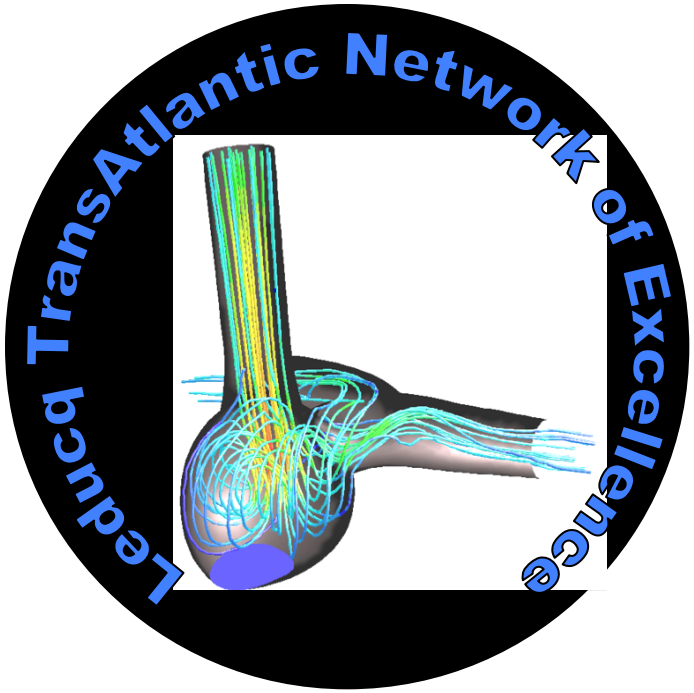



## The Trans-Atlantic Network of Excellence

## Multi-Scale Modeling of Single Ventricle Hearts for Clinical Decision Support – An overview

John D. McGregor

johnmc@cs.clemson.edu

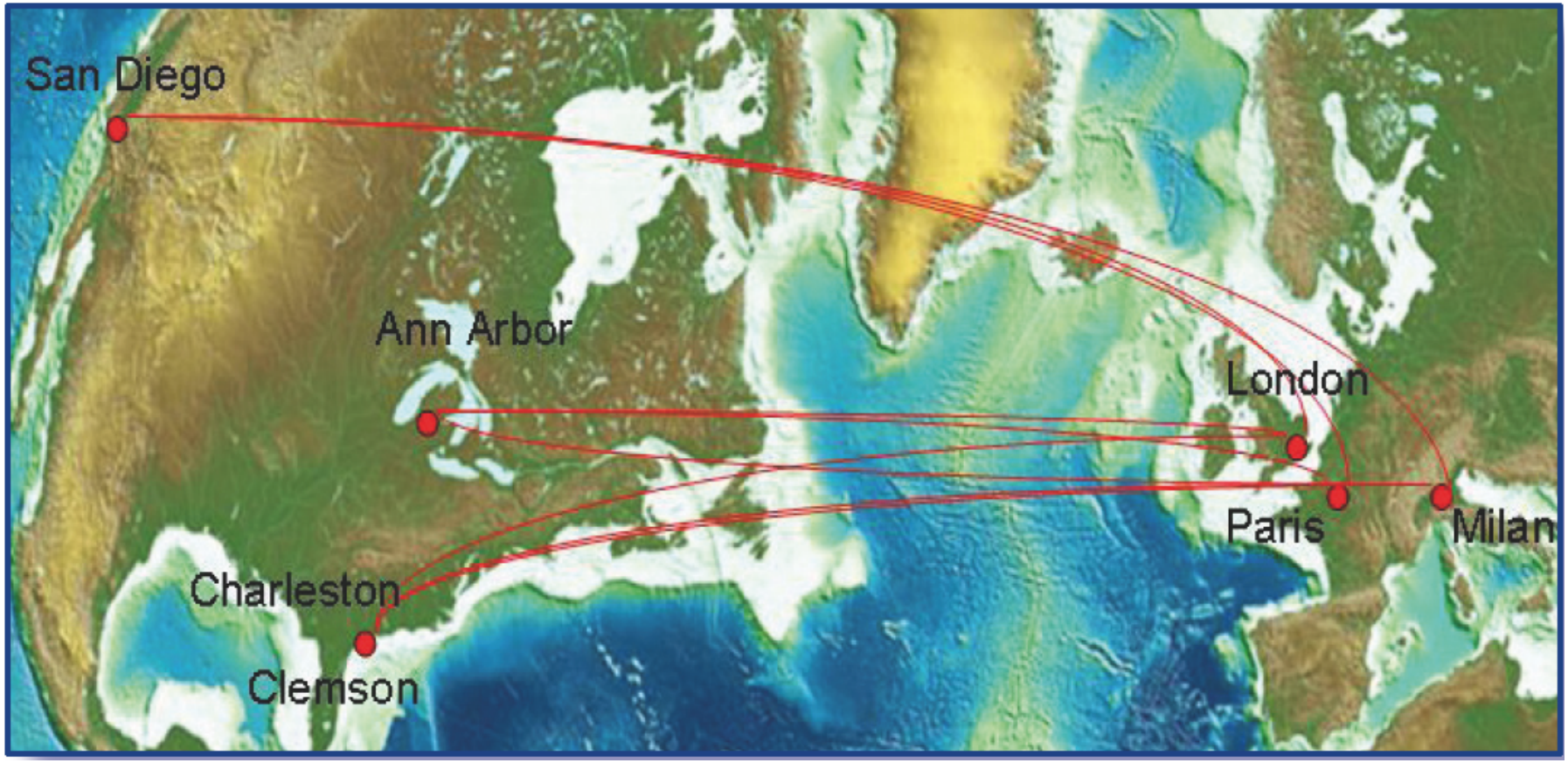
# Funding Body

FONDATION LEDUCQ

Dedicated to improving human health through international efforts to combat cardiovascular disease.

http://www.fondationleducq.org/

# The Network

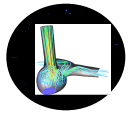



**Anthony Hlavacek**
MUSC
Charleston, SC, USA

**Initiated by T. Y. Hsia**

# The Network





MICHIGAN

POLITECNICO MILANO

MUSC Children's Hospital

Discovering. Understanding. Healing.

UCL INSTITUTE OF CHILD HEALTH

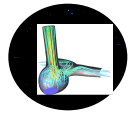
CLEMSON UNIVERSITY

Great Ormond Street Hospital for Children NHS Trust

INRIA

UC San Diego

Local Impact, National Influence, Global Reach



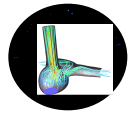
## Multi-Scale Modeling of Single Ventricle Hearts for Clinical Decision Support

**Integration** of expertise in pediatric cardiology, surgery, imaging, engineering, and computer science

**Development** of a modeling system that can assist and support the clinical management of complex congenital heart disease (CHD).

**Simulation** of virtual operations using patient-specific data with a modeling strategy including **physiologic changes over time** that could alter initial treatment strategies.

# The Project



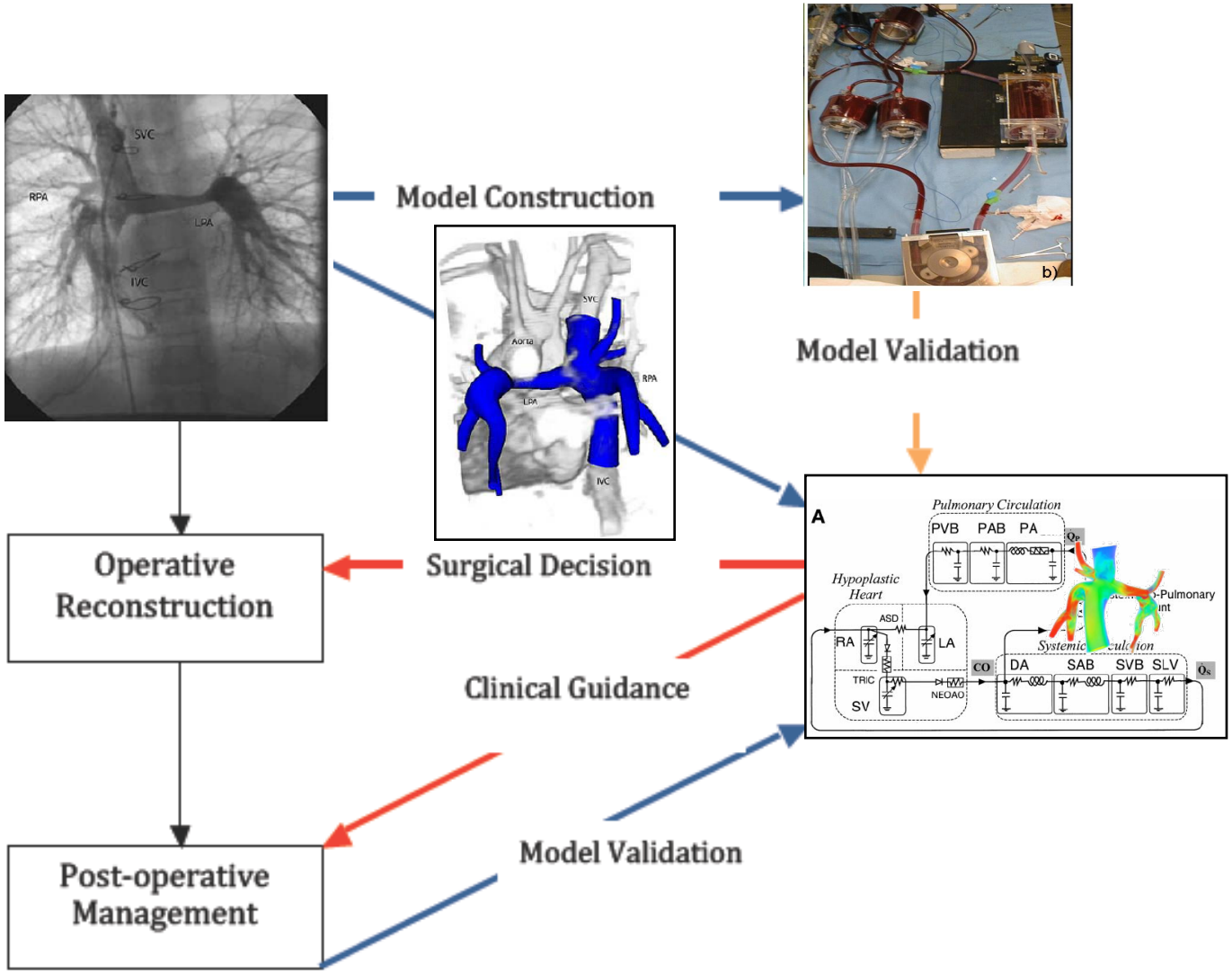
The surgical and medical management of children with HLHS is **challenging**, and each child's unique anatomy and physiology requires an **individualistic approach**.

Important parameters that regulate pressure and flow, such as pulmonary vascular resistance, **dramatically change** between birth and adulthood.

A further complicating issue is that there are **different operations for each Stage**, all intended to achieve the same circulatory physiology, but with dissimilar hemodynamics, and potentially different clinical outcomes.

# The Project

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Model Construction
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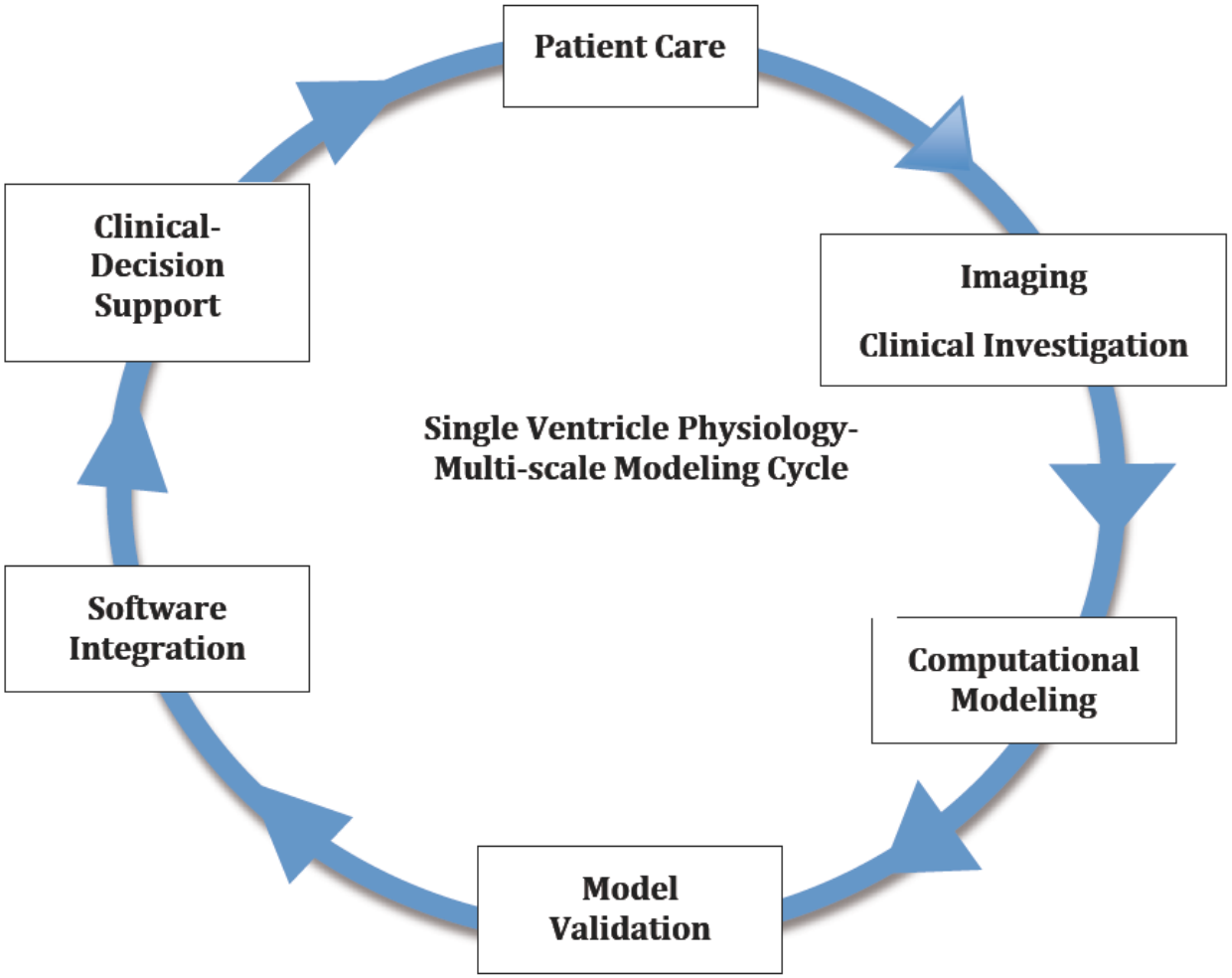



http://modelingventricle.clemson.edu/

# Software Product Lines



The goal of the software product line strategy is to establish a production capability that can

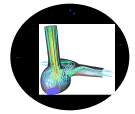
- rapidly and accurately produce multiple products within a well-defined scope
- achieve specific business goals that

  can be affected by the way the

  organization produces products.

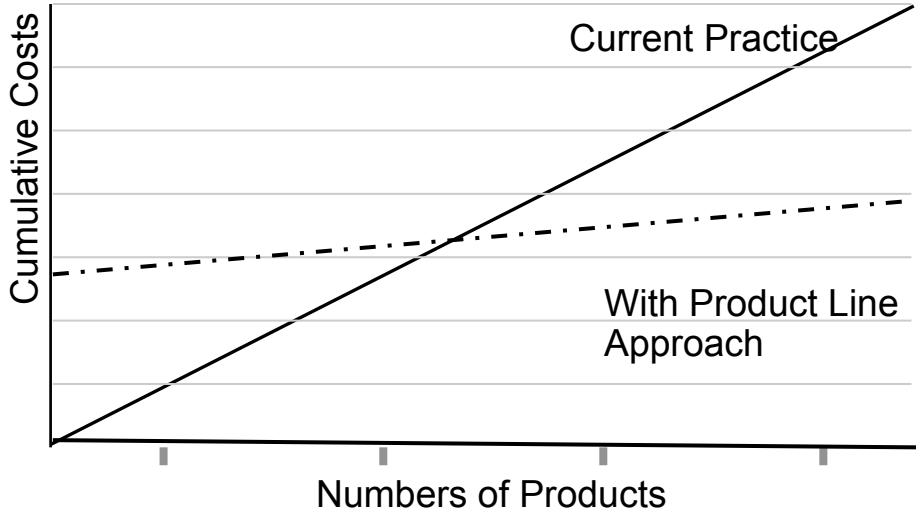
We will develop a set of products suitable for the range of computer resources available to surgeons around the world.

# The payoff

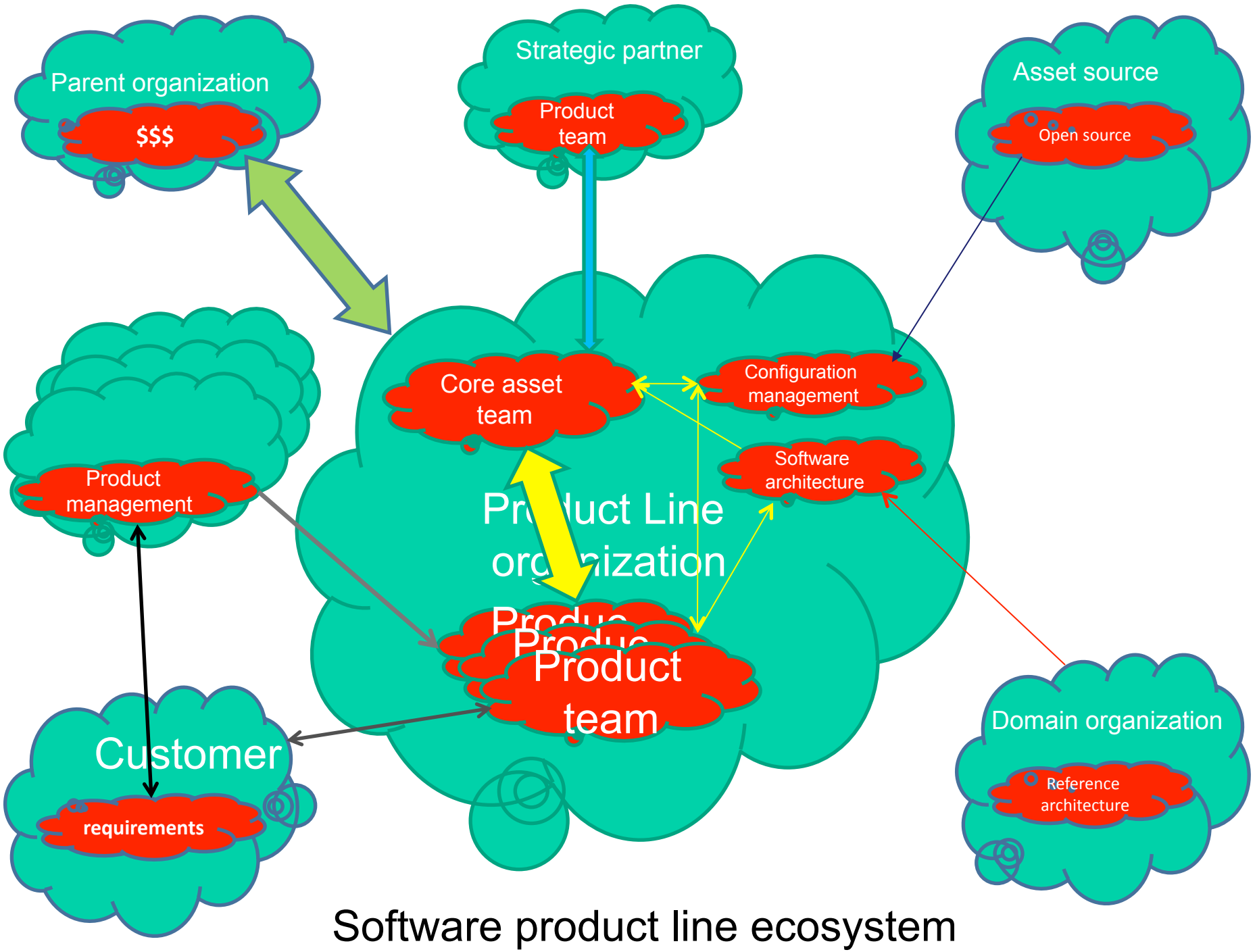


Initiating a software product line strategy requires some amount of up-front investment although it can be minimal.

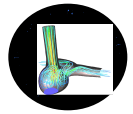
If the commonality is sufficiently high, payback can happen after a relatively small number of products.




Many organizations have reached the payoff point



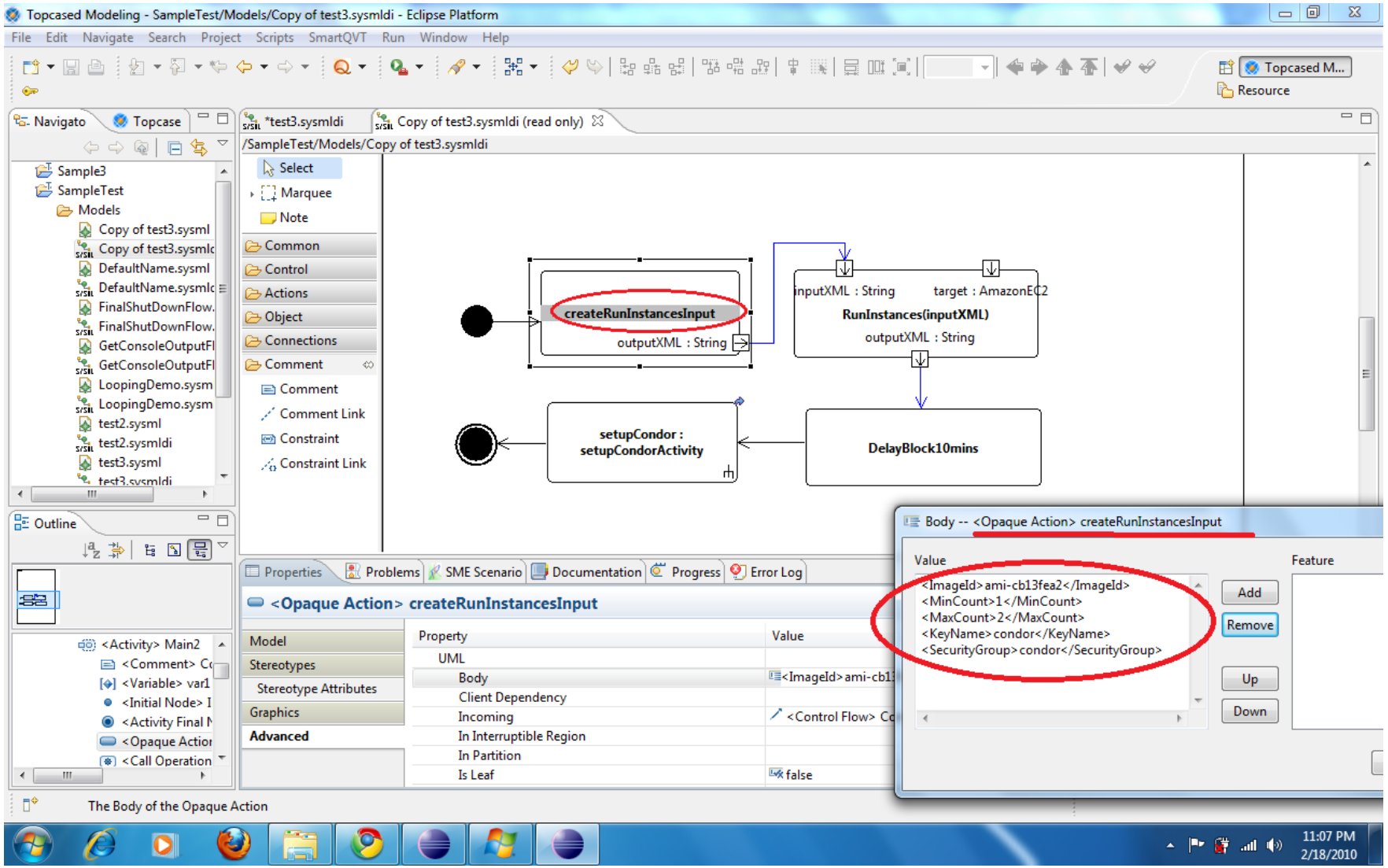

Software product line ecosystem



## Structured Intuitive Model of Product Line Economics

Supports cost/benefit analysis of a product line

$$\sum_{j=1}^{nbrBenefits} B_{ben_j} - (C_{org}() + C_{cab}() + \sum_{i=1}^{n} (C_{unique}(product_i) + C_{reuse}(product_i)))$$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