From Vision to Reality: Realizing Composable Operations for Enterprise Success

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FEATURING

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AGENDA

01 **Composability - An Enabler for Cx**

How composability accelerates productivity improvements.

02 **Composability Concepts & Tools**

Using composability concepts, methods and tools for successful adoption of Tulip

03 **Building a Composability Framework for Continuous Transformation**

Discussion and experience sharing about successful Tulip adoption with governance and control.

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Why digital transformations fail?

Bottom Up

- Over-centralizing efforts and stifling bottom-up, composable improvements
- Measuring success in incremental gains instead of exponential productivity outcomes

Agility

- Treating digital as a technology project instead of a paradigm change

Democratization

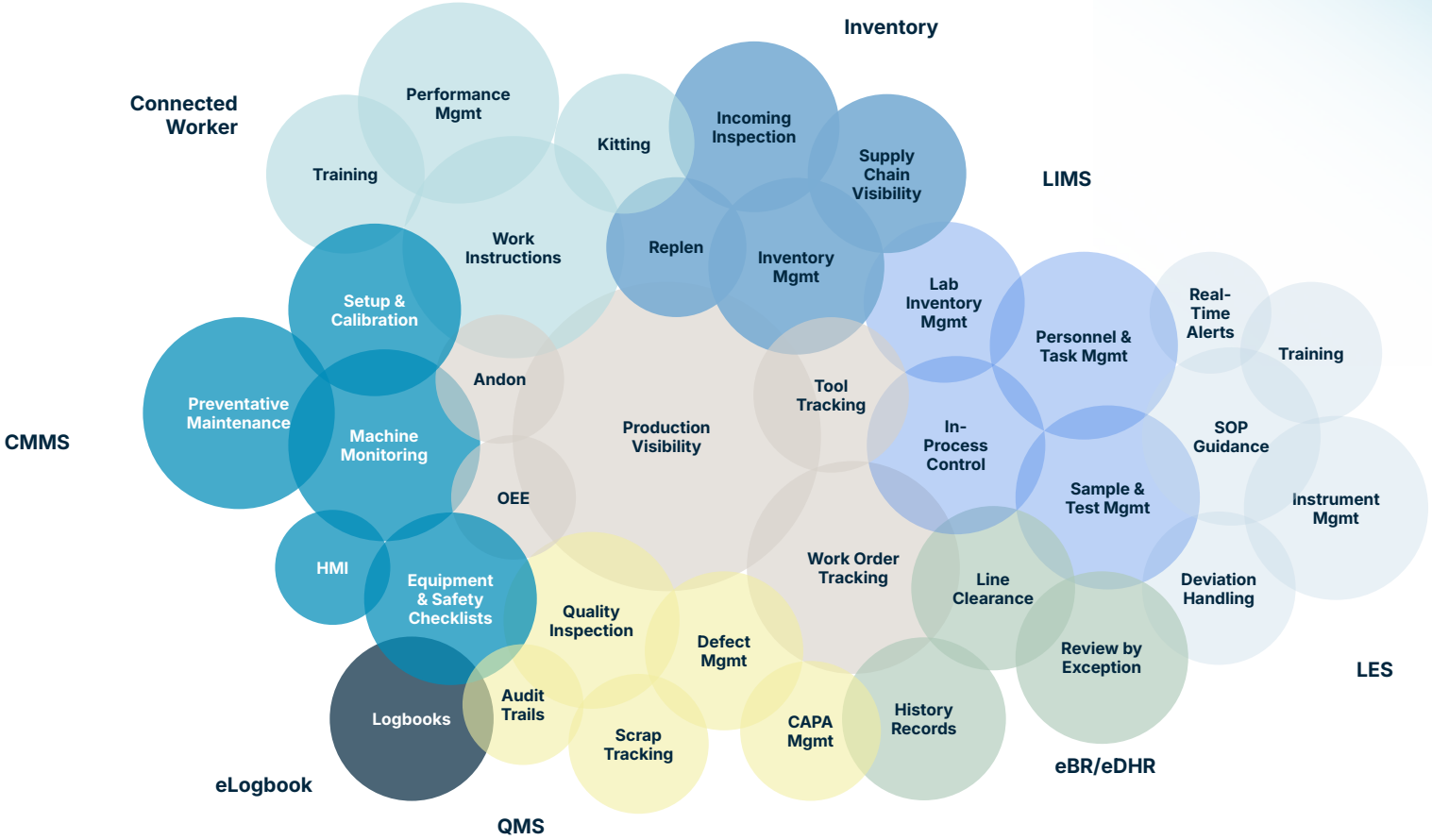
- Failing to democratize digital—keeping ownership in IT, not empowering operations
- Lack of strategic focus—initiatives not tied to business goals or customer value

Human Centric

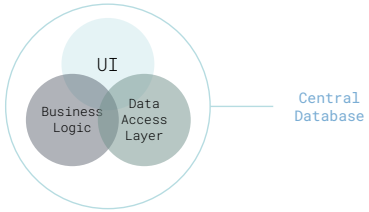
- Focusing on tools and systems rather than value creation in the value stream
- Ignoring culture and mindset change, assuming tech alone can transform

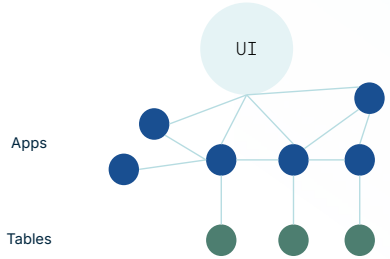
Compliance

- Neglecting governance and data integrity when scaling digital



Monolithic is not a Viable Option for a Composable Solutions





Data Model Centric

- Process and Activity **Models are defined by data in Tables** and Apps are used to execute on the model.
- Data models are an abstraction of the complexity of the operations in a **one size fits all** approach.

Process Centric

- Apps are built execute functions based on a **Functional Decomposition** of the process.
- Apps are intended to provide the **same functio**n to frontline operators anywhere in the operation.

Designed for Maintainability

- Less Apps **intended to ease maintenance** and management.
- Function based apps - **operators serve the solution** by choosing applicable function.

Monolithic - The Old Way

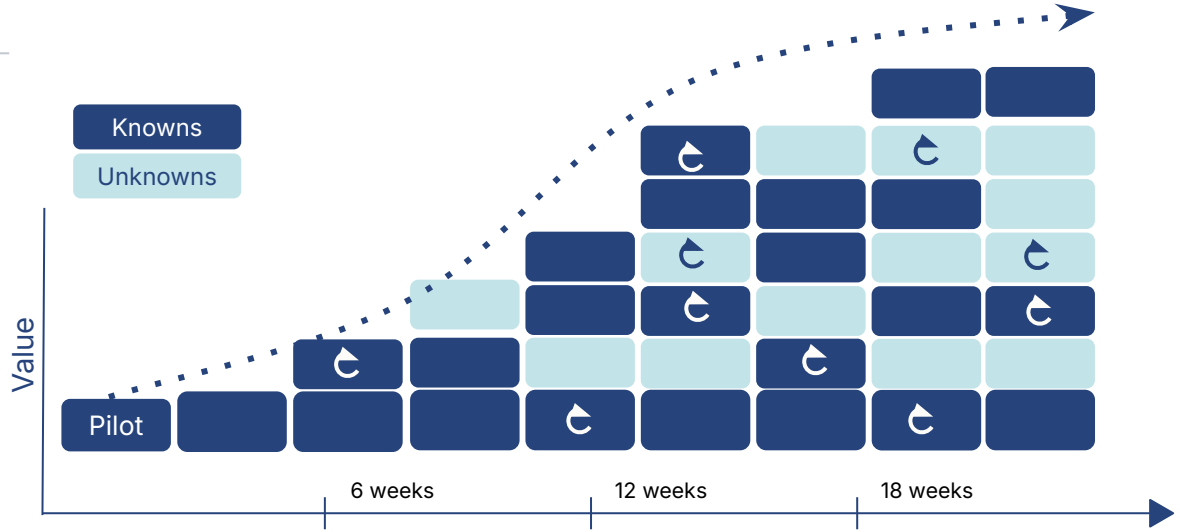
Top Down, big-bang waterfall

- High-risk solution
- All-or-nothing
- Delayed value
- Declines over time

Composable - The Way Forward

Bottom-up, adaptable and iterative

- Low-risk solution
- Iterative growth
- Immediate value
- Continuously improves



Bottom Line!

Monolithic App Solutions **rob** your organization of **rapid time to value** and exponential **productivity increases**.

Composability for Frontline Operations

Composability

Digital Maturity
Effective adoption of composable architectures with technical capabilities, culture, and processes.

Bottom Up
The digital solution emerges through building targeted content for each use case.

Agility
Inherent alignment with continuous improvement, operational excellence and iterative build.

Democratization
Empowered process experts create solutions, driving innovation and fast time to value.

Human Centric
Focused on enhancing human capabilities, enabling operators to work more efficiently and increase productivity.

Compliance
Embedding compliance with technology based on risk based approach and validation for intended use.

Connectivity & Data Integrity
Accurate, consistent, and trustworthy data, for streamline decision-making.

Cloud
Multi-tenant SaaS

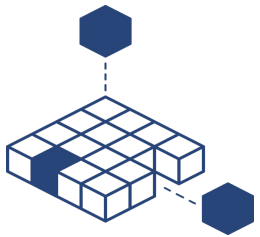
Cognitive
Built-in AI/ML and Generative AI

Edge
Connected, autonomous and collaborative IIoT

Bottom-up

Composability starts at the operational level, focusing on **solving problems at the frontline**, rather than imposing broad, generic solutions from the top. This allows organizations to build **solutions that are tailored** to specific processes, activities, and operations.

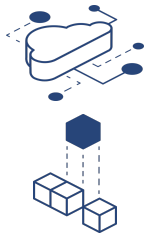
Monolithic



Top Down
(Hierarchical Control)

The Digital Divide

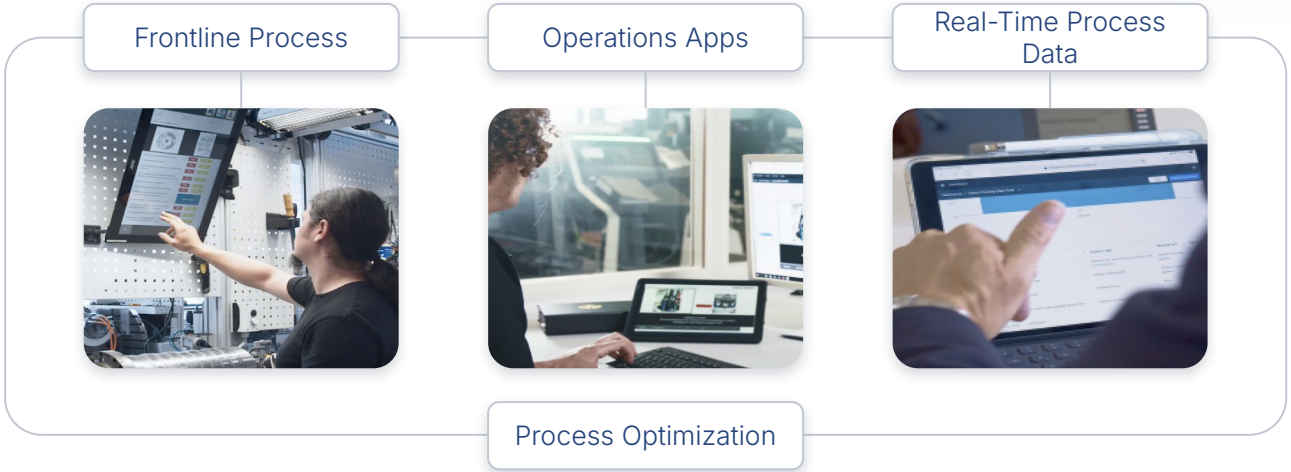
Composable



Bottom-Up
(Emergent Control)

Agility

In manufacturing, **continuous improvement** is key and **agility** is non-negotiable. Composable solutions, by design, are highly adaptable and enable organizations to iterate quickly. Agility also allows for faster implementation and a **reduced time-to-value**, meaning that benefits can be realized almost immediately after deployment.



Democratization

Empowering the people who know the process best to create content and develop solutions. This critically **reduces dependency** on a software skills, centralized IT and specialized OT departments. It fosters a culture of innovation, encourages experimentation, and **accelerates digital transformation**. It eliminates the translation between IT, OT and operations.

59%

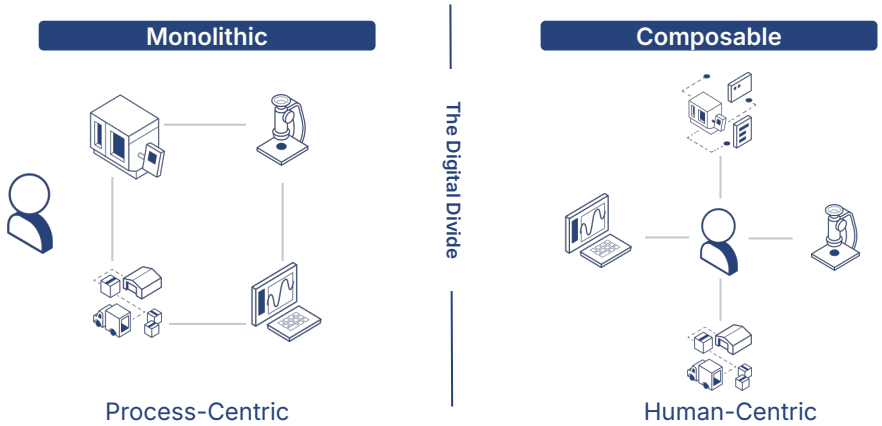
rated **"Improving Employee Decision Making and Competency"** as extremely important criteria for MES investment Justification. (Gartner)

↑30%

Gartner expects Low-Code Application Platforms are expected to grow 30%

Human Centric

Solutions that **serve operators that are empowered** by tools that assist them in performing tasks more efficiently, providing real-time insights, and reducing manual effort and driving **productivity increases** by augmenting human decision-making and capabilities. By connecting operators with their environment through digital tools, sensors, and IIoT devices, composable systems **elevate the performance** of the workforce, ensuring that technology acts as a productivity enabler.



Compliance

Tulip has defined:

Digital Quality Foundation

A modern digital approach to validation that is risk-based and focused on demonstrating fitness for intended use.

Provides an order of magnitude reduction in effort and time for validation.

Tulip is working on:

Governance and Ease of Validation

Product features for enhanced governance and control with visibility to changes.

Testing capabilities that allow for maintaining data for historical purposes, but not impacting production data.

Tulip's vision is:

Continuous Validation

Seamless, built-in compliance with automated testing. App life cycle changes are controlled and automatically tested.

Enable rapid change & continuous improvement with full compliance.

Tulip tools:

- Tulip Docs
- Tulip uses Tulip
- Continuous Validation

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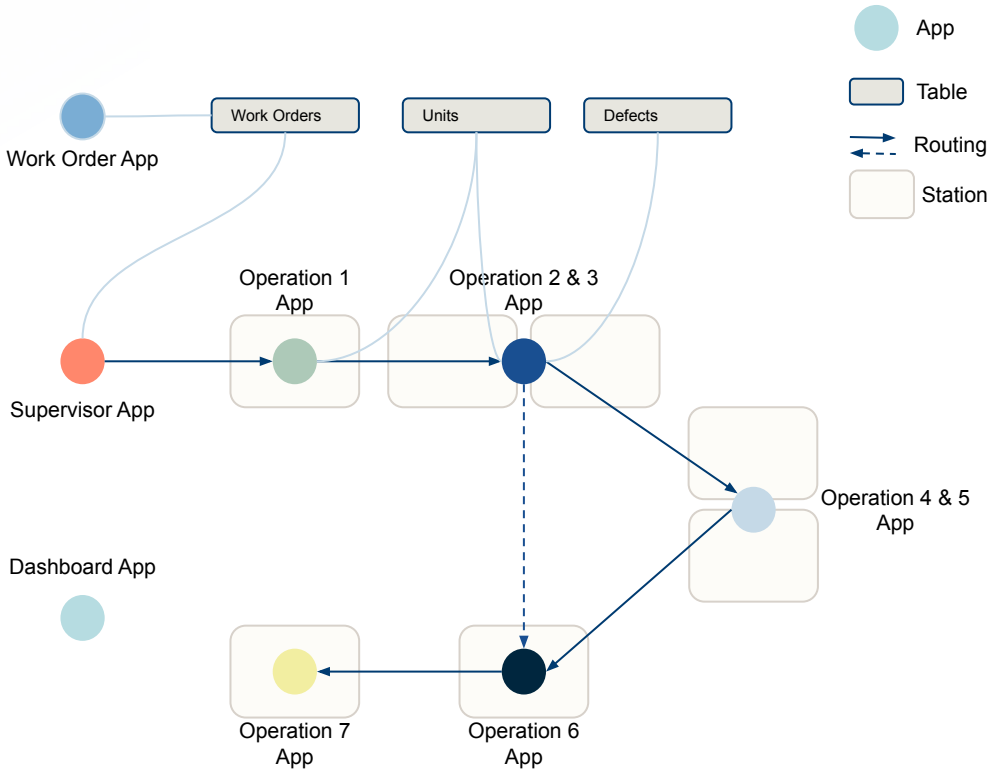
02 Composability Concepts & Tools

Using composability concepts, methods and tools for successful adoption of Tulip

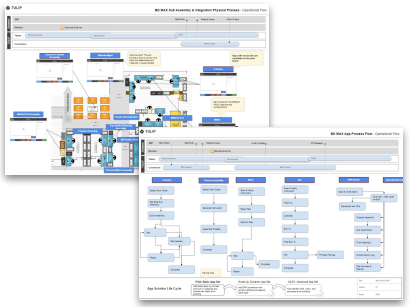
Composability in a Practical Example



Composability Concepts

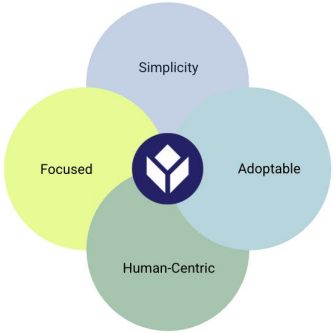
Composability Concepts

Artifact Model & Solution Design



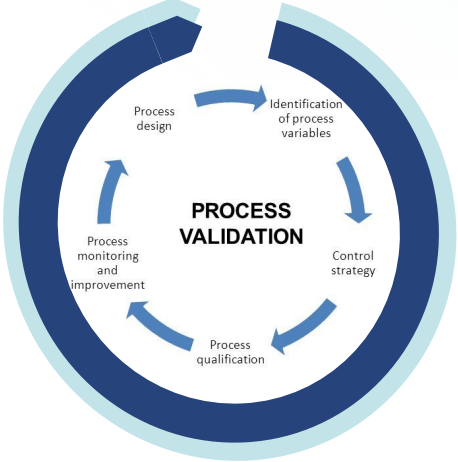
Physical Artifacts & Operational Artifacts = Intuitive ‘Digital Twin’

Solution Credo



Guiding principles for composable solution development.

Validation 4.0



A modern risk-based approach to validation.

Artifacts in Solution Design Process

Business Objectives (Problems to Solve)

Physical Layout of Process

Frontline Operations & Activities Flow

Identify Physical Artifacts

Identify Operational Artifacts

Tables

Iterate Towards MVP

- Develop with Tulip Solution Credo in mind
- Templatize Components where possible
- Parameterize where sensible

Identify Use Cases / User Stories to Satisfy Objectives

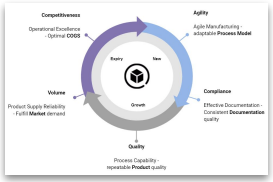
Objective: Minimize Stock-Out

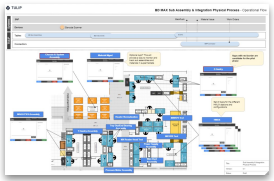
User Story: I want to request rapid material replenishment.

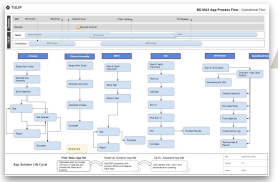
Identify Use Cases / User Stories Relevant per Location

Identify Use Cases / User Stories Relevant per Persona

Apps







Physical Perspective

Shared Tables Enables Composability Across Use Cases

Tables Used

Work Orders
Units
Bill of Materials
Notes
Station Activity History
Inspection Results

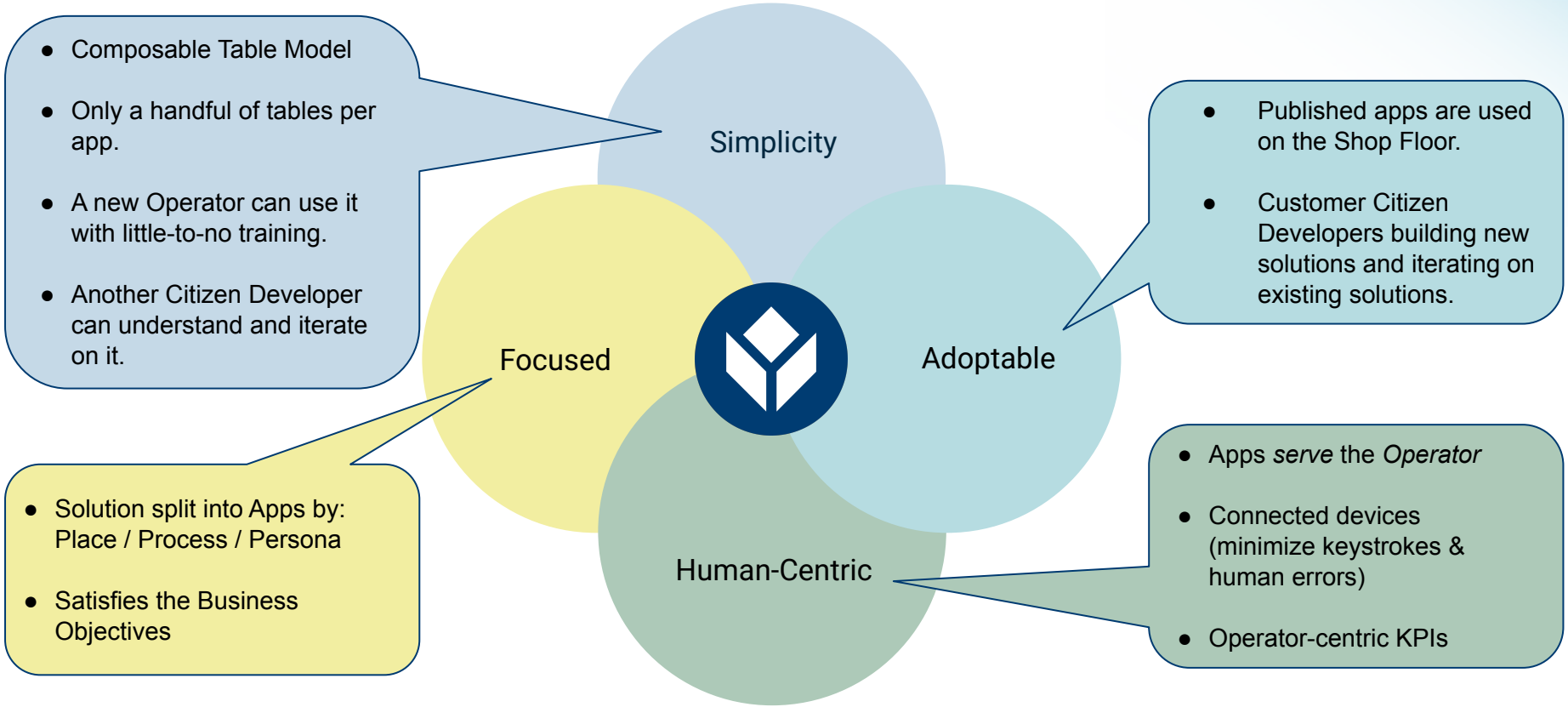
Tables Used

Work Orders
Units
Station Activity History
Stations

Tables Used

Work Orders
Units
Defects
Inspection Results

The Tulip Solution Credo provides guiding principles towards Composable solutions



Validation 4.0 - An Integrated Approach

Pharma 2.0/3.0

Design → Dev → IQ → OQ → PQ

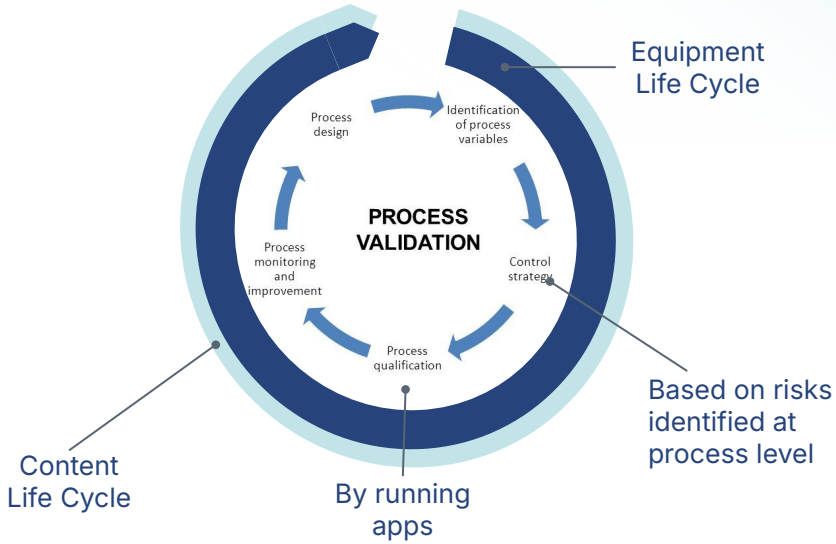
Tulip Platform + Content

Design → SAT/ FAT → IQ → OQ → PQ

Filtration skid, blending, weigh scale

The Digital Divide

Pharma 4.0

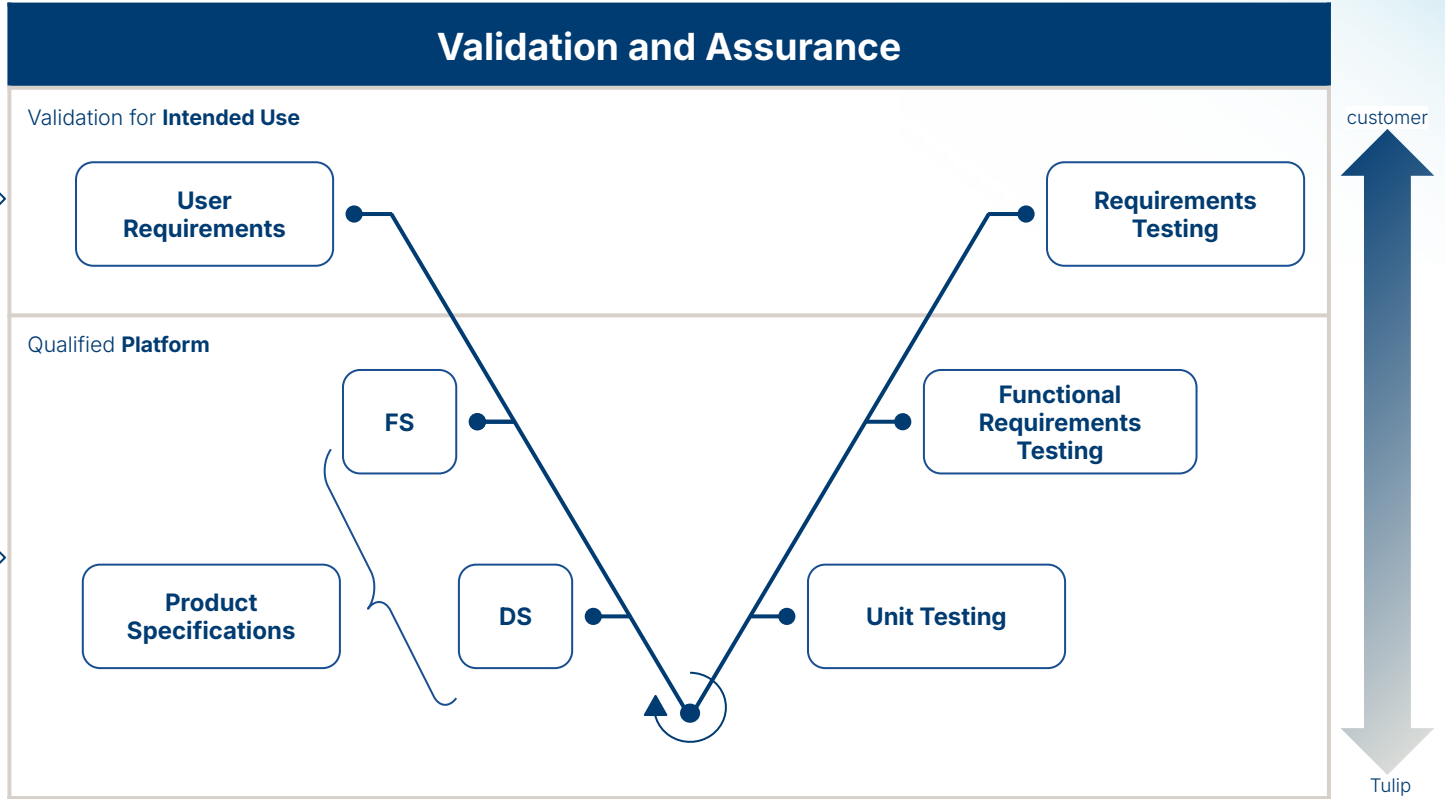


Automation & System is validated for intended use, integral to the process

Leverage Tulip's Life-Cycle Documentation to Accelerate Your Validation Processes

Customer validates for intended use

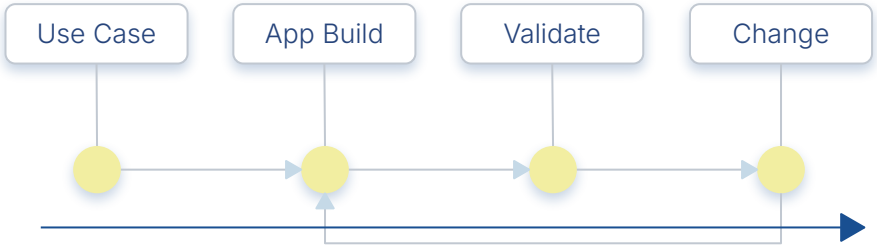
Tulip provides a qualified platform

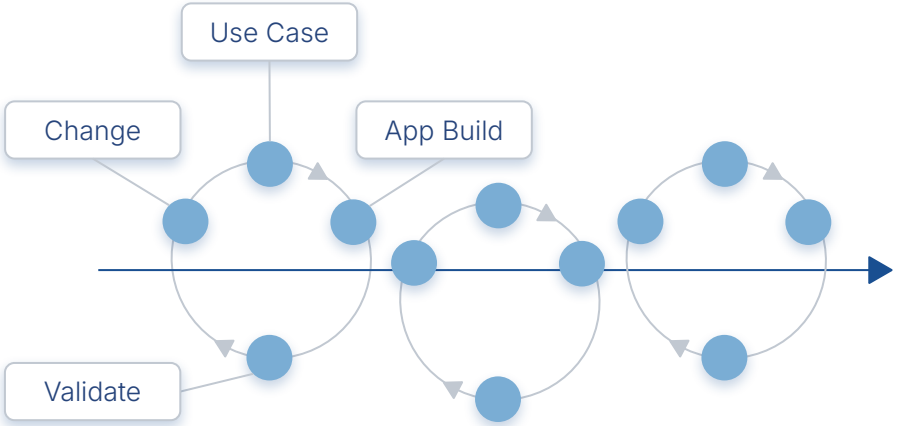


Why is Digital Quality important?

Current Approach

Quality & Compliance is a bottleneck and **barrier to adoption**.
It is a **sequential process** documented on **paper,** outside of the solution.





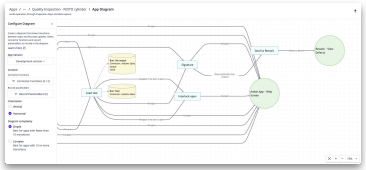
Tulip's Digital Quality Approach

Quality & Compliance is "built-in" to the platform with a **digital, self documenting and continuous** part of the App life-cycle. It supports **rapid, agile build-deploy cycles** which **increase digitalization and adoption**.

Tools to Enable Composability

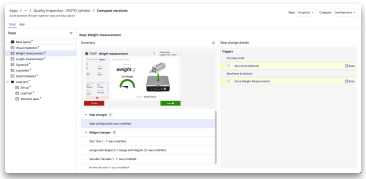
Composability Tools

App Diagrams



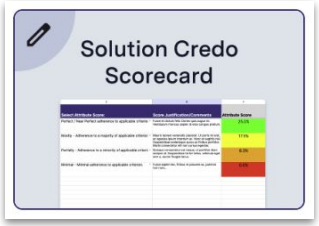
App Editor feature providing visibility to solution architecture.

App Diffs



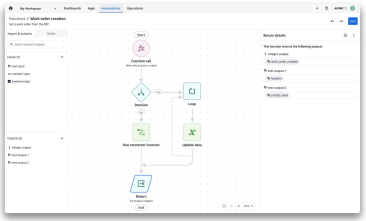
App Editor feature providing visibility to changes by app version. Helps enforce low-impact continuous improvement.

Credo Scoring



Check solution adherence to Credo via: AI Agents, Scorecards, Checklists

Functions

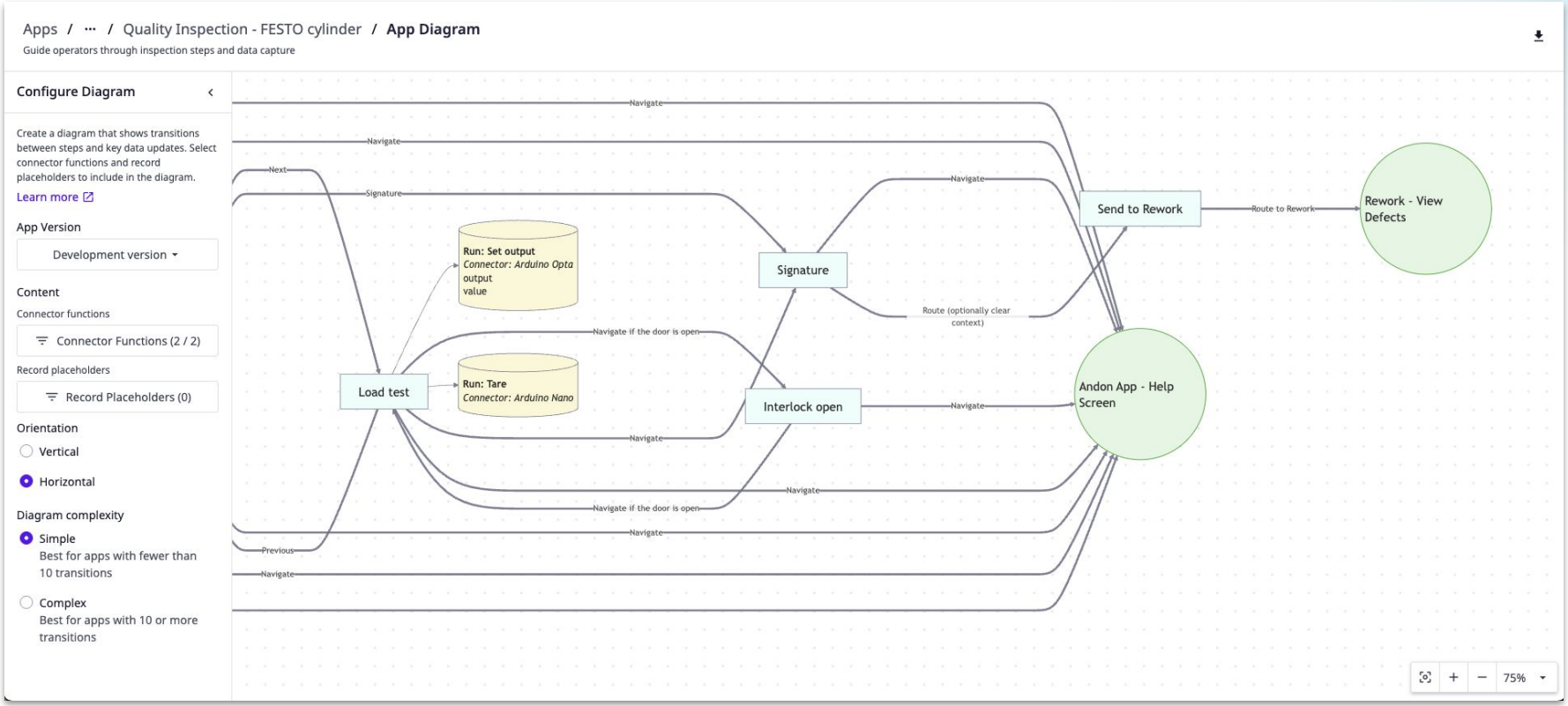


Centralizes App Trigger logic - the latest leap in Tulip solution composability.

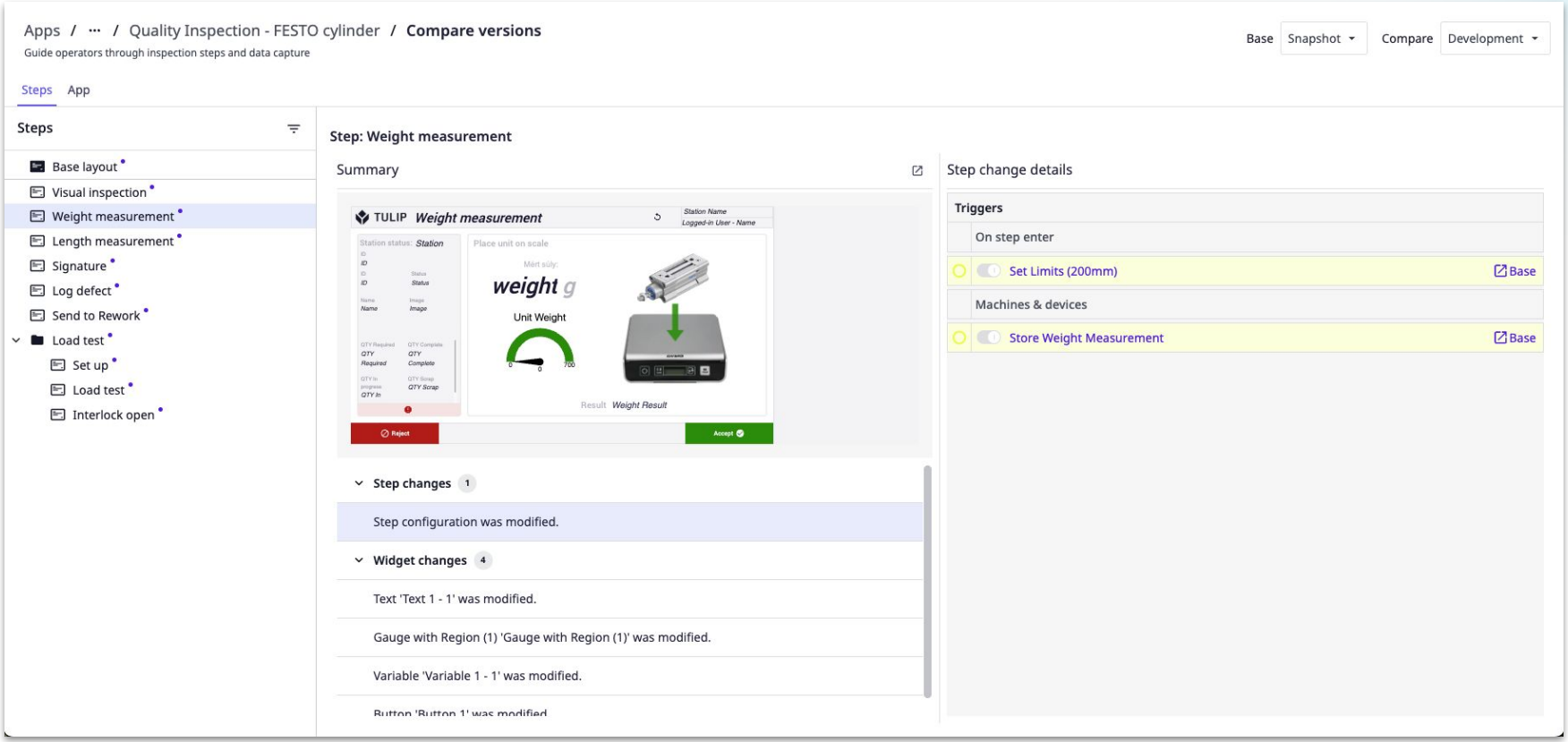
OpsMoto

Enables visibility to platform adoption and development activities.

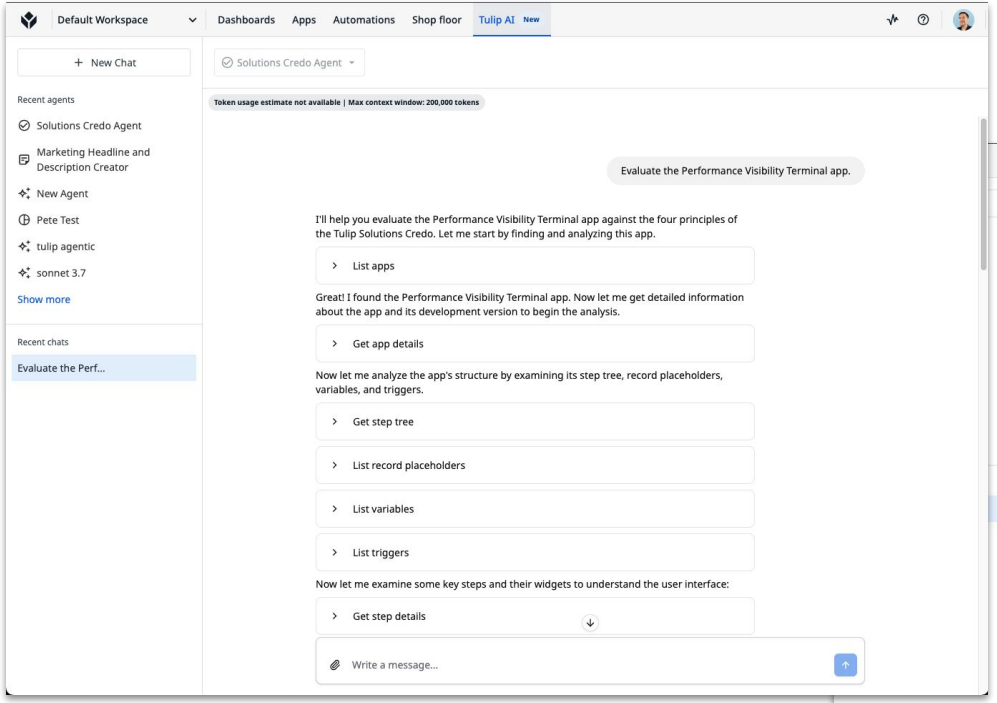
App Diagrams

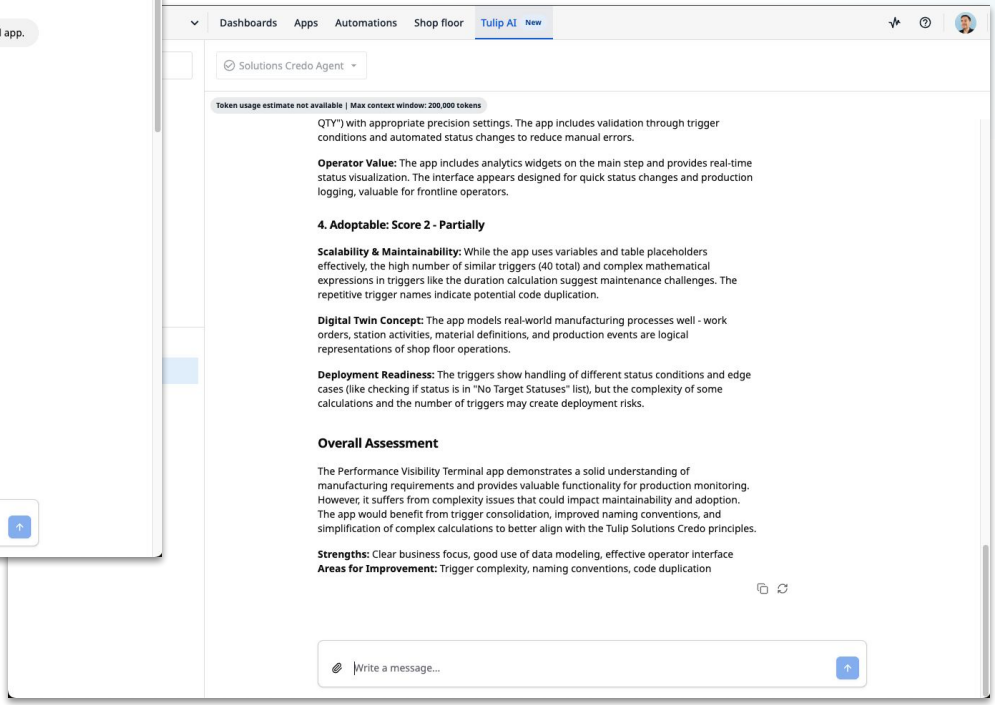


“App Diffs” / Compare Versions

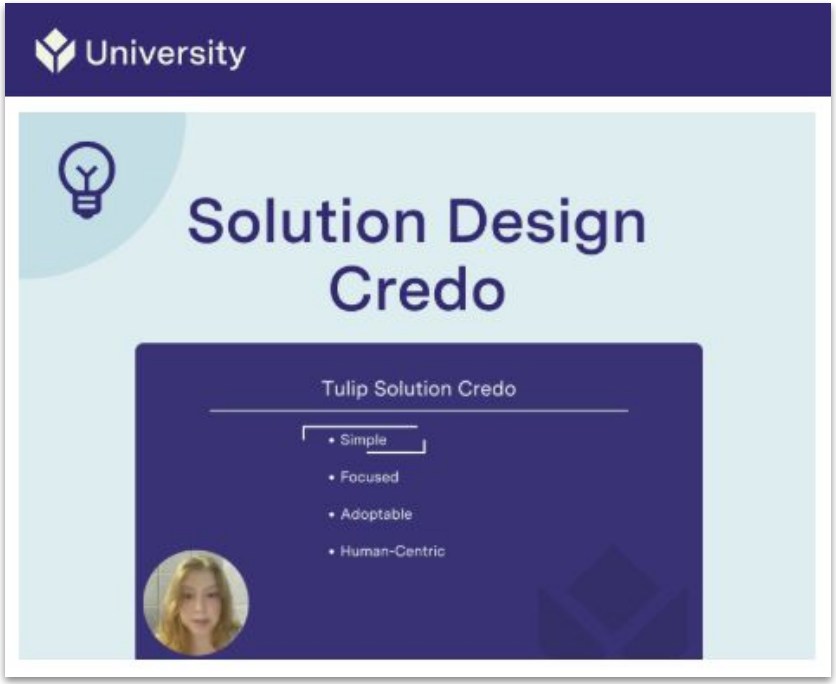


Solutions Credo Tulip AI Agent



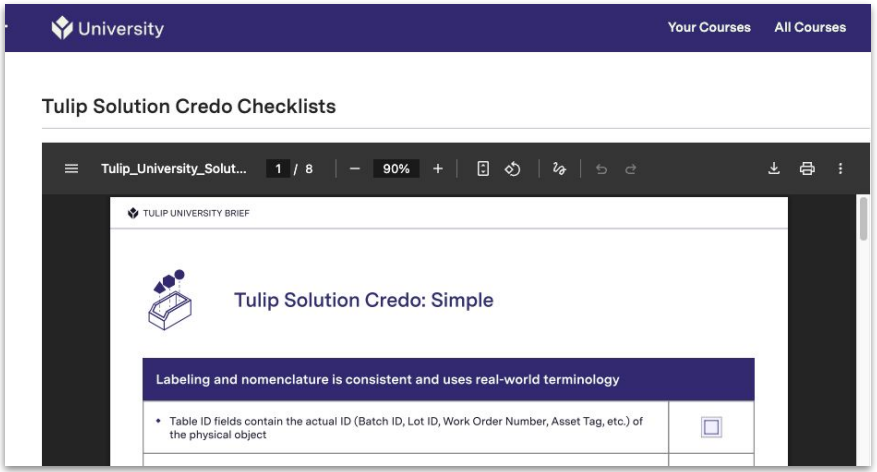


Tulip University Course - Solution Design Credo



https://university.tulip.co/page/catalog?q=solution%20credo

Tulip University - Solution Credo Checklist



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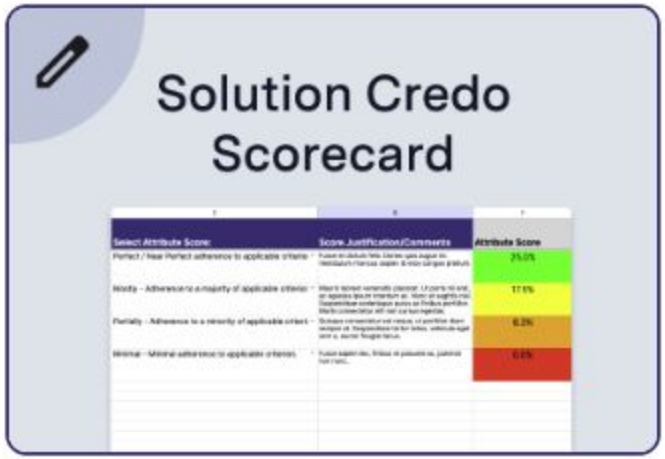
Solution Credo Scorecard



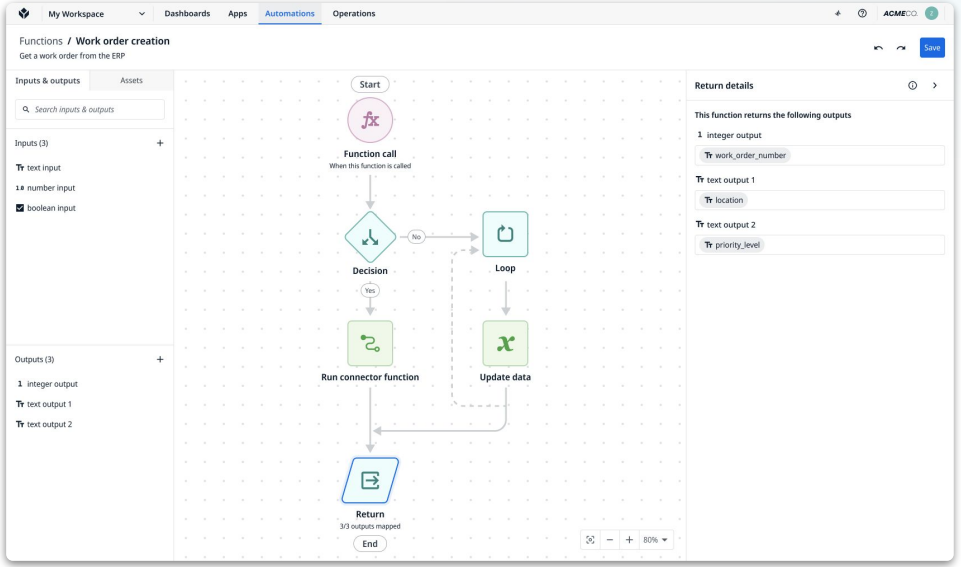
https://university.tulip.co/page/catalog?q=solution%20credo

Prod EA out now!

Write business logic once and reuse everywhere with **Functions**

Functions Help You Build Composable Solutions Faster

- ✓ **Standardize logic and reuse integrations**
  Enhance governance and ensure compliance with validated, centralized components
- ✓ **Accelerate app development**
  Empower citizen developers to combine centrally-developed logic with user-specific requirements



Examples

- Bundle multiple connector calls for easy ERP data integrations
- Consolidate core Work Order processing logic across hundreds of apps
- Reuse logic for barcode scans and manual barcode entry

OpsMoto

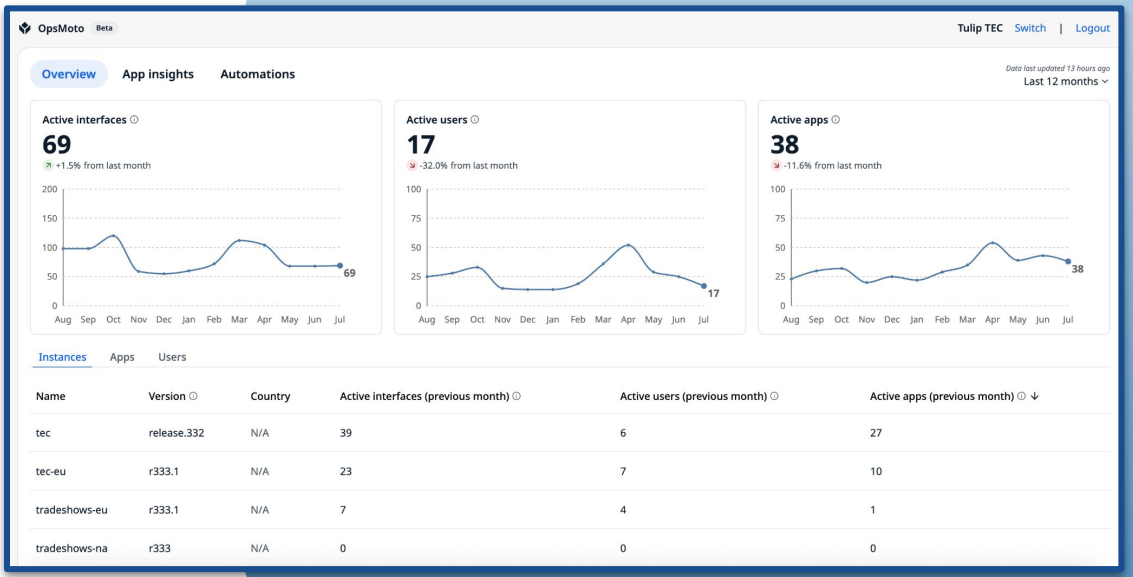
OpsMoto provides a 'single pane of glass' view, summarizing customer's instance activity

Centralize Enterprise Visibility

Get near real-time trends across multiple global sites at once

AI-Accelerated Governance

Leverage AI insights to identify successful innovation in order to standardize best practices enterprise-wide



OpsMoto™ Beta

ACME Co. Switch | Glossary | Logout

Overview | App insights | Automations

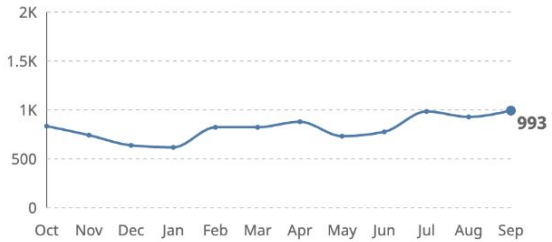
Data last updated 3 hours ago

All instances | Last 12 months

Active interfaces

993

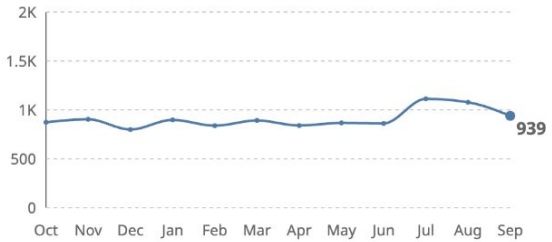
+7.0% from last month



Active users

939

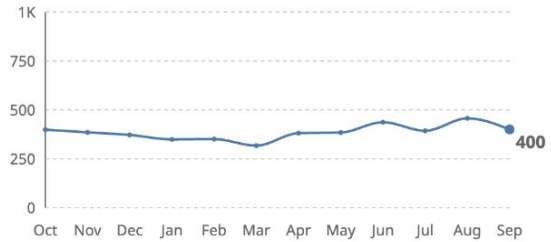
-12.9% from last month



Active apps

400

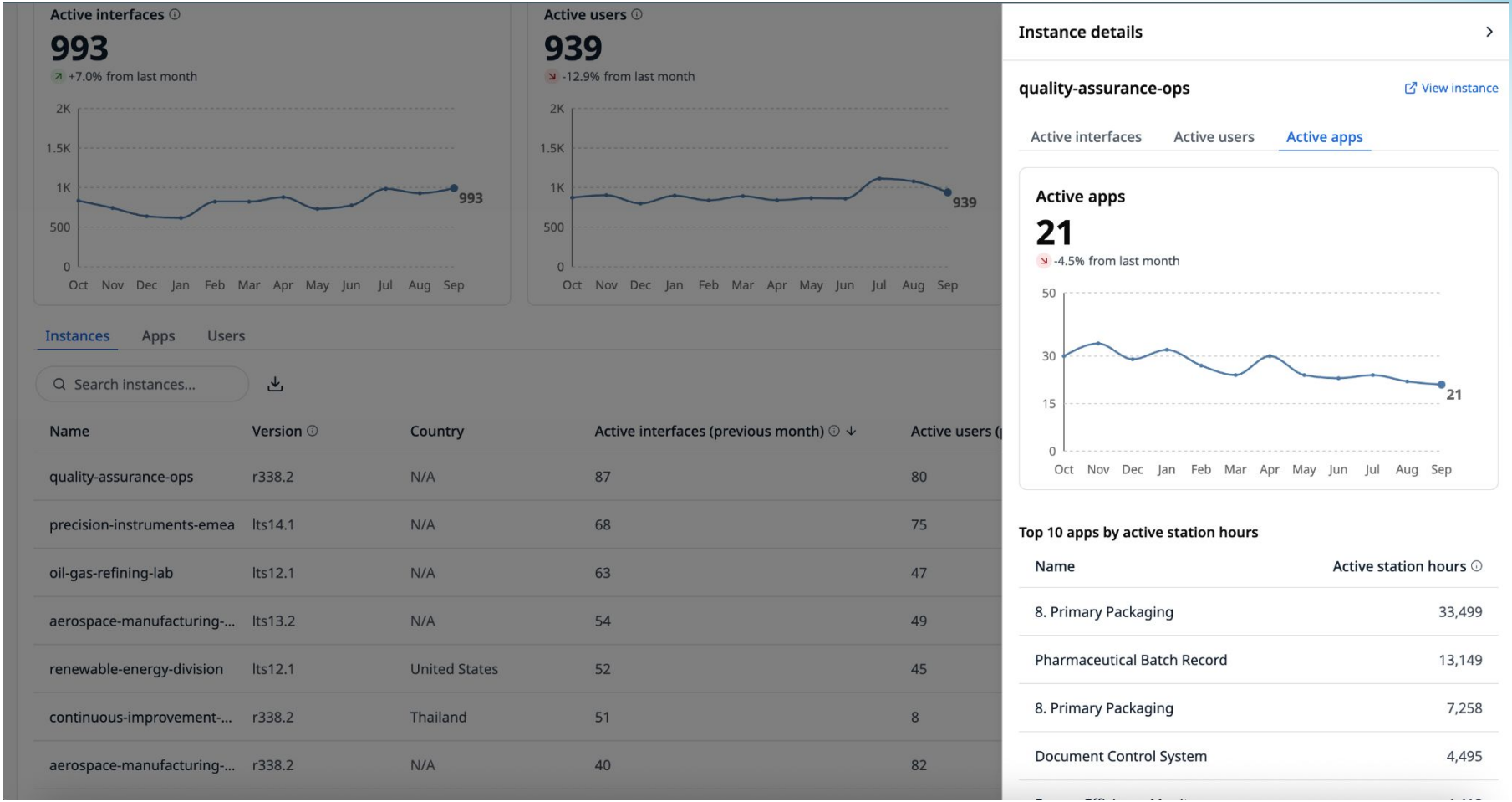
-12.5% from last month



Instances | Apps | Users

Search instances...

Name ↑	Version	Country	Active interfaces (previous month)	Active users (previous month)	Active apps (previous month)
acme-data	lts14.1	N/A	3	11	4
advanced-ceramics-regional	lts14	Germany	19	18	2
aerospace-manufacturing-...	r338.2	N/A	40	82	14
aerospace-manufacturing-...	lts13.2	N/A	54	49	15



Overview | App insights | Automations

Active interfaces
993
+7.0% from last month

Active users
939
-12.9% from last month

Instances | Apps | Users

Search apps...

Name	Instance	Workspace	Station hours (all time)	Sta
2. Blending	data-analytics-regional	Default Workspace	103,880	3,0
Augmented Reality Guide	warehouse-logistics-divisi...	Default Workspace	76,585	4,3
Performance Metrics Dashboard	renewable-energy-division	Default Workspace	69,528	1,4
Root Cause Analysis	3d-printing-ops-central	Default Workspace	68,543	1,7
Data Collection Terminal	paper-pulp-mill-secondary	Default Workspace	64,926	1,7
Manager app	six-sigma-quality-primary	Default Workspace	63,039	1,0

App details

2. Blending

View app

Description
This smart manufacturing solution digitizes blending operations for enhanced control. It provides operators with step-by-step guidance and real-time feedback. The application captures detailed production history for traceability and continuous improvement.

Created
Aug 6, 2021

Created by
LS Laura Stewart

Last updated
Aug 20, 2025

Last updated by
JN Jennifer Nguyen

Station hours (all time)
103,880

Station hours (prior month)
3,022

Use cases
Production Tracking | Defect and Nonconformance Management | Quality Inspection

Contributors
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Editing history
Aug 20, 2025

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03 Composability Framework for Continuous Transformation

Enabling successful Tulip adoption with governance and control

Reflection on topics we covered today...

Differences between a Monolithic and Composable approach to software development	Composable approach increased time to value, agility, is human centric, and built to leverage digital technologies
Composability Concepts	Artifact Model, Credo Score, Solution Design, Validation 4.0
Tulip Tools that enable Composability	OpsMoto, App Diagrams, App Diffs, Credo & artifact agents, Functions

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QUESTIONS?

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THANK YOU