

The Future of Electrical & Electromechanical System Design



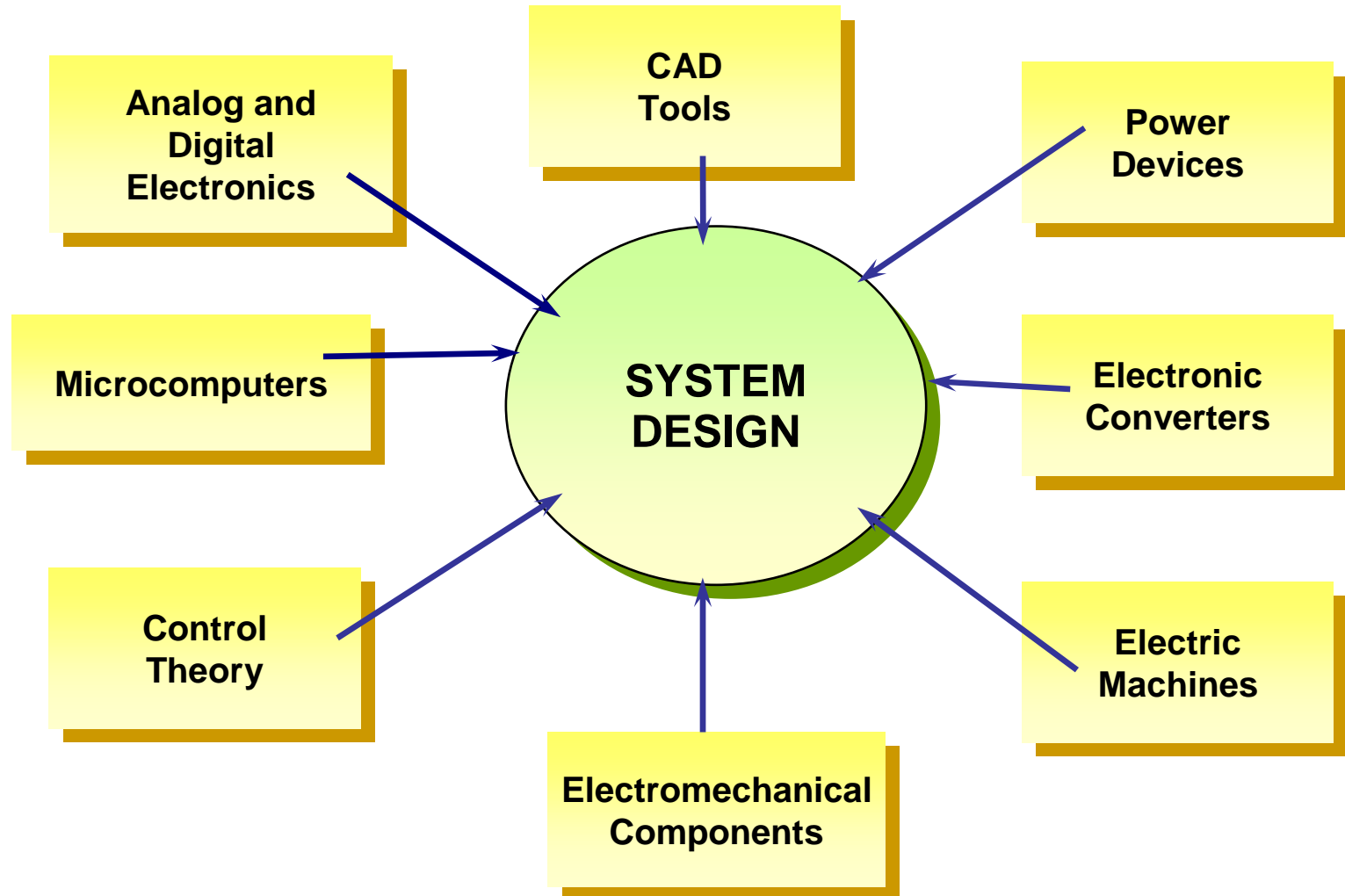
Michael Smocer

Director of Sales, EM Products

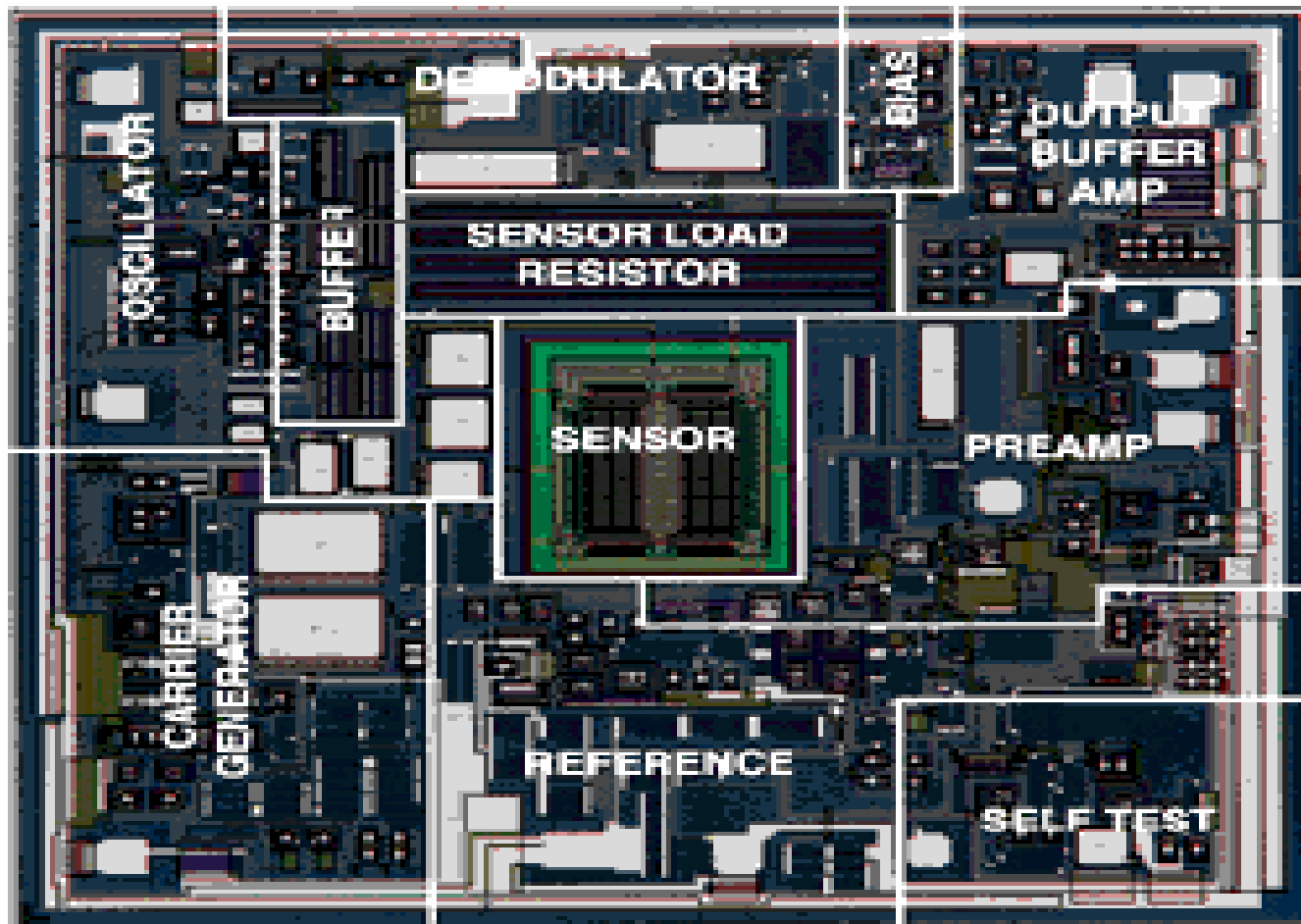
Agenda

- Possibilities
- Evolution
- Engagement

Defining a System

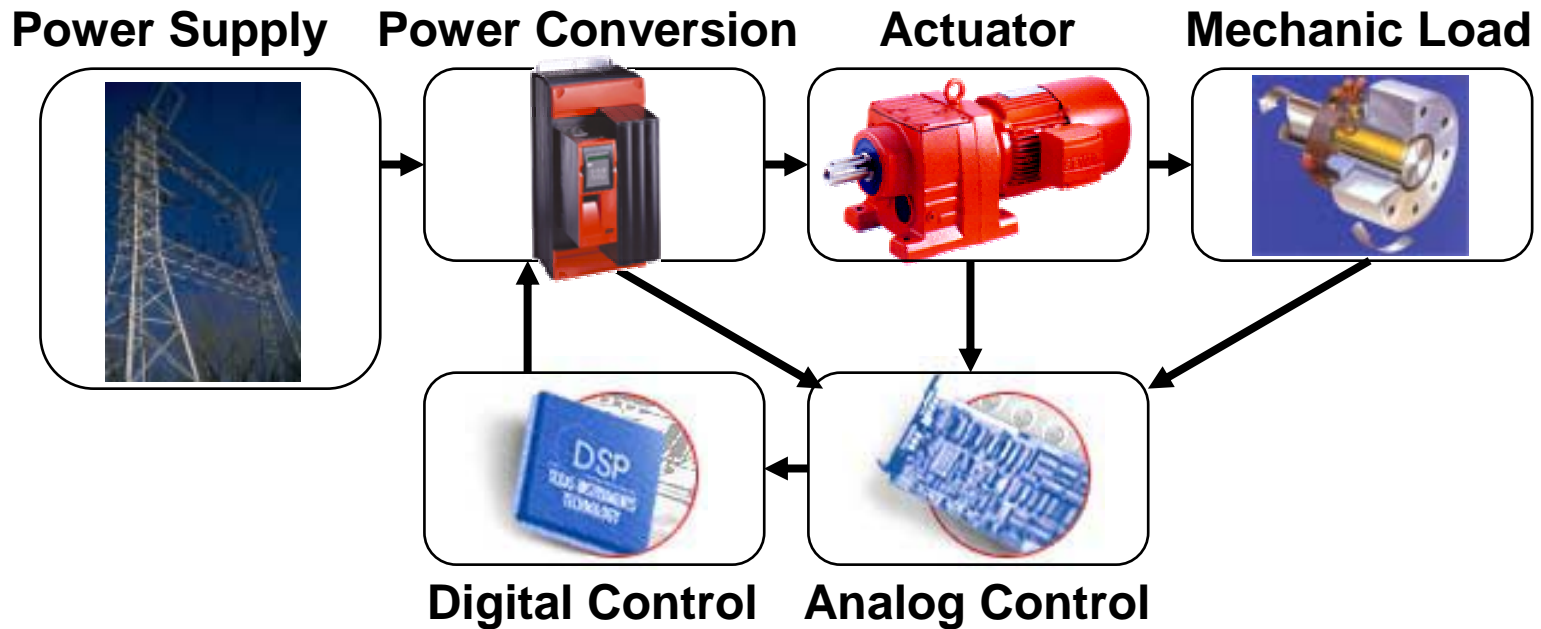


Defining a System



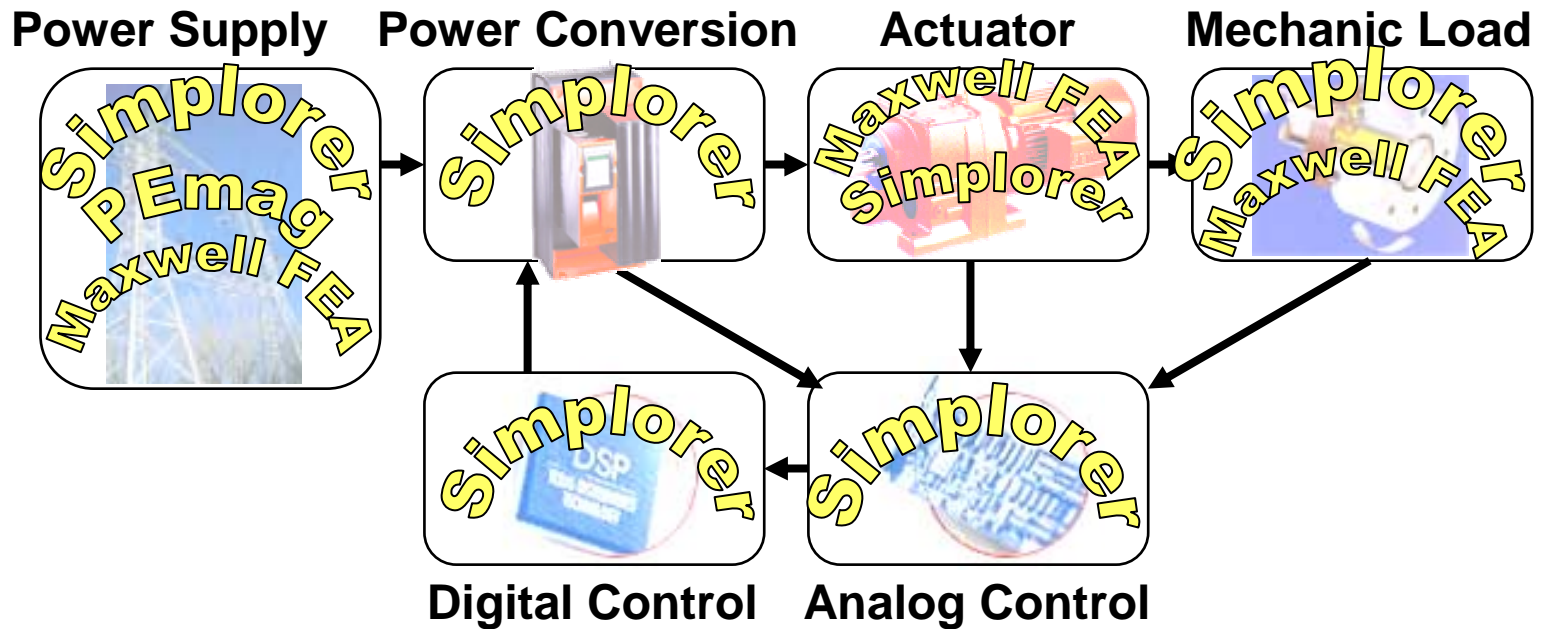
Capacitive Accelerometer - Analog Devices ADXL05

Defining a System



Automotive and railway systems, electric drives, home appliances and other systems consist of a variety of components. Each component may influence the behavior of another component.


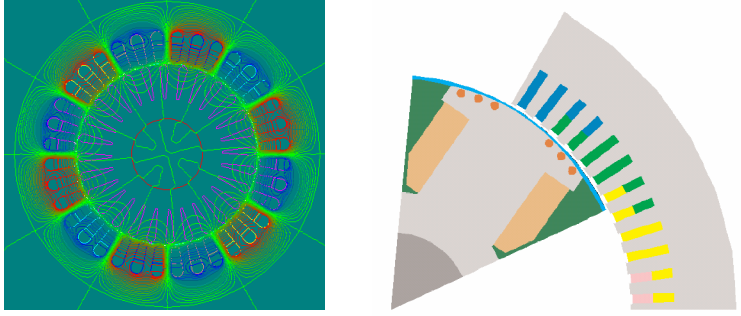


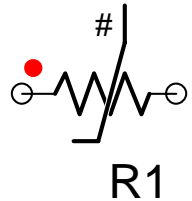
Defining a System



Automotive and railway systems, electric drives, home appliances and other systems consist of a variety of components. Each component may influence the behavior of another component.

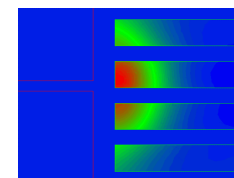
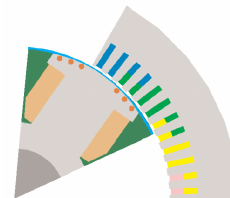
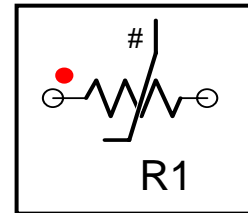
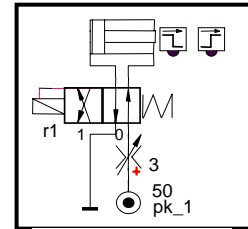
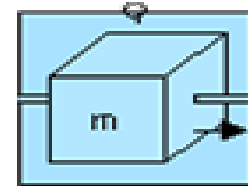
Types of Systems

Model Requirements

	<p>Component Level: Electrical Machine Designer</p>	
	<p>Subsystem Level: Circuit and Control Designer</p>	$ \begin{aligned} v_{1d}(t) &= i_{1d}(t) \cdot R_1 + \frac{d\psi_{1d}(t)}{dt} - p \cdot \omega(t) \cdot \psi_{1q}(t) & v_{ed}(t) &= i_{ed}(t) \cdot R_e + \frac{d\psi_{ed}(t)}{dt} \\ v_{1q}(t) &= i_{1q}(t) \cdot R_1 + \frac{d\psi_{1q}(t)}{dt} + p \cdot \omega(t) \cdot \psi_{1d}(t) & v_{eq}(t) &= 0 \end{aligned} $
	<p>System Level: Variable Load Resistance</p>	

Examples of Component Models

- Mechanics
- Hydraulic
- Electrical
- Electromechanical
- Electromagnetic



Where Do Models Come From?

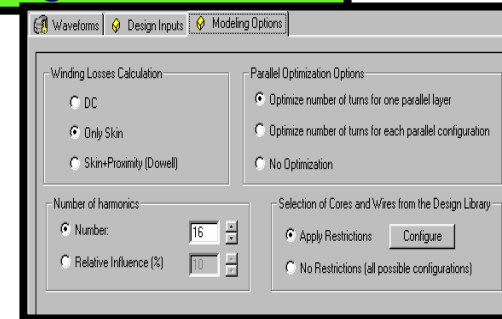
Open Languages

- VHDL-AMS
- Spice
- C++

Design Tools

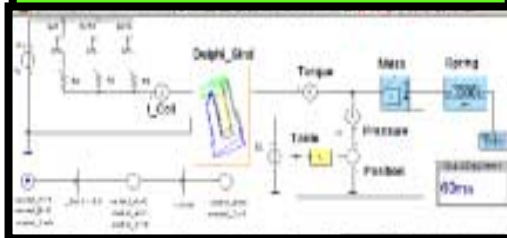
- RMxpvt
- PExprt
- PEmag

SIMPLORER
system simulation



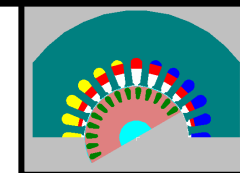
Lumped-Parameter

- Maxwell 2D
- Maxwell 3D



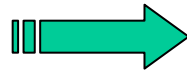
Transient FEA

- Maxwell 2D Transient
- Maxwell 3D Transient

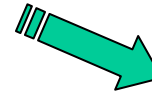


Modeling New Technologies

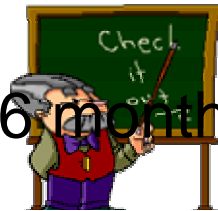
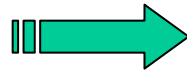
The Possibilities



6 months...



ABS actuator

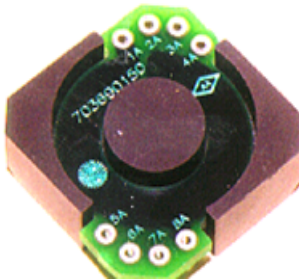


6 months...

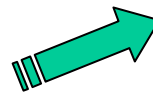


$$\frac{dx_r(t)}{dt} = F(x_r(t)) + b_r u(t)$$

$$y(t) = c_r^T x_r(t)$$



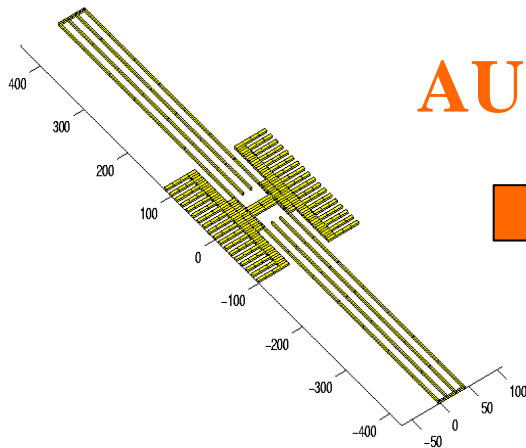
6 months...



Model for the
System Simulator

Model Generation From Ansoft

The Possibilities



AUTOMATIC



$$\frac{dx_r(t)}{dt} = F(x_r(t)) + b_r u(t)$$

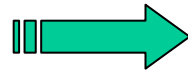
$$y(t) = c_r^T x_r(t)$$

Complicated Geometry,
Coupled Electrostatics,
Electromagnetic,
Thermal

Low order state-space
model which captures
input (u) / output(y)
behavior

Modeling New Technologies

The Possibilities



Fast solver &
Model order
reduction



ABS actuator



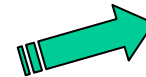
Fast solver &
Model order
reduction



$$\frac{dx_r(t)}{dt} = F(x_r(t)) + b_r u(t)$$
$$y(t) = c_r^T x_r(t)$$



Fast solver &
Model order
reduction



Model for the
System
Simulator

Evolution

*Defined: The act of evolving;
formation, growth, or development*

*Premise: Businesses must evolve
if they are to survive*

Evolution

- *How are your strategic simulation tools performing?*
- *Have they evolved?*
- *Is there a clear vision?*
- *Is there an integration plan with other tools?*
- *Where will you be in 6 months, 1 year, 3 years?*
- *What is required to continue your leadership position?*



Evolution

What characteristics do you demand of your strategic tools' partners?

- *Healthy company with a strong vision for the future*
- *Fortunes are directly tied to its ability to serve and support the industry*
- *Proven track record of delivering as promised*



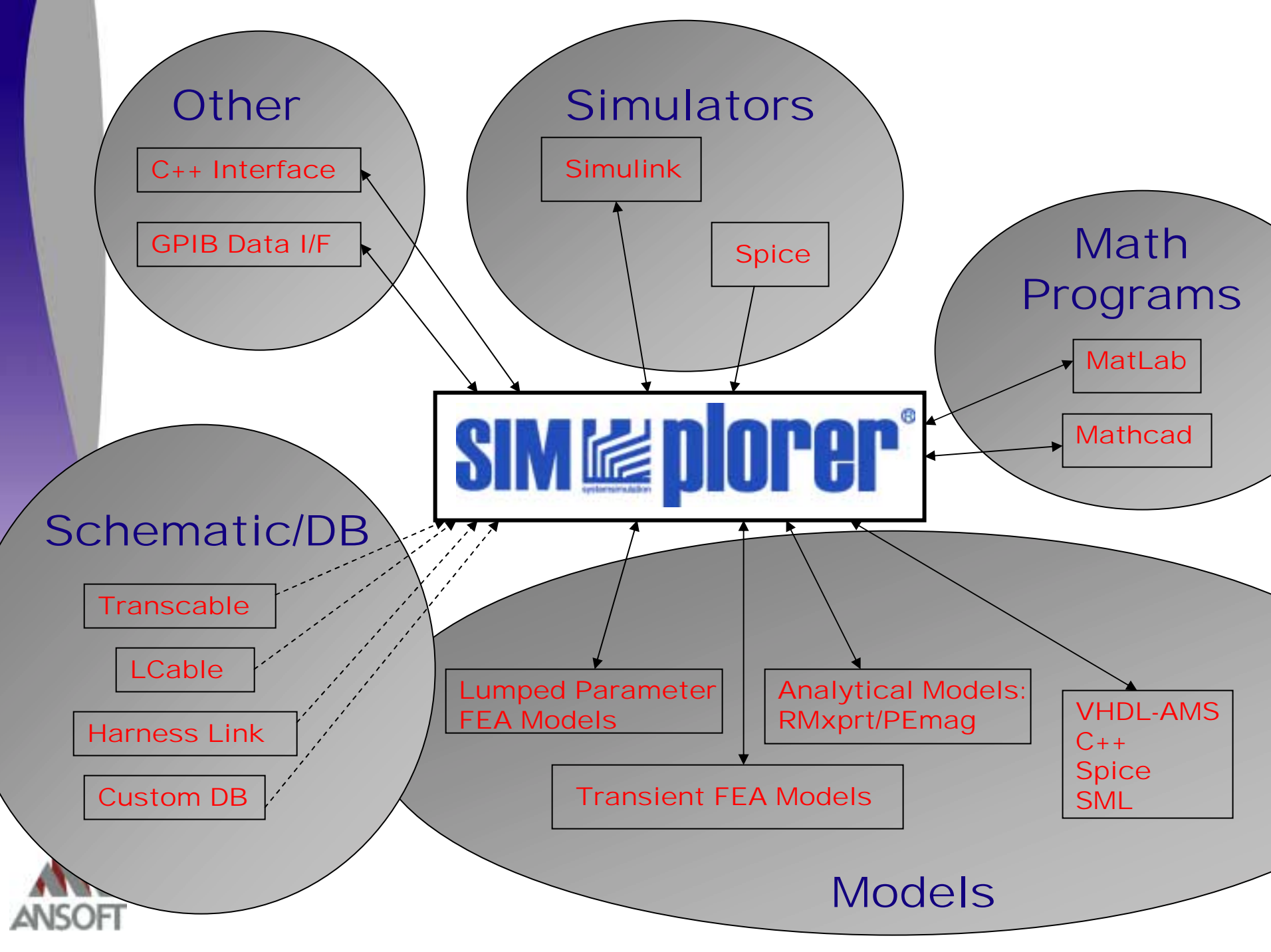
Evolution

- *How are your strategic simulation tools performing?*
- *Have they evolved?*
- *Is there a clear vision?*
- *Is there an integration plan with other tools?*
- *Where will your vendors be in 6 months, 1 year, 3 years?*
- *What is required to continue their leadership position?*



Evolution

- 1984-1992: Maxwell 2D. Static force, fields, saturation.
- 1988-1995: Maxwell 3D. Static analysis, 3D effects.
- 1996: Parametrics. Multiple static solutions, one set-up.
- 1996: 2D EMSS. Transient solutions. Spice and Saber links.
- 1997: PEmag. Power electronics design tool.
- 1998: RMxpert. Motor design tool.
- 1998: Maxwell 2D Transient. True transient performance.
- 2000: Optimetrics. Analysis tool becomes design tool.
- 2000: 3D EMSS. Lumped parameter solution moves to 3D.
- 2000: Maxwell 2D Thermal. Independent & coupled.
- 2001: Simplorer. Complete multi-domain simulation.
- 2002: Maxwell 3D Transient. Transient source capability.
- 2002: Maxwell 3D Thermal



Other

C++ Interface

GPIB Data I/F

Simulators

Simulink

Spice

Math Programs

MatLab

Mathcad

Schematic/DB

Transcable

LCable

Harness Link

Custom DB

Lumped Parameter
FEA Models

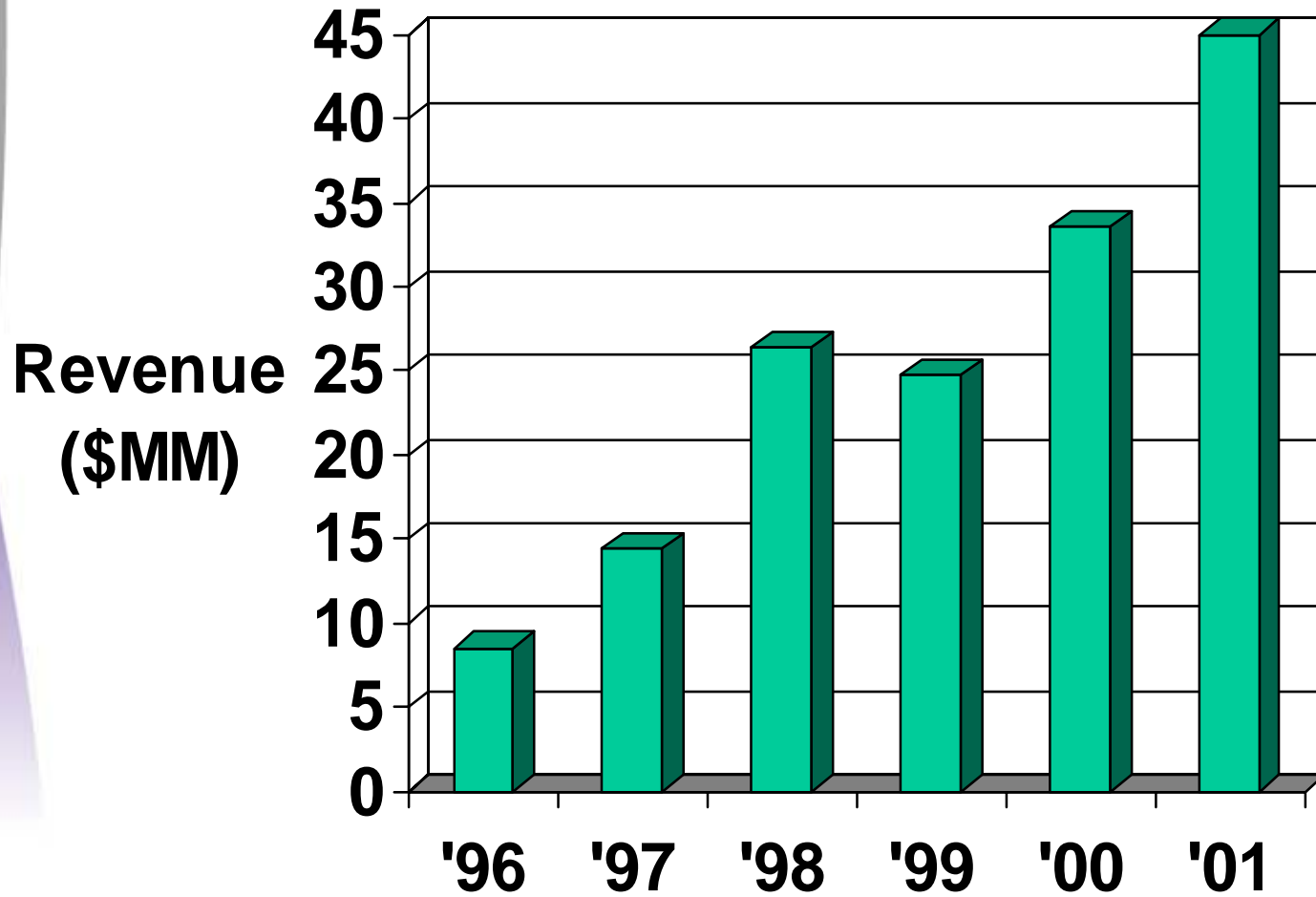
Analytical Models:
RMxpert/PEmag

Transient FEA Models

VHDL-AMS
C++
Spice
SML

Models

Evolution



Evolution

What characteristics do you demand of your strategic tools' partners?

- *Healthy company with a strong vision for the future*
- *Fortunes are directly tied to its ability to serve and support the industry*
- *Proven track record of delivering as promised*



Engagement

- Proven service
- Proven responsiveness
- Vision – Lack of complacency
- Dedicated employees

Work with us!