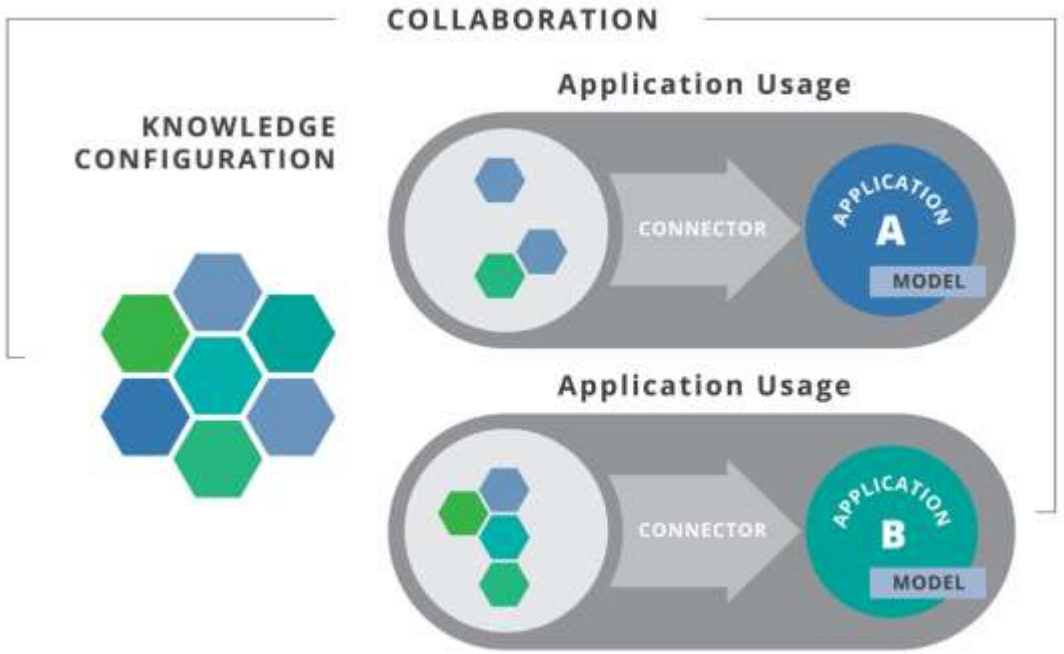
Digital Product Simulation

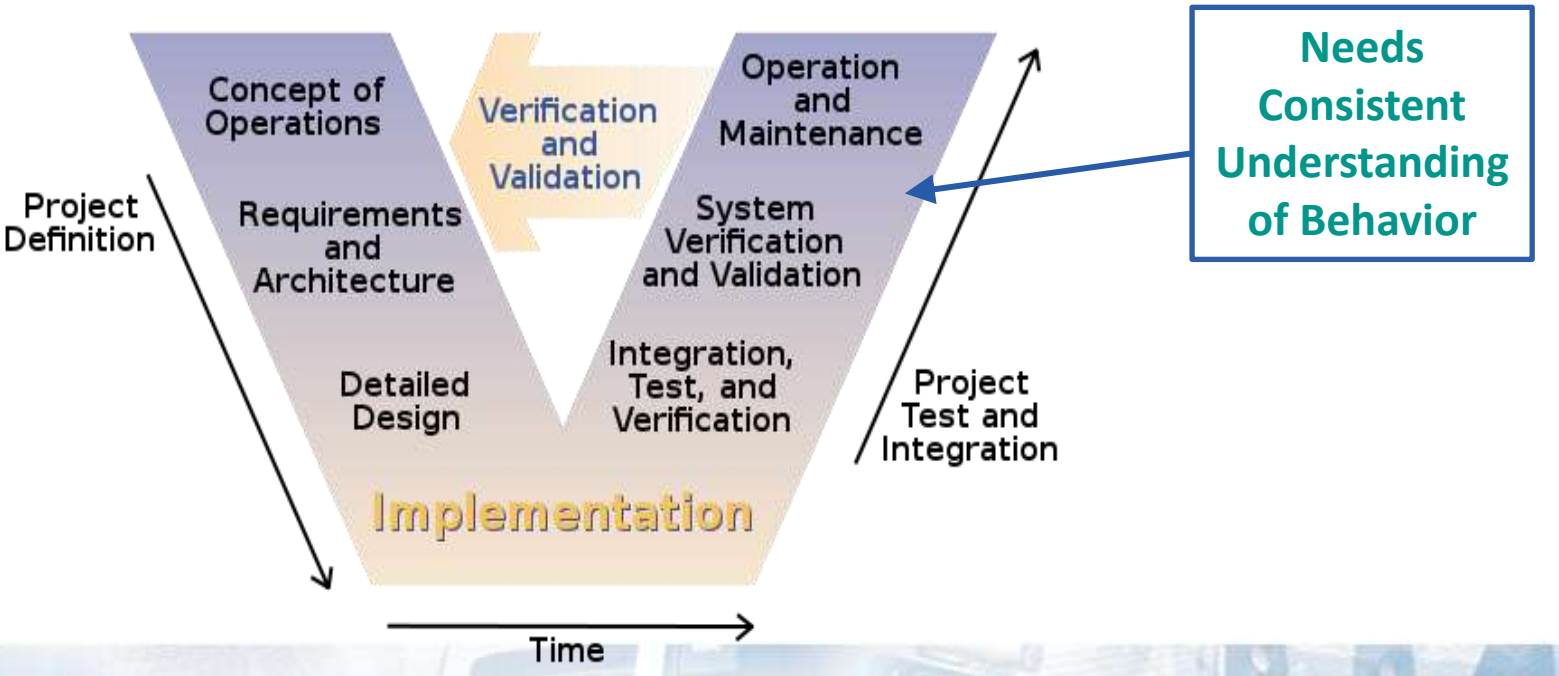
A Brief Introduction to KARREN

The right information - at the right time - for the right person



Engineering Processes Today

- Increasing importance of Systems Engineering
  - Smarter products (IoT, …) leading to more complex engineering and development processes
  - Consistency and re-use of knowledge is vital for **multi-fidelity environments**



Engineering Processes – What's Next?

- Products getting smarter
- Engineering processes getting more complex
- Competitive pressure rising

➢ We need to do things right the first time!

➢ We need smarter engineering processes!

Introducing KARREN for
Behavior Based Engineering Collaboration

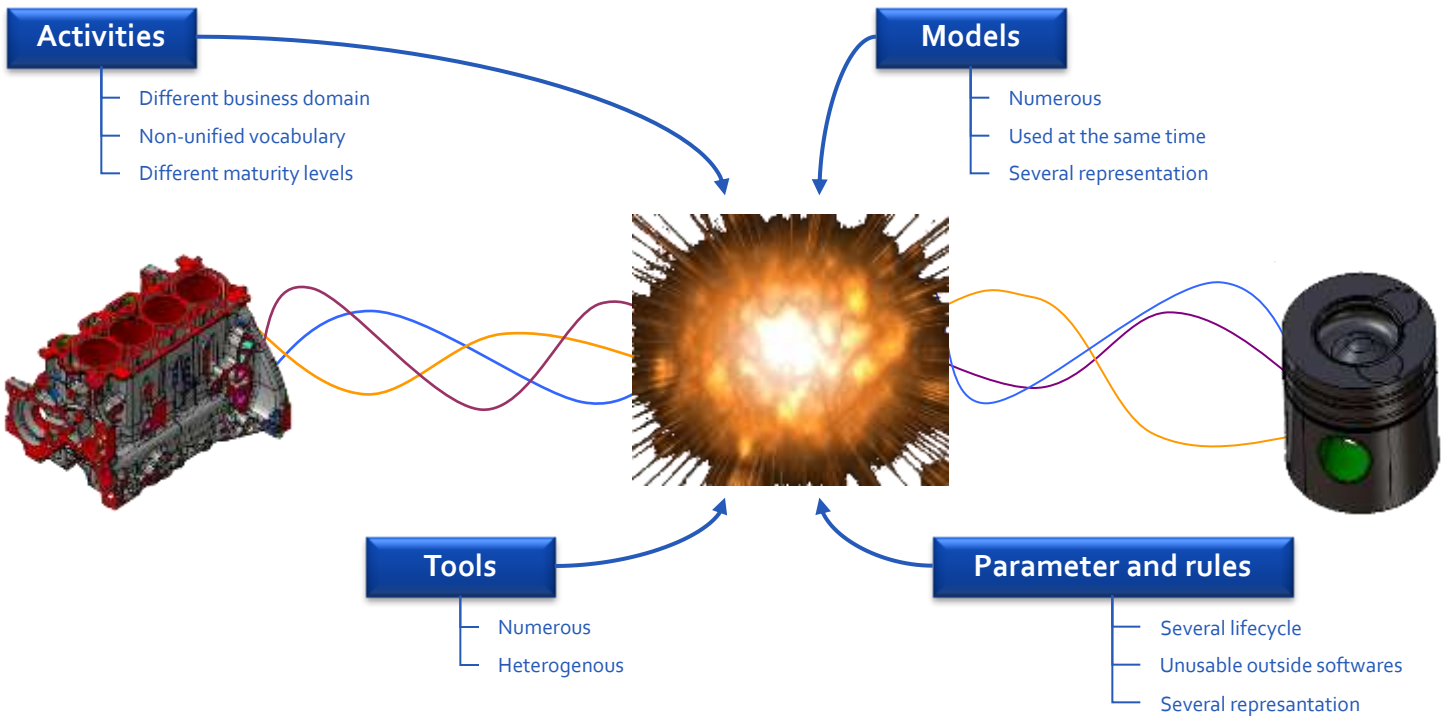
Smarter Engineering Processes

- **Behavior Based Engineering Collaboration**
  - Smarter design decisions through understanding product behavior
  - Better decisions earlier in the design process
  - Consistent sharing and re-use of parameters and knowledge
    - Across disciplines
    - Across organizations
    - Across the entire design process
    - Across Systems Modeling processes
  - Safely enabling independent “what if” investigations and resolution of differences

KARREN - Behavior Based Collaboration

- Each CAD/CAE/CAX model using consistent parameters and rules shared with other disciplines from various business domains:

Parameters and best-practice rules driving efficient, dependable design decisions



The right information - at the right time - for the right person

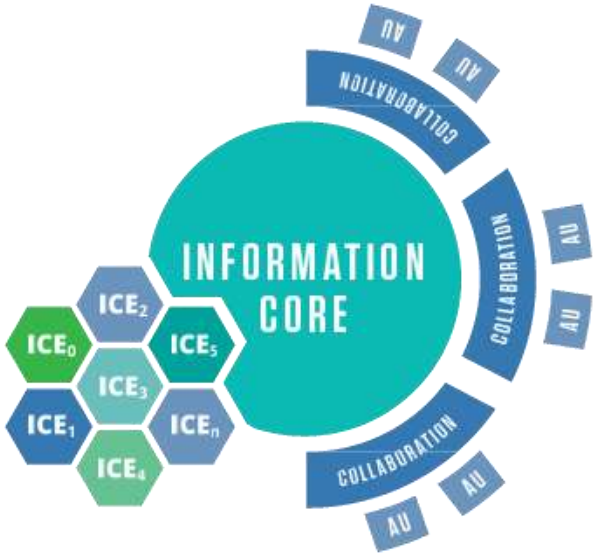
KARREN Overview

KARREN

- Tool independent **knowledge** capture & reuse **to support behavior** studies **across multiple disciplines**
- **Collaboration Infrastructure** for sharing common behavior knowledge
- **Model Based Engineering Enabler** for systems & component behavior studies
- **Design Support Infrastructure** for evaluating independent “what if” investigations and “trade-offs”

KARREN General concept

- **KARREN enables effective and dependable Behavior Based Engineering Collaboration and decision support.**
  - KARREN empowers existing tools with knowledge
  - KARREN captures behavior data, information and context for efficient and effective reuse of knowledge
  - KARREN provides valid and consistent information at each stage while enabling local “what-if” investigations
  - KARREN improves collaboration across multiple applications, disciplines and multiple organizations



KARREN General concept

- **KARREN empowers existing tools**

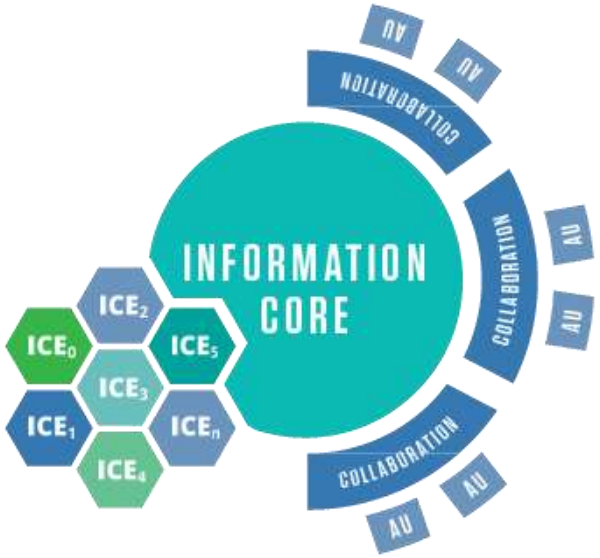
  No change is required regarding software tools used in existing behavior simulation processes, design processes or Product Lifecycle Management.

  Works with your tools and with your partner's tools.

- **User benefits:**

  KARREN allows customers a more efficient/intelligent use of existing software tools and thereby increase the return on previous investments.

  KARREN stores knowledge independent of the software tools which makes the knowledge available not only to multiple existing applications but also to applications added in the future.



KARREN General concept

- **KARREN captures behavior data, information and context for efficient and effective reuse of knowledge**

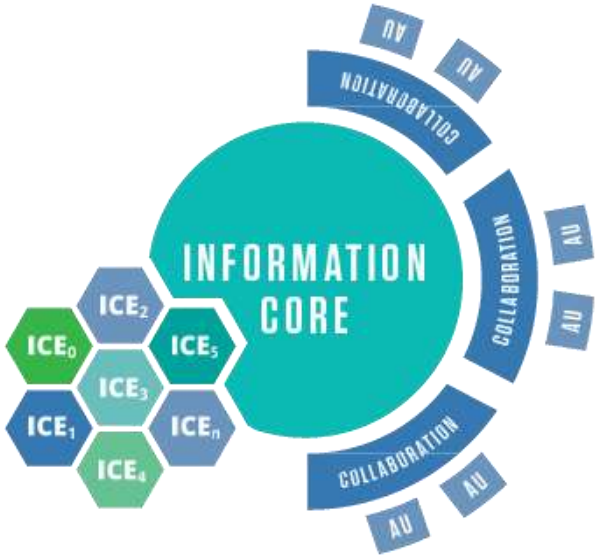
  Common parameters and rules for best practices are used across multiple behavior simulations and design stages from requirements to results from concept to completion in a centralized database of knowledge.

- **User benefits:**

  Reliable and comparable results, significantly reduced re-work, connection of systems and component behavior studies.

  Parameters are only defined once.

  Rules capture and warrant best-practices and ensure that correct parameter values are applied.



KARREN General concept

- **KARREN provides valid and consistent information at each stage while enabling local "what-if" investigations**

  Knowledge capture and reuse is applied with multiple managed instances enabling each behavior activity to explore parameters locally, e.g. for reconciliation of local optima.

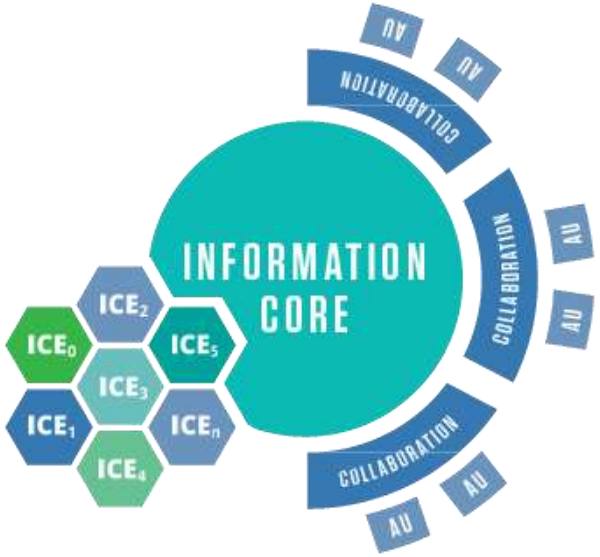
- **User benefits:**

  Reliable control of "trade-off" decisions ensuring consistent usage of available design ranges for all parameters independent of the number of tools involved in a design study.

  Consistent use of parameters across tasks.

  Variation allowed in each task within valid value ranges for each Collaboration that can be refined as high level "trade-off" decisions are made.

  Dramatically reduced time to understand affects of design option and to make educated design decisions



KARREN General concept

- **KARREN improves collaboration across multiple applications, disciplines and multiple organizations**

  Common parameters, rules and Collaborations are used across multiple departments, projects or organizations.

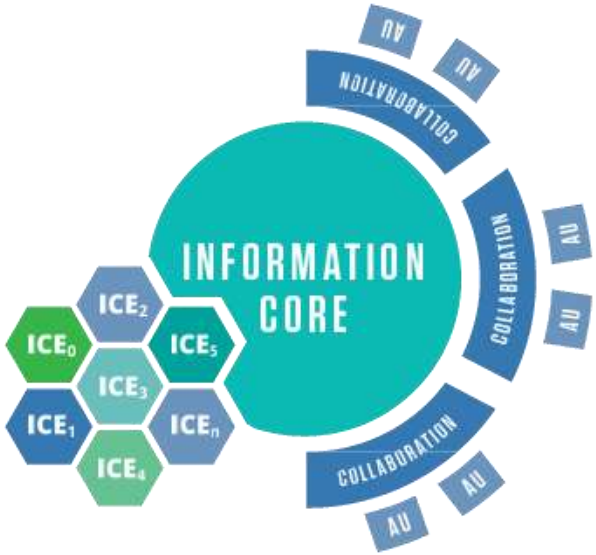
  Roles, user rights and Collaboration access can be assigned to protect Intellectual Property across (and within) organizations.

- **User benefits:**

  Reliable understanding of complex, multi-disciplinary and multi-dimensional behavioral results.

  Consistent use of parameters and rules for a variety of tasks ensure best practices.

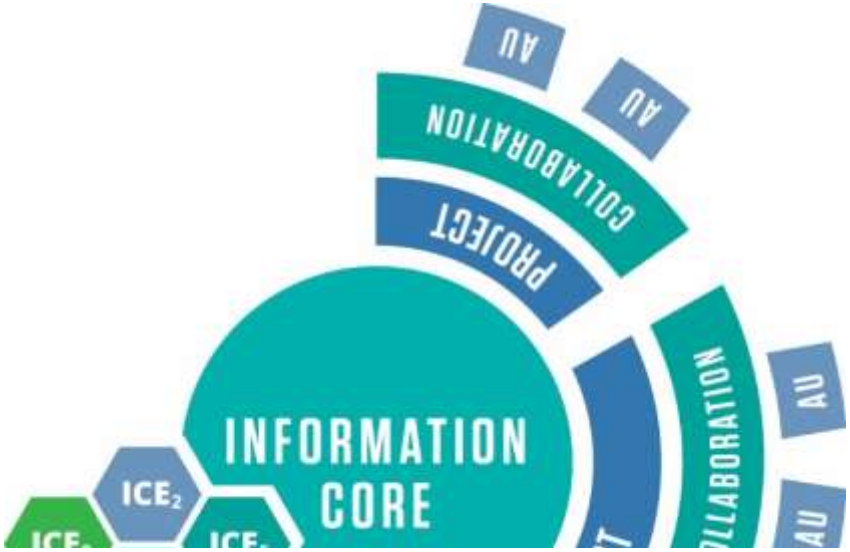
  More design options can be evaluated in less time in more diverse groups

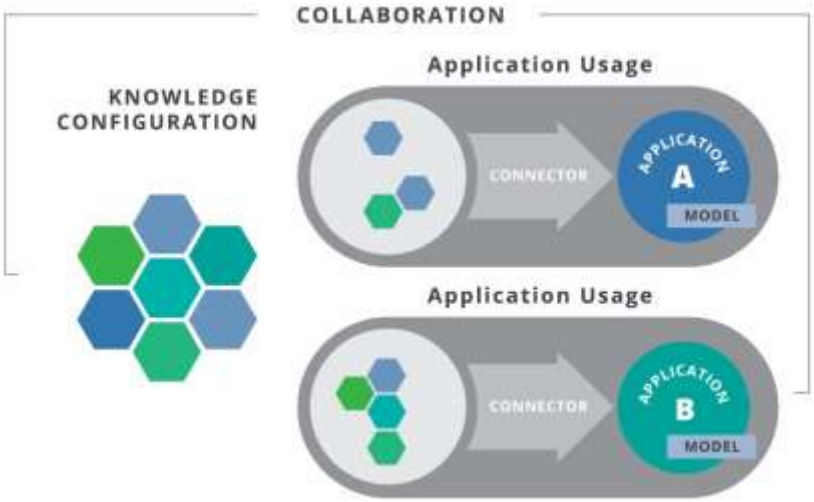


Getting to Know KARREN

KARREN Infrastructure

- Information Core Entities (ICE)
  - Containers for parameter and rule definitions
- Information Core
  - KARREN Database Server
  - Projects
  - Collaborations
- Connectors
  - Interfaces linking KARREN with specific software tools





Getting to Know KARREN

Information Core Entities

- KARREN is composed of a collection of information molecules known as **Information Core Entities** (ICE)
- **ICE** = Definition of groups of parameters and generic rules, grouped as makes sense for intended usage

ICE0	ICE1	ICE2
• Parameter 1 • Parameter 2 • Parameter 3 • Rule 1 • Rule 2	• Parameter 4	• Parameter 5 • Parameter 6

Parameter and Knowledge Handling via ICE

Customers generally provide textual specifications.
These can be traced, described, quantified within the ICE structure for reference and consistent use by all engineering and design tools.

Customer specifications

ICE

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Compression ring is used to prevent the leakage from combustion chamber during combustion process. It is located closest to the piston head. The wiper ring is placed between compression ring and oil ring. It further seals the combustion chamber and keeps the cylinder wall clean by wiping out the excess oil. Combustion gases passed through the compression ring are stopped by the wiper ring. Oil ring is located near the crank case which is used to wipe excess oil from the cylinder wall during piston movement.

Piston ring must be provided with a radial fit between the cylinder wall and the running surface of the piston for an efficient seal. Piston ring varies depending upon the size of the engine.

Piston head is exposed to heavy pressure when the engine is operating under load. The expanding gases of combustion apply forces on the piston head. At the same time, the flame front crosses the piston head also exert forces with higher magnitude. The force differentials caused by the expanding combustion gases and the flame front crossing exert forces the piston head can reach two to three times this force. Due to the reciprocating movement of the piston from Top Dead Centre (TDC) to Bottom Dead Centre (BDC) and high temperature fluctuations during operation, this can be called as thermal cycle loading. The temperature of the initial flame front during combustion exceeds 2200°C. When the piston is subjected to this temperature for a short span of time, the thermal stress and expansion of the piston head are to be considered as serious factors.

The piston is a vital component of a cylindrical engine. It reciprocates inside the cylinder bore. The piston acts as a moveable end of the combustion chamber. The cylinder head is the stationary end of the combustion chamber. 0 piston head is the top surface (closest to the cylinder head) of the piston which is subjected to pressure fluctuation, thermal stresses and mechanical load during normal engine operation. By the forces of combustion, piston reciprocates inside the cylinder bore.

In order to increase the efficiency of operation and better functionality, the piston material should satisfy the following requirements:

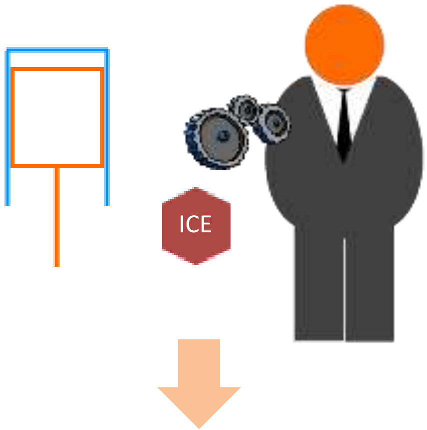
- Light weight
- Good wear resistance
- Good thermal conductivity
- High strength to weight ratio
- Free from rust
- Easy to cast
- Easy to machine
- Non magnetic
- Non toxic

Piston should be designed and fabricated with such features to satisfy the above requirements.

Parameter and Knowledge Handling via ICE

Requirements


Piston Requirements



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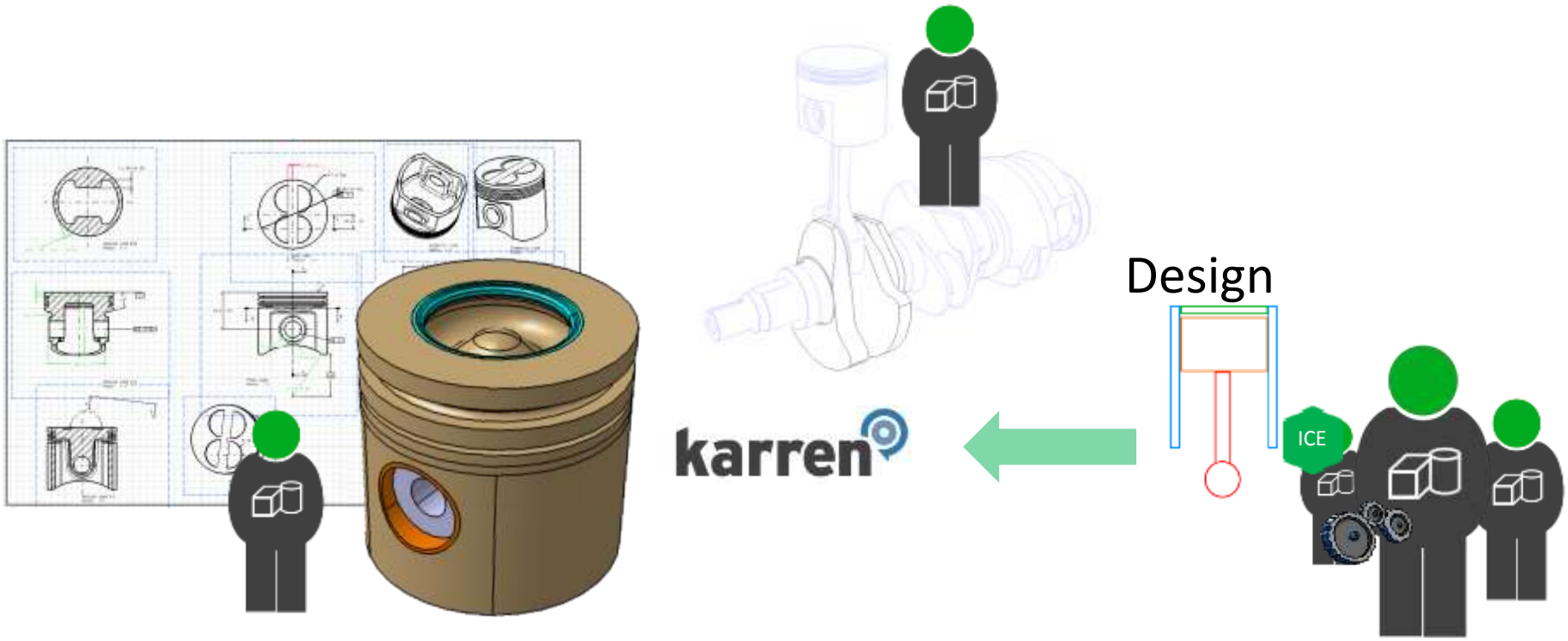
The project or product manager can add further ICE structures referencing parameters and/or rules from the specification ICE.

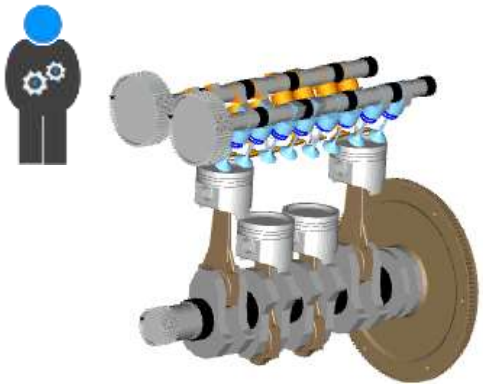
Parameter and Knowledge Handling via ICE

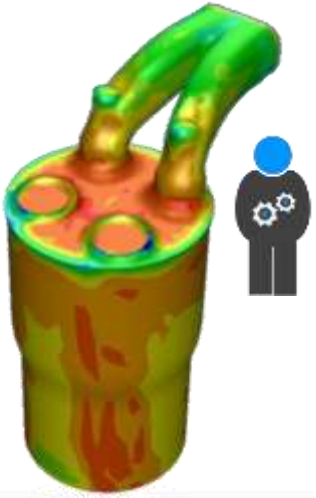


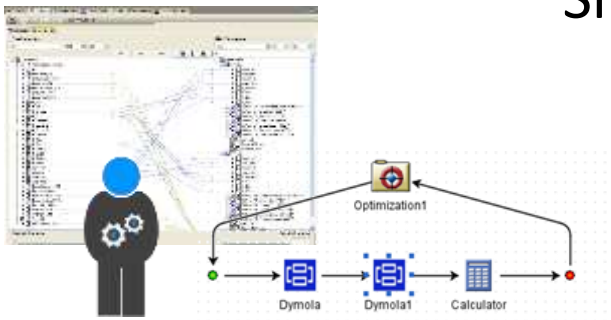
Creating the system/product architecture allows its representation as a set of quantifiable design rules and parameters.
They can provide several configurations of the system/product that can be referenced based on ICEs and configuration objects.

Parameter and Knowledge Handling via ICE

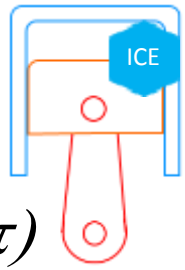
Engineering domains build and use various sets of simulation models to verify the system or product design. Authoring tools can exchange parameter rules and values via ICEs promoting consistency and best practices thereby enhancing the decision making process.







Simulation



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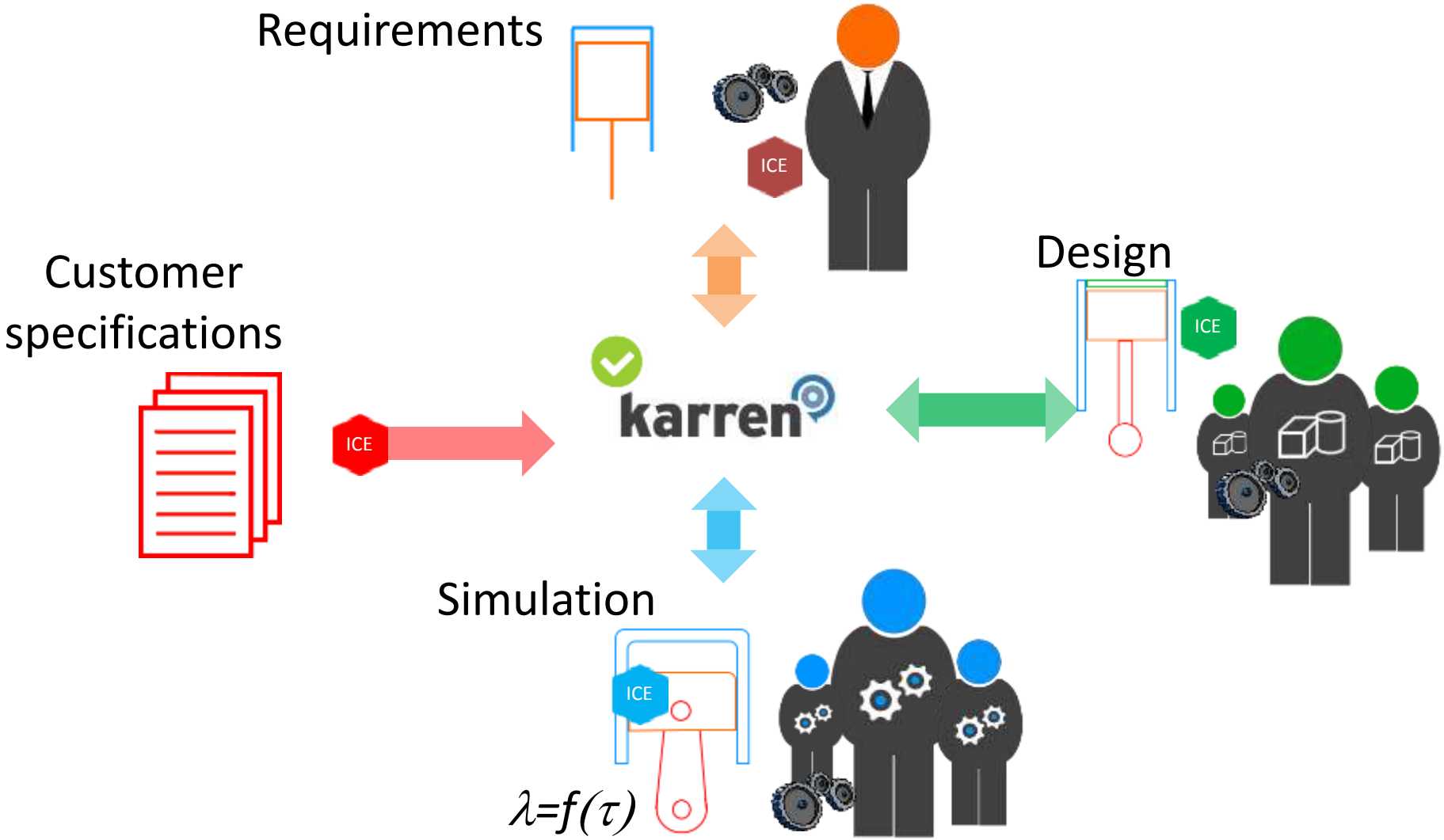
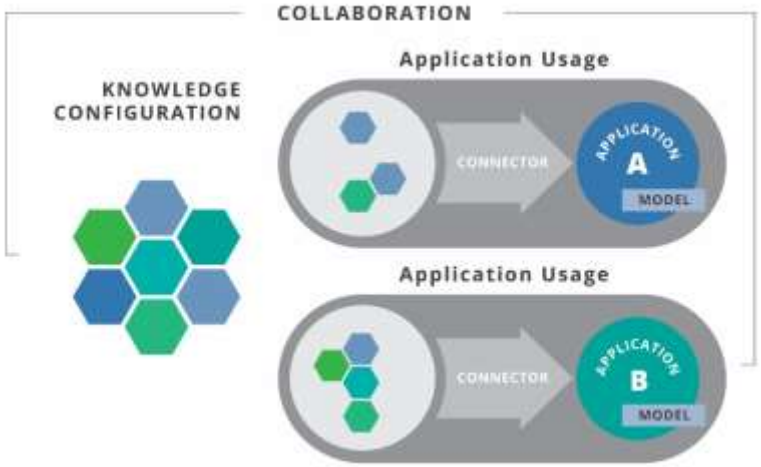
Collaboration Use Case



Getting to Know KARREN

KARREN User Roles

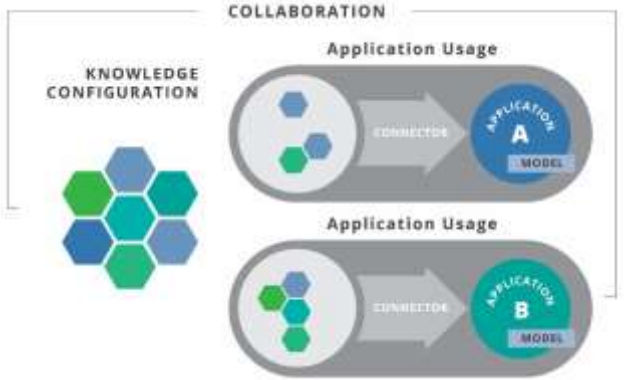
- KARREN Administrator defines roles and access rights for all users
- Project Manager defines & manages **Projects**
- Collaboration Manager defines & manages **Collaborations** with **Knowledge Configurations** consisting of suitable **ICEs**
- User defines and manages **Application Usages (AU)** with **Usage Configurations** of required **ICEs** along with **KARREN Connectors** to communicate to/from applications & models



Getting to Know KARREN

KARREN User Roles (cont.)

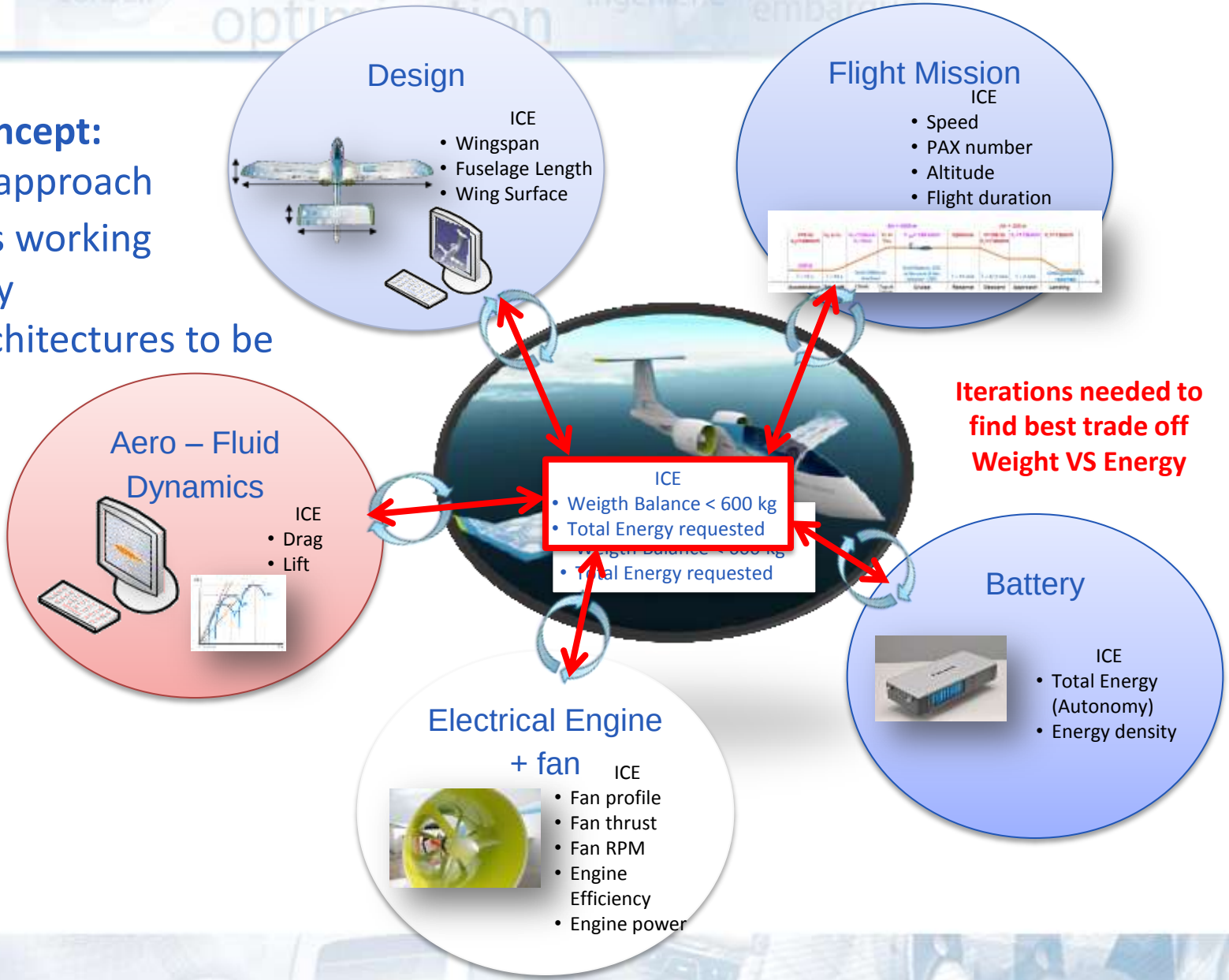
- Any user can have multiple roles & rights
- Build & deploy a library of **ICE, Projects, Collaborations,** and **Application Usages**
- Users run applications that are tied to **KARREN Application Usage(s)**
- Configuration Manager performs “trade-offs” and reconciliation
- Updated parameters are available to all participants



Example KARREN Application

Pre-design concept:
Collaborative approach

- 5 disciplines working concurrently
- Multiple architectures to be evaluated



KARREN Summary

- **KARREN enables . . .**
- Significantly reduced re-work
- More effective control of “what if” investigations and “trade-off” studies
- Improved understanding through intelligent behavior based collaboration
- Smarter use of existing software tools through knowledge sharing
- The right information at the right time for the right person
- **. . . BEHAVIOR BASED ENGINEERING COLLABORATION**

KARREN Summary

- Tool independent **knowledge** capture & reuse **to support behavior** studies **across multiple disciplines**
- **Smart Model Based Engineering Enabler** for systems & component behavior studies
- **Faster and better design decisions** through **intelligent behavior based collaboration**
  - Significantly reduced re-work

BEHAVIOR BASED ENGINEERING COLLABORATION

Delivering the right information at the right time for the right person

For more information please visit

WWW.DPS-KARREN.COM