Model Based Design Approach for Complex System Design
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UTC Climate, Controls & Security's fire safety, security, building automation, heating, ventilation, air conditioning and refrigeration systems and services promote safer, smarter and sustainable buildings.

Key Facts

- 56,475 Employees
- $16.9B Net sales
- $3.1B* Adjusted operating profit

*Adjusted operating profit is a non-GAAP financial measure. For additional information regarding the use of this measure, the corresponding amounts prepared in accordance with generally accepted accounting principles (GAAP) and a reconciliation of the differences between the non-GAAP and GAAP measure, please refer to page 73 of the UTC 2019 Annual Report.

Carrier's refrigerated containers carry more than $6 billion worth of goods every day.

Since 2002, Kidde has donated more than 1 million smoke and carbon monoxide alarms to fire departments.
Otis elevators, escalators and moving walkways keep people moving. As the world's leading installer and maintainer, we are committed to safety, performance and service.

Key Facts

67,396 Employees

We introduced the world's first safety elevator to the market in 1853.

$11.9B Net sales

Our companies maintain 1.9 million elevators, escalators and moving walkways worldwide.

$2.2B* Adjusted operating profit

Otis is providing 670 elevators and escalators to the Hyderabad Metro in India, the largest elevator contract in the country's history.

*Adjusted operating profit is a non-GAAP financial measure. For additional information regarding the use of this measure, the corresponding amount prepared in accordance with generally accepted accounting principles (GAAP) and a reconciliation of the differences between the non-GAAP and GAAP measure, please refer to page 74 in the UTC 2016 Annual Report.
UTC CLIMATE CONTROLS & SECURITY BRANDS

United Technologies Announces Opening of New Hyderabad Research & Design Center
COMPLEX SYSTEM

Sample System Diagram for a Building Automation System

COMPLEX SYSTEM DESIGN

Main Challenges

- Complex interfaces
- Prolonged Development time
- Late Identification of Quality issues
- Dynamic Behavior Simulation
- Lower Reliability
- Convoluted Impact of changes during iterations
- Increased data matrices for development, testing
- Changes in regulations, legal restrictions

The architecture of a complex system is a function of its components as well as the hierarchic relationships among these components.

COMPLEX SYSTEM DESIGN

Main Challenges

- Designs are becoming more complex: 51%
- Early identification of system level problems: 42%
- Lack of cross functional knowledge / overcoming silos of knowledge of expertise: 37%
- Difficulty predicting system behavior until physical prototypes exist: 32%
- Constantly changing customer requirements: 26%

Comparison of Best in Class and Others in using Simulation throughout the Design Phase

- Multiple design criteria are analyzed simultaneously: 92%
- “Real-life” design performance is analyzed during development with virtual prototypes: 85%
- Existing analytical models used for simulating systems behavior: 75%
- Simulation used to verify interactions between subsystems before building physical prototype: 73%

Reference Source: Aberdeen Group, January 2014
MODEL BASED DESIGN

Benefits

✓ Use a common design environment
✓ Link designs directly to requirements
✓ Integrate testing with design
✓ Refine algorithms through multi-domain simulation
✓ Automatically generate embedded software code and documentation
✓ Develop and reuse test suites
✓ Accelerate time to market

MODEL BASED DESIGN

Benefits

 Entire Refrigeration Cycle can be simulated using tools and dynamic behavior can be virtualized to enhance product development.

Changing customer expectations, faster time to market and increased regulations ...

Model Based Design is the way forward!
Thank you!