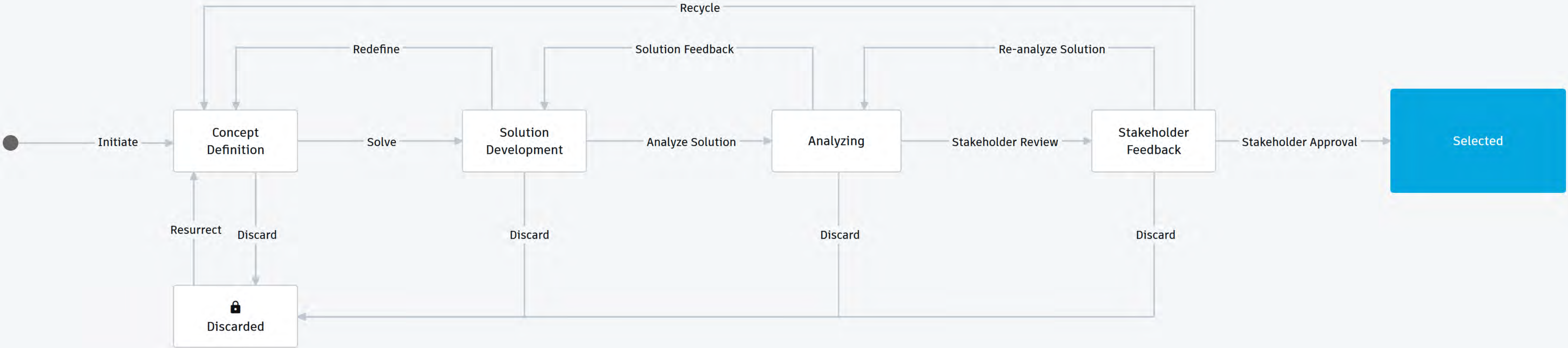
No workflow actions available ▾

Item Details

Workflow Actions

DfAM Solutions (3)

Change Log





```
graph LR; PD[Product Definition] --> DC[DfAM "Cards"]; DC --> Cycle((1:m)); subgraph Cycle; SD[Solution Development] <--> CD[Concept Definition]; CD <--> SF[Stakeholder Feedback]; SF <--> A[Analysis]; A <--> SD; end; Cycle --> PV[Process Validation]; PV --> IP[In Production]; DE[Design Enabler] --> Cycle; DI[Design Inhibitor] --> Cycle; YOU[YOU ARE HERE] --- PV;
```

The diagram illustrates the **Rapid Innovation Cycle**, a process for developing and manufacturing products. The cycle is enclosed in a dashed line and features a large green checkmark at the bottom.

**Process Flow:**

- Product Definition** (What is the use case/needs?)
- DfAM "Cards"** (Guiding dimensions)
- 1:m Cycle** (Central hub for iterative development):
  - Solution Development**
  - Concept Definition**
  - Stakeholder Feedback**
  - Analysis**
- Process Validation** (Confirm manufacturing feasibility)
- In Production** (Release to manufacturing)

**Design & Process Guidance:**

- Design Enabler** (Green box) and **Design Inhibitor** (Red box) are shown at the top, influencing the cycle.
- A yellow diamond labeled **YOU ARE HERE** is positioned above the **Process Validation** step.
- The text **Process & Design Guide** is located at the top right.
- The text **DfAM Design Analysis** is located at the bottom right.



# APD | Review Item Details with Solution Info

## AM Fixturing / Workholding for CNC Machining | APD-000008

Locked

Process Validation

Workflow actions

- Item Details
- Workflow Actions
- Concept Whiteboard (3)
- RICs (3)
- Attachments (0)

Edit

### Product Definition (1 of 3)

Title

AM Fixturing / Workholding for CNC Machining

ID

APD-000008

Definition of Need

Rapid generation of complex, high mix, short-run workholdings used for CNC machining.

Find the right blend of performance, cost, sustainability.

	Decision Drivers	Design Objectives	Applications	Processes	Industry	Material	
Creative Dimensions	Application Design	Gernatively Designed	Performance Optimization	Binder Jetting	Industrial	Metals	
	Performance	High-Strength	Process	Hybrid		Polymer	
	Time to Market	Industrially Designed	Sustainability	SLA			
		Low/High Volume	Tooling & Manufacturing	SLM			
				SLS			
	Size (LxWxH mm)	Surface Finish (µm)	Target Cost (\$)	Production Qty	Matr'l Properties	Mech Properties	Feature Res. (mm)
Additive Manufacturing Dimensions	300x300x300	400.00	100.00	100	Corrosion-resistant	Thermoplastic	1.00

### Solution (2 of 3)

Solution Link

AM Fixturing | Reuse & Generative Design | RIC-000024

Design Data

<https://a360.co/3dOgas0>

Mfg. Process

Binder Jetting | HP Metal Jet

Design Analysis

DfAM Analysis | DA-000028

### Points Of Contact (3 of 3)



# APD | Review Rapid Innovation Cycle States

Home > Agile Product Development

## AM Fixturing / Workholding for CNC Machining | APD-000008

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🔒 Locked

📍 Process Validation

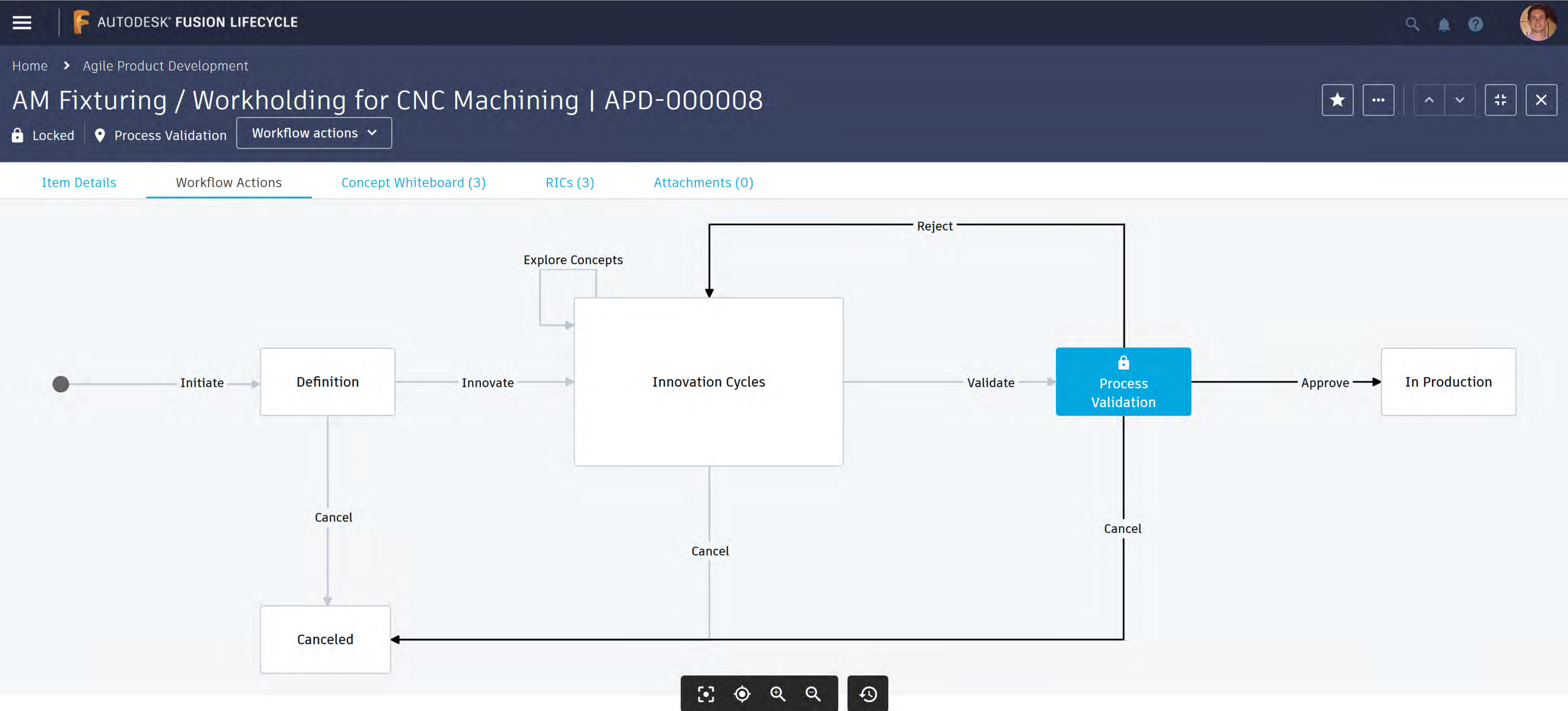
Workflow actions ▾

- Item Details
- Workflow Actions
- Concept Whiteboard (3)
- RICs (3)
- Attachments (0)

Item	Workspace	Current State	Direction Type	Description
AM Fixturing   Reuse & Generative Design (SPLIT)   RIC-000026	Rapid Innovation Cycle	Discarded	↔ Bi-Directional	Rapid Innovation Cycle
AM Fixturing   Reuse & Generative Design   RIC-000024	Rapid Innovation Cycle	Selected	↔ Bi-Directional	Rapid Innovation
INNOVATION CYCLE   RIC-000025	Rapid Innovation Cycle	Discarded	↔ Bi-Directional	Rapid Innovation

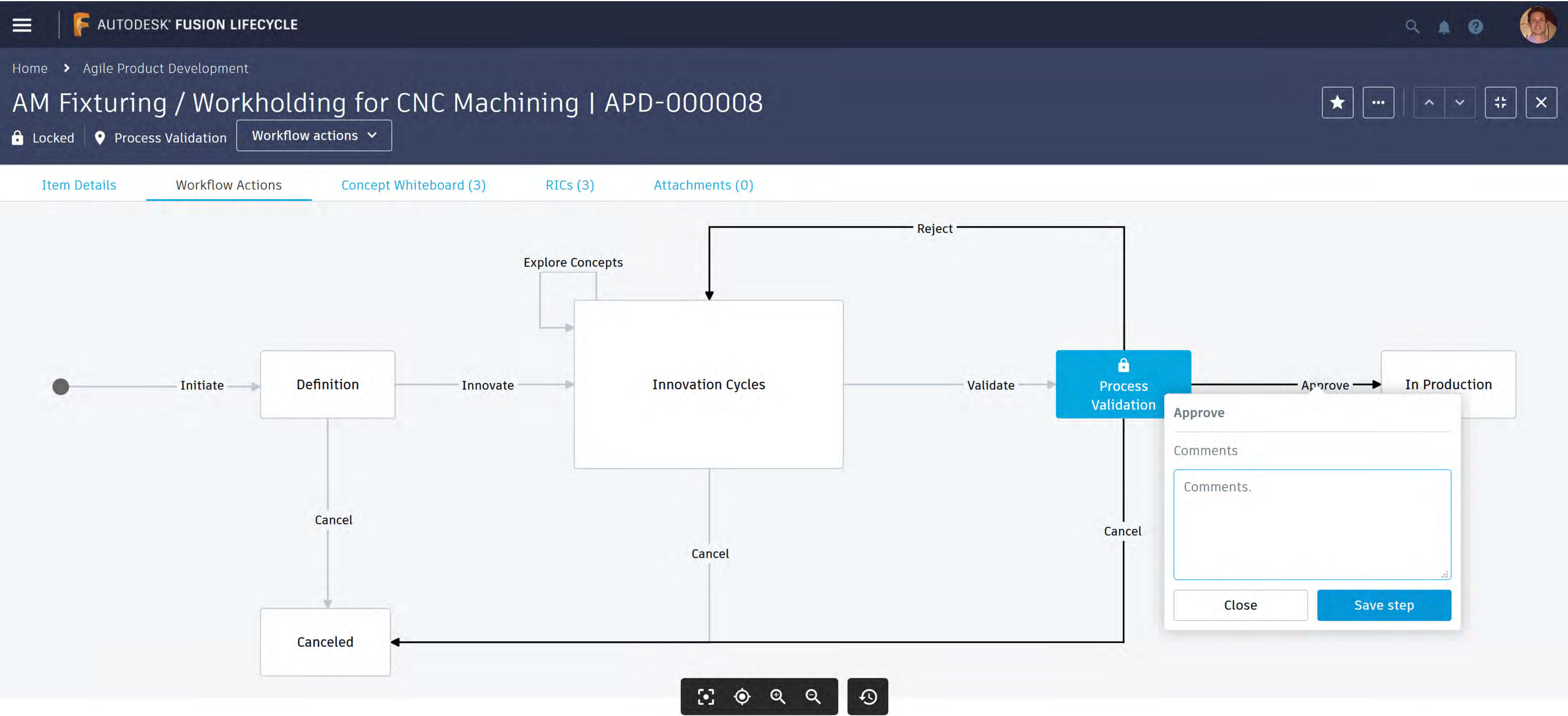


# APD | Validate Your Selected Process



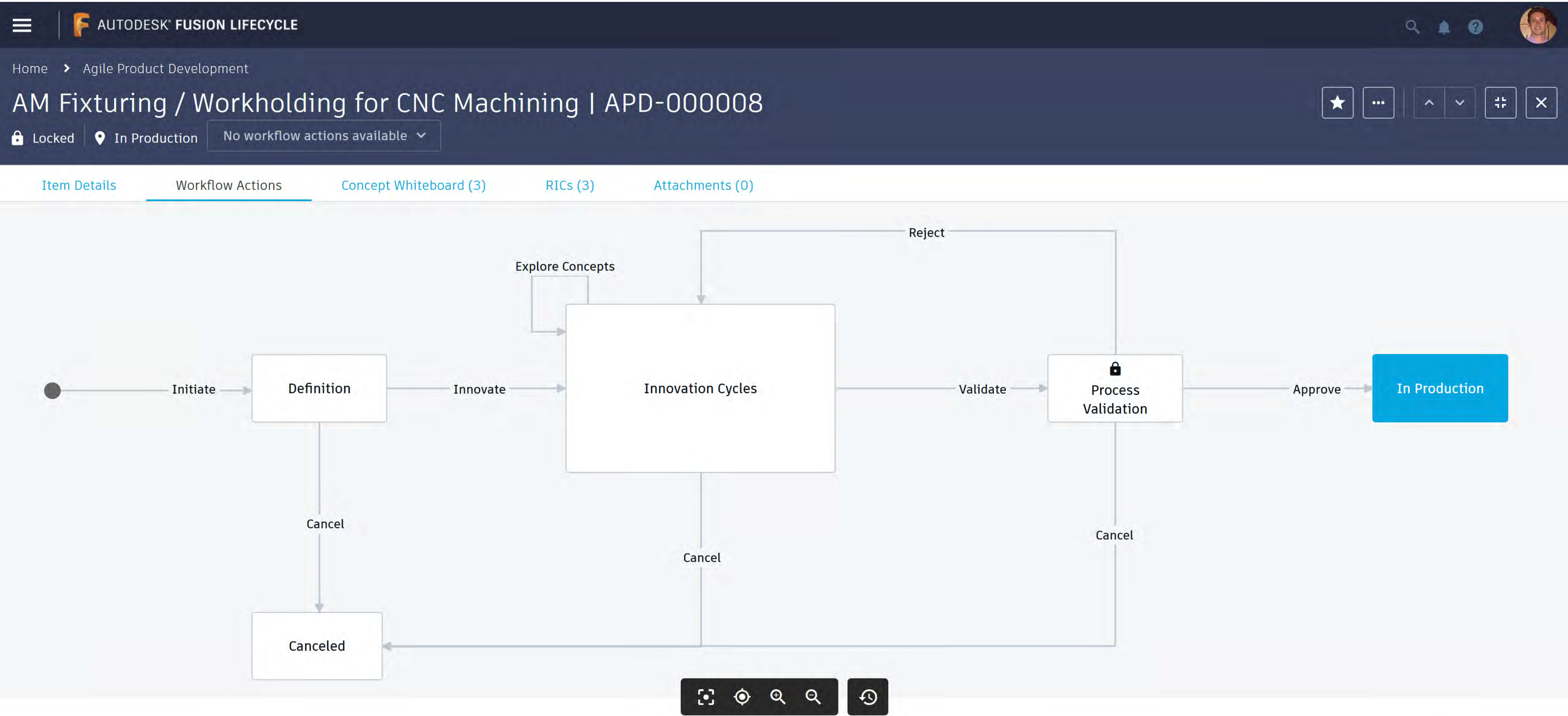


# APD | Hand-Off to Product Owner



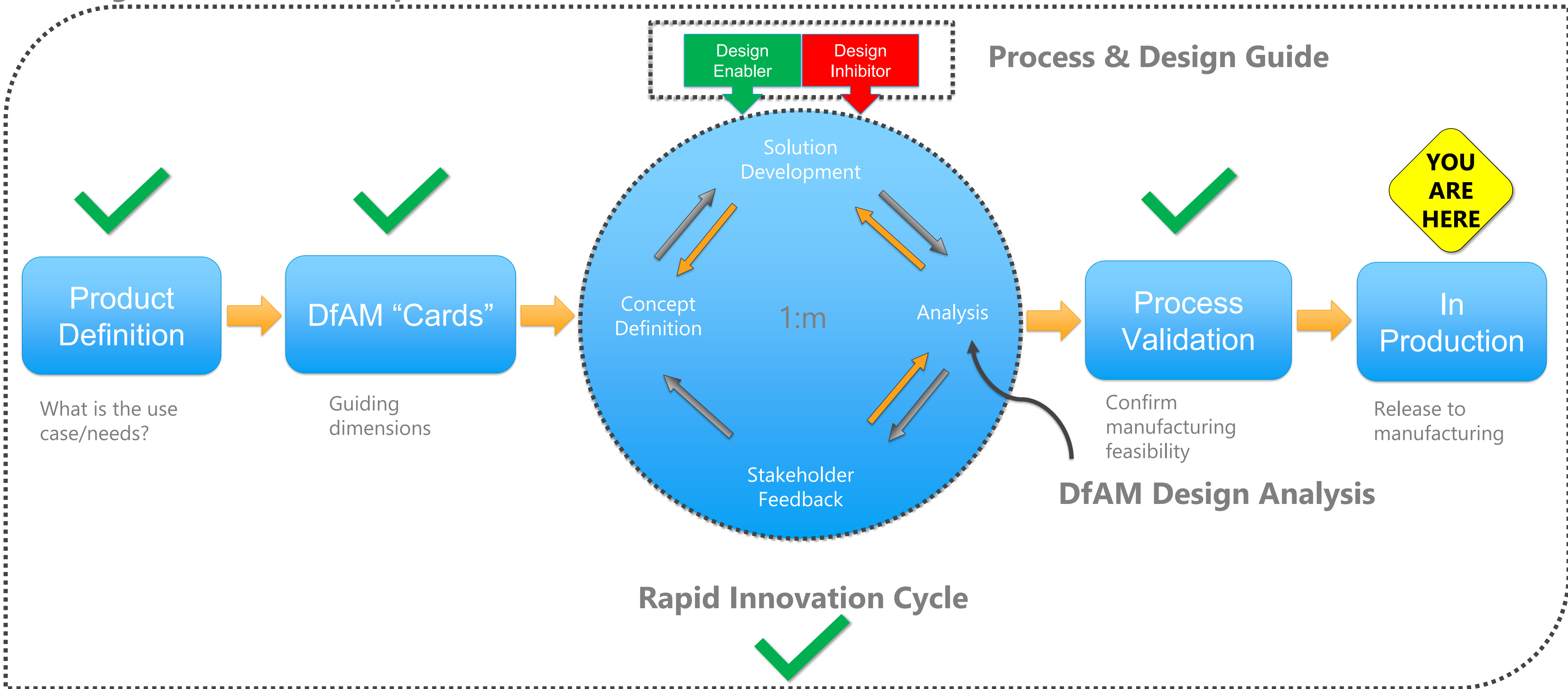


# APD | Ready for Production





# Agile Product Development



Inspired by the MIT course "Additive Manufacturing for Innovative Design and Production"





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