

**Applying Informatics to Autonomy in
Experimentation**

Properties

Process

Structure

1/27/2015

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Michael Krein



Lockheed Martin
Advanced Technology Laboratories

Lockheed Martin Corporate Alignment



Aeronautics



Information Systems & Global Solutions



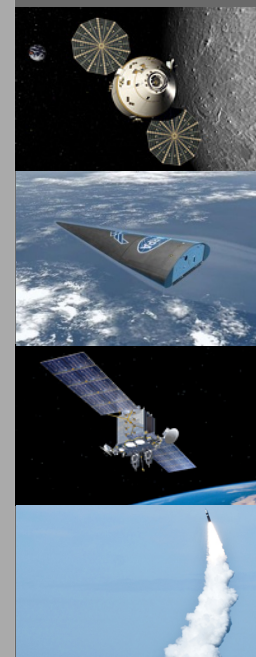
Missiles & Fire Control



Mission Systems & Training



Space Systems



International



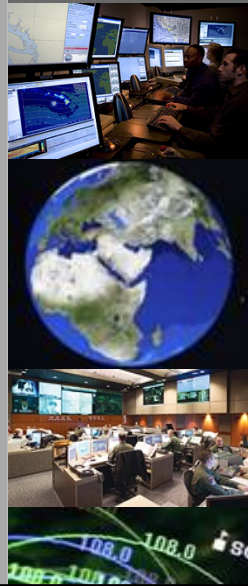


ATL's Role in Lockheed Martin

Aeronautics



Information Systems & Global Solutions



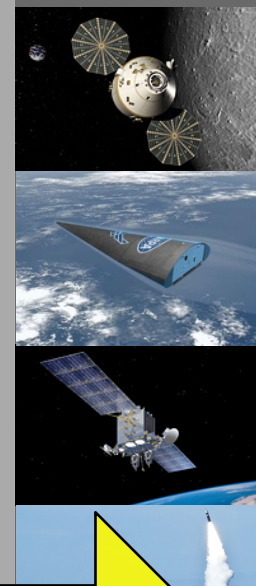
Missiles & Fire Control



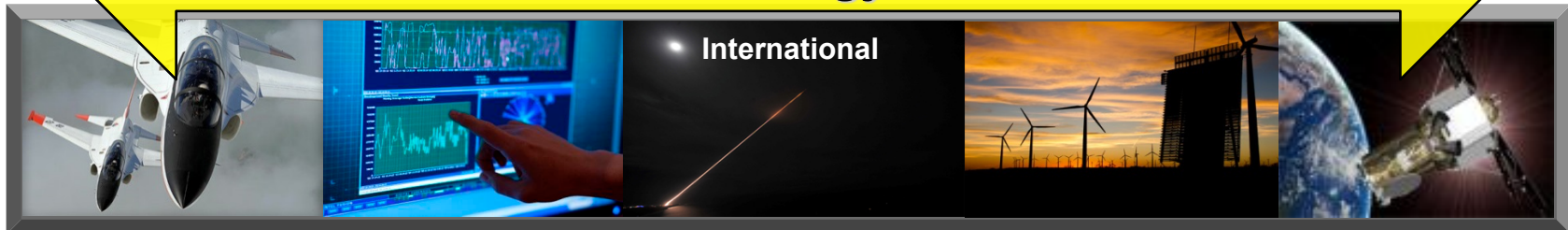
Mission Systems & Training



Space Systems

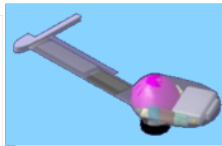


Corporate Engineering & Technology
Advanced Technology Laboratories



Advanced Technology Laboratories

Innovation with Purpose



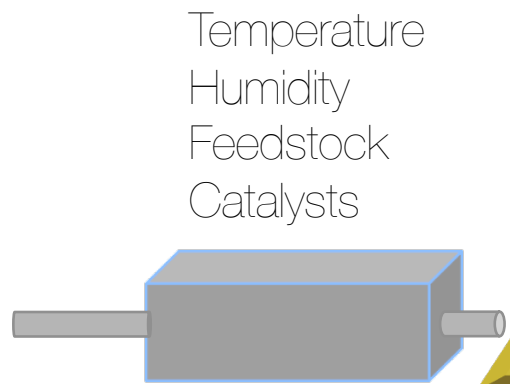
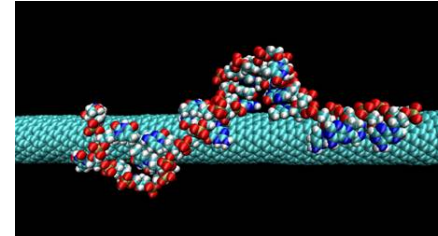
We partner with the Business Areas to engage the S&T community, develop innovative and disruptive technologies, and provide ground-breaking capabilities to extend programs of record and expand into new lines of business.

Engaging the S&T customer to support creation of the next generation LRP

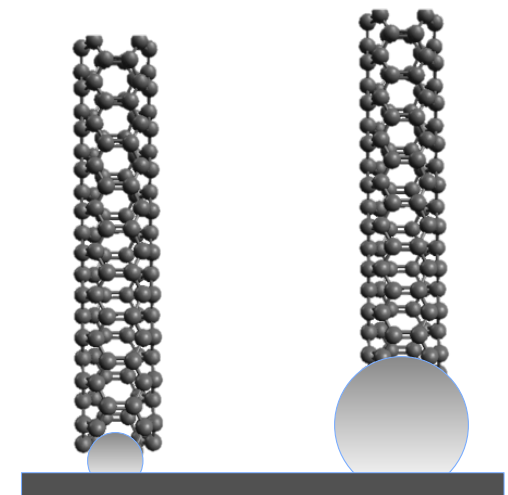


The Materials Science Golden Triangle

Properties



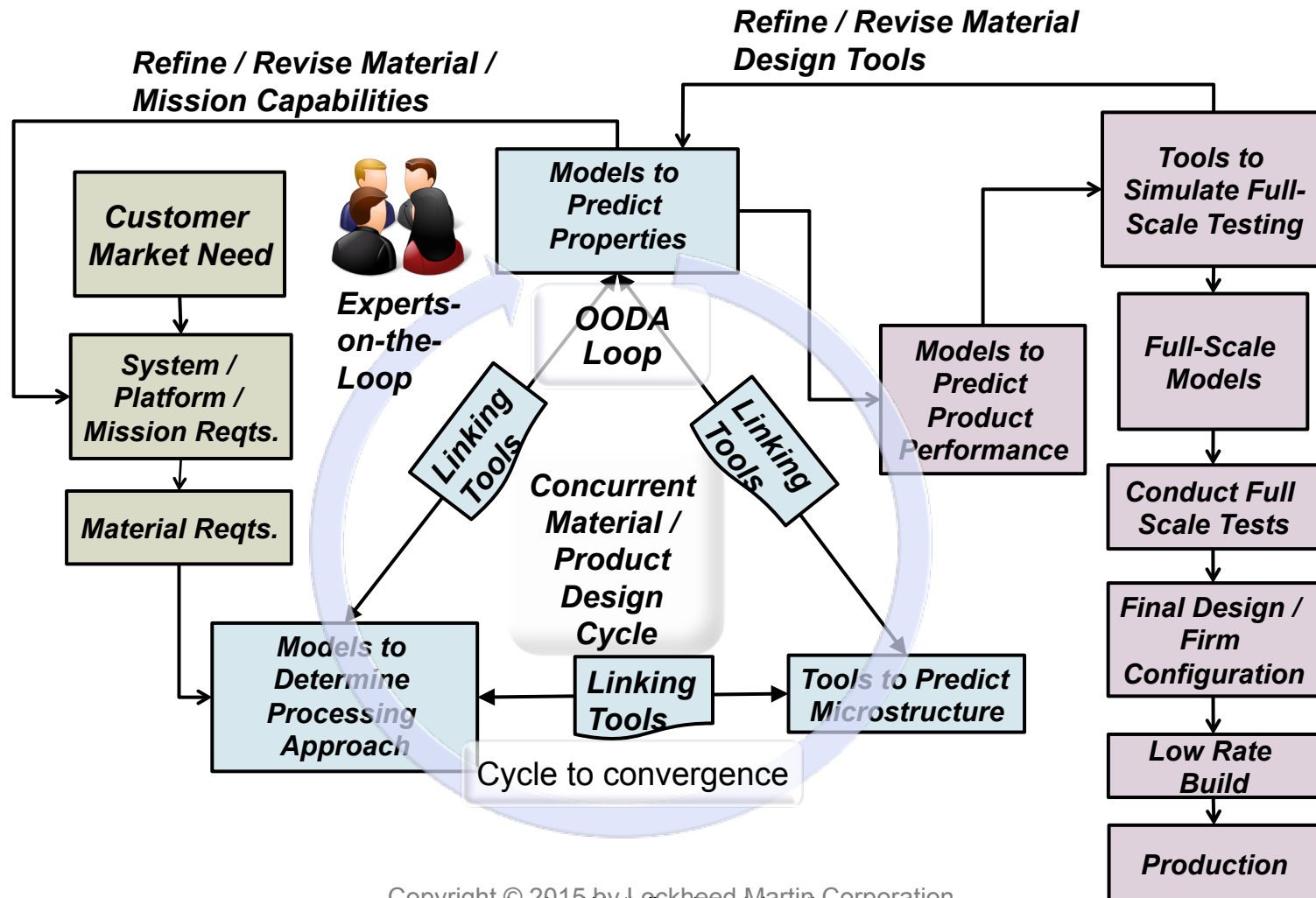
Process



Structure

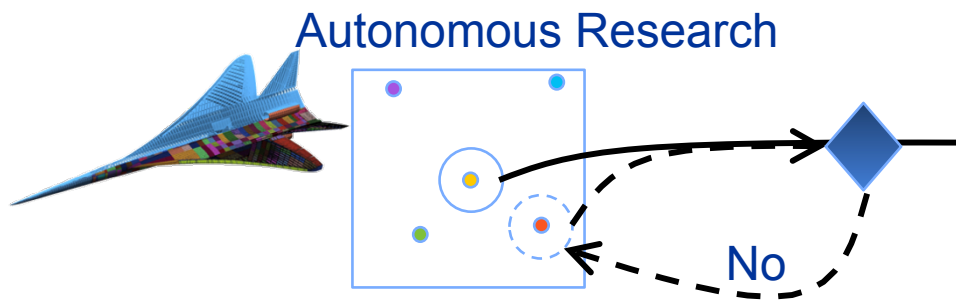
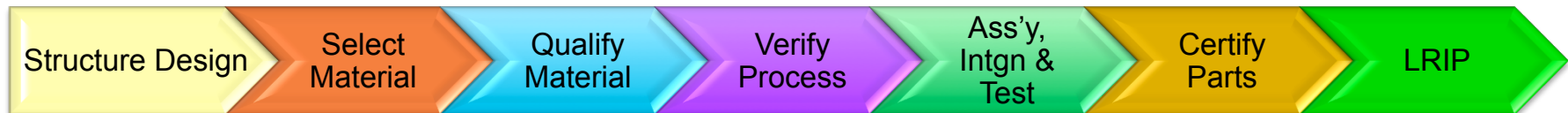


A Vision for Innovation in Future Systems Development



Autonomous Research:

Short Circuiting Current Materials-to-Manufacturing Design Process



Rapid exploration of materials, process, and design choices allow early optimization.

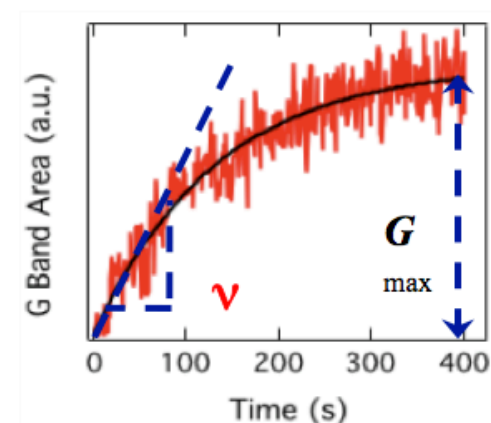
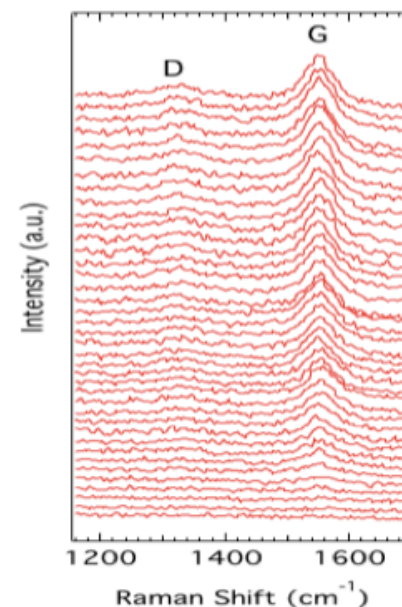
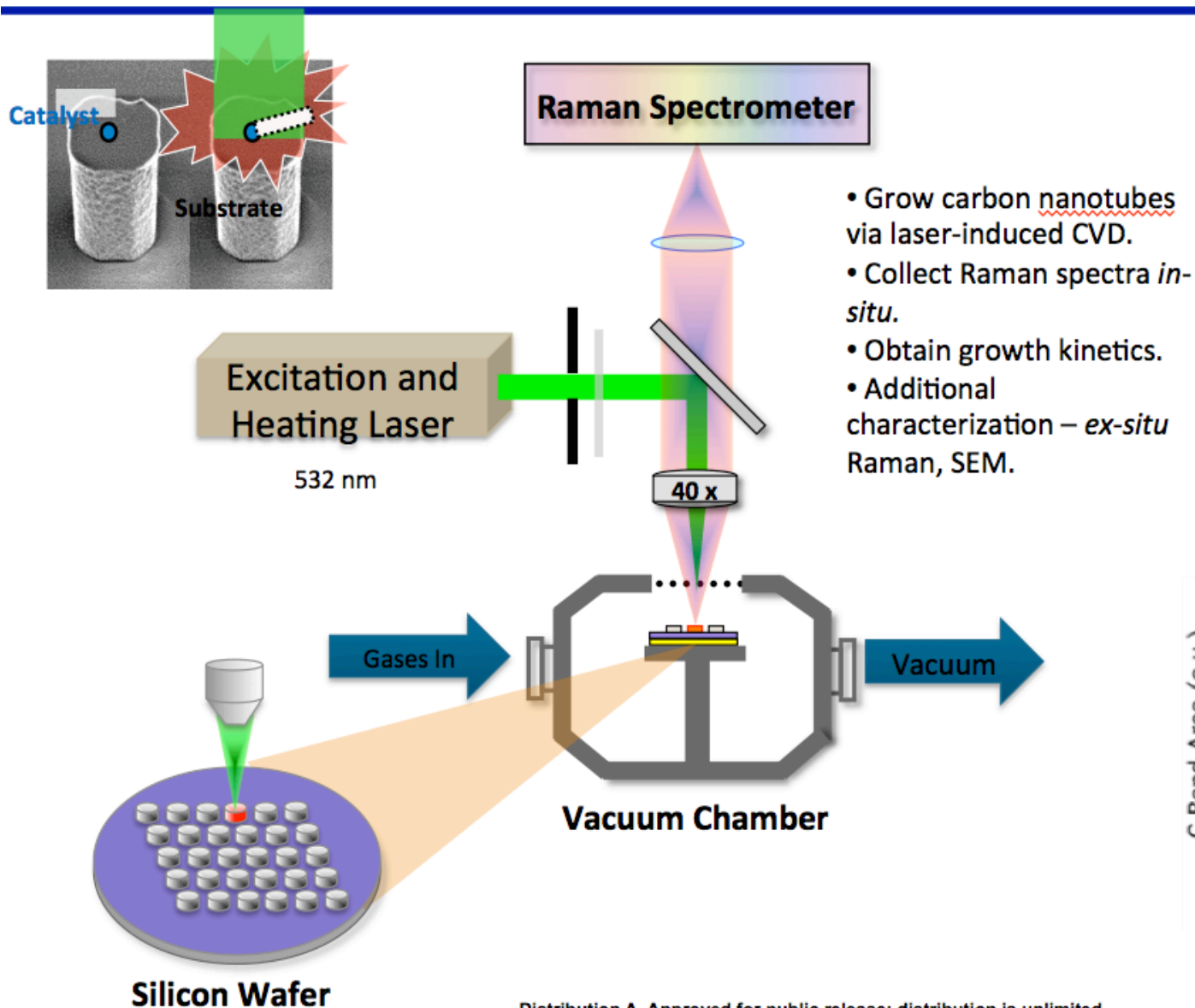
Pass/fail designs “early” in the process.

Reduce surprises in design manufacturability and performance.

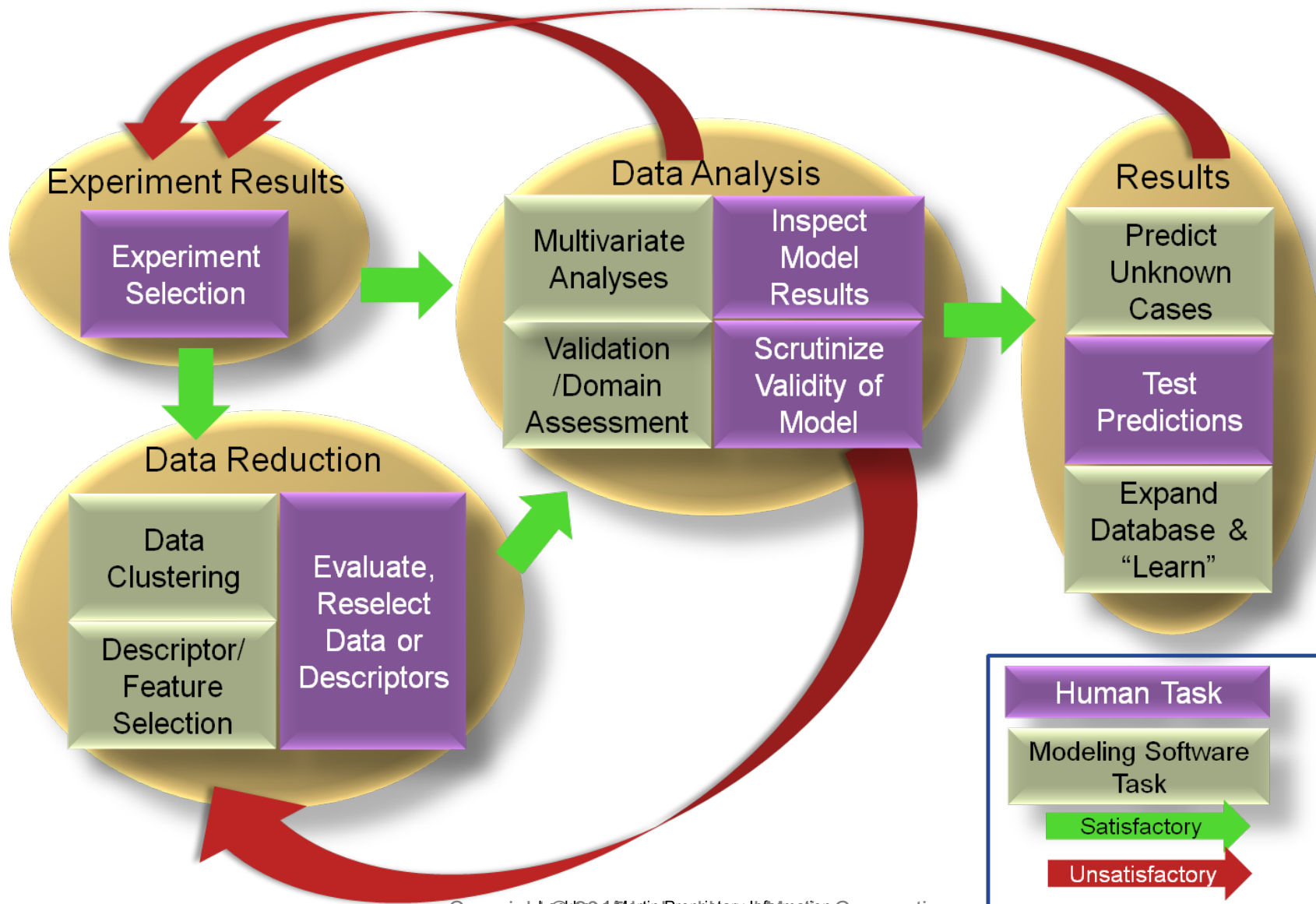
Autonomous Research Enables Rapid Exploration of Concept Space



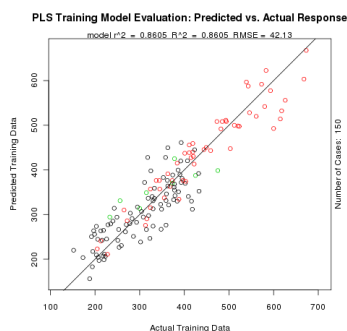
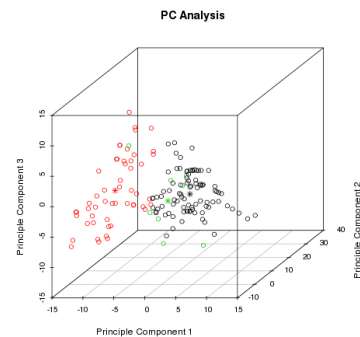
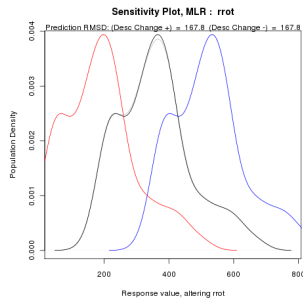
Adaptive Rapid Experimentation and in-situ Spectroscopy (ARES)



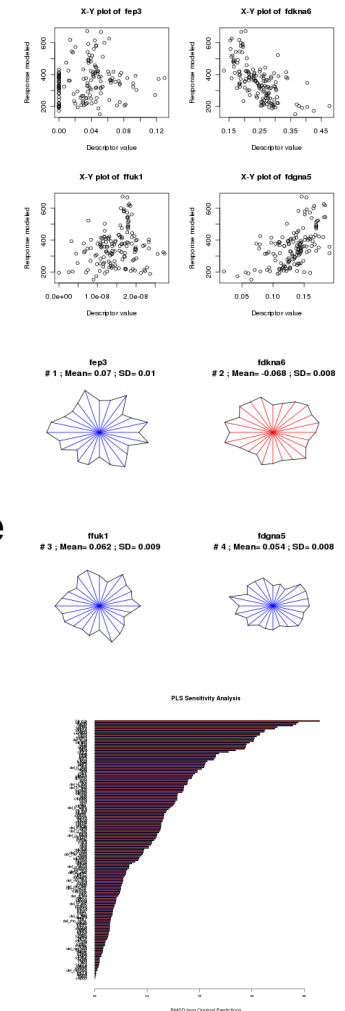
Informatics Methods Applied to Autonomous Research



Informatics Tool Developed by LM



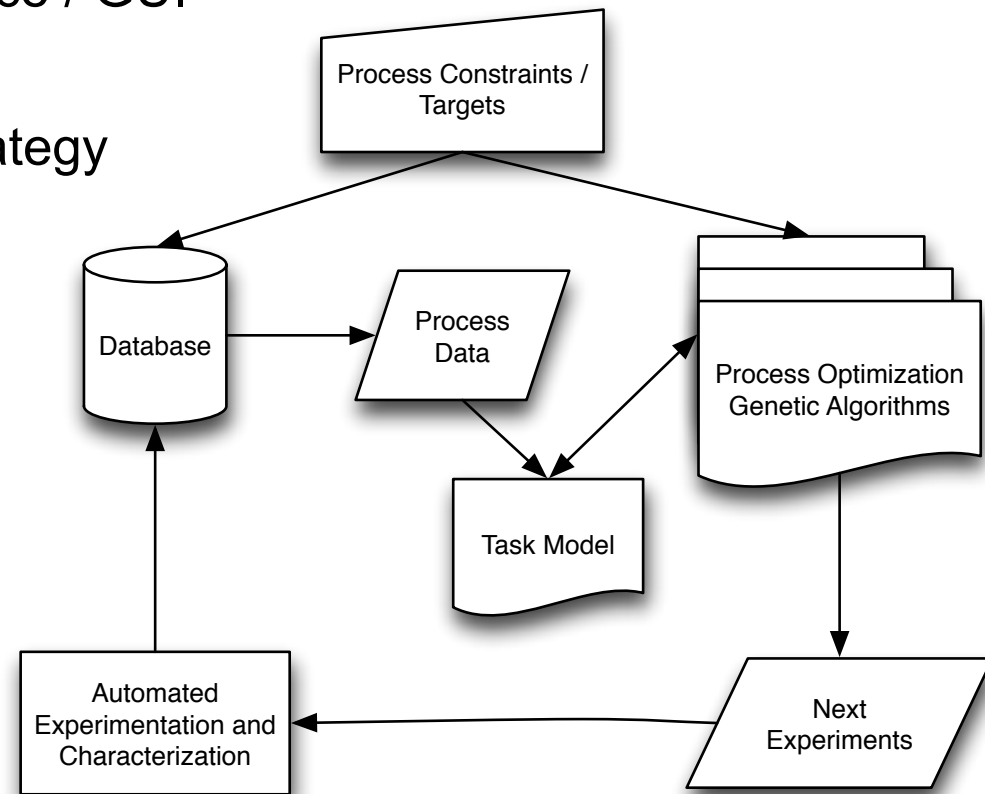
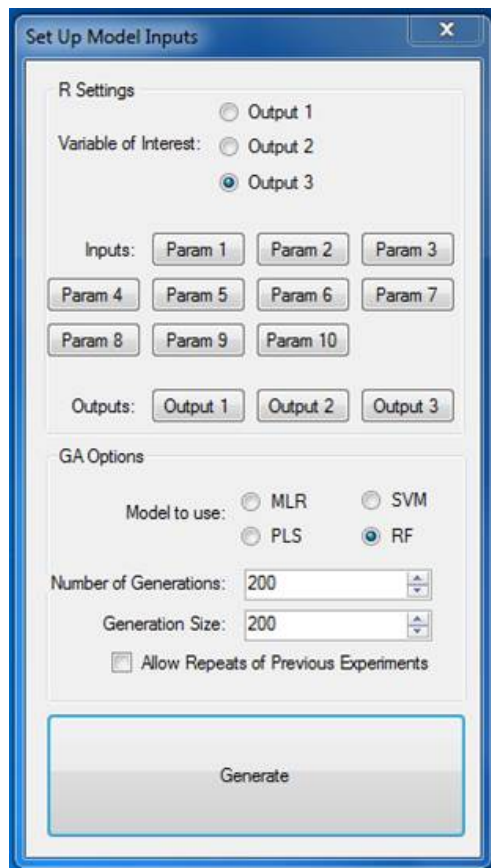
- The “Material Data – Mining, Modeling and Management (MD-M3)” Tool.
 - Analyzing trends in data sets, e.g. product performance and efficacy
 - Determining inter-measurement relationships and dependencies, data trends/analysis
- Has over 10 analysis algorithms that run in series or in parallel to predict results based on input numerical data, the next set of experiments (configurations)
- Significant visualization techniques to provide the user with insights that are not clearly apparent



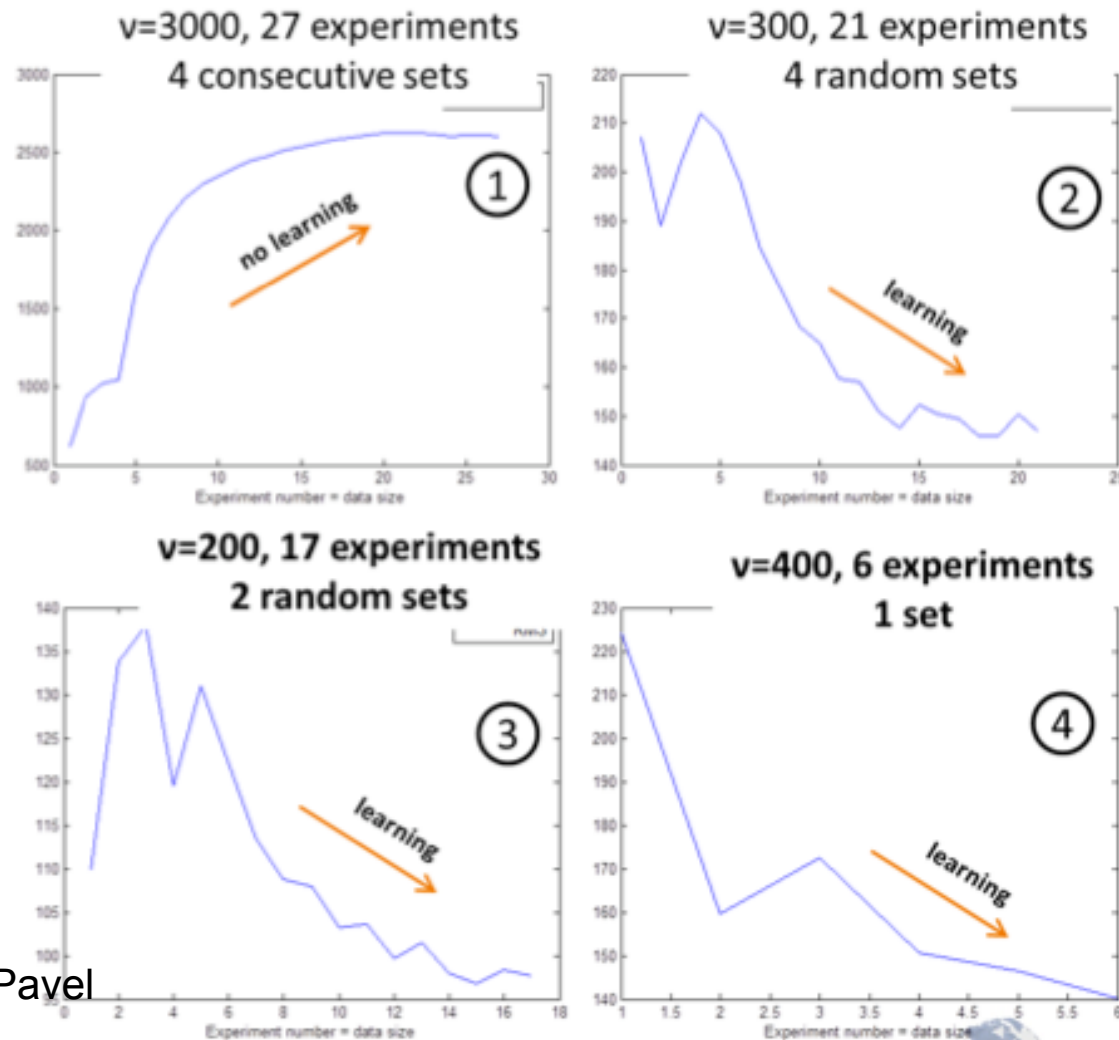
Saves time and money on development efforts by creating virtual configurations that focus future efforts more efficiently, enabling autonomy

Current Approach

- Integrate with ARES platform
 - Create Operational Interface / GUI
- Develop optimized models
 - Define an optimization strategy



LM MD-M3 / AFRL ARES Integration: 1st demonstrations of learning

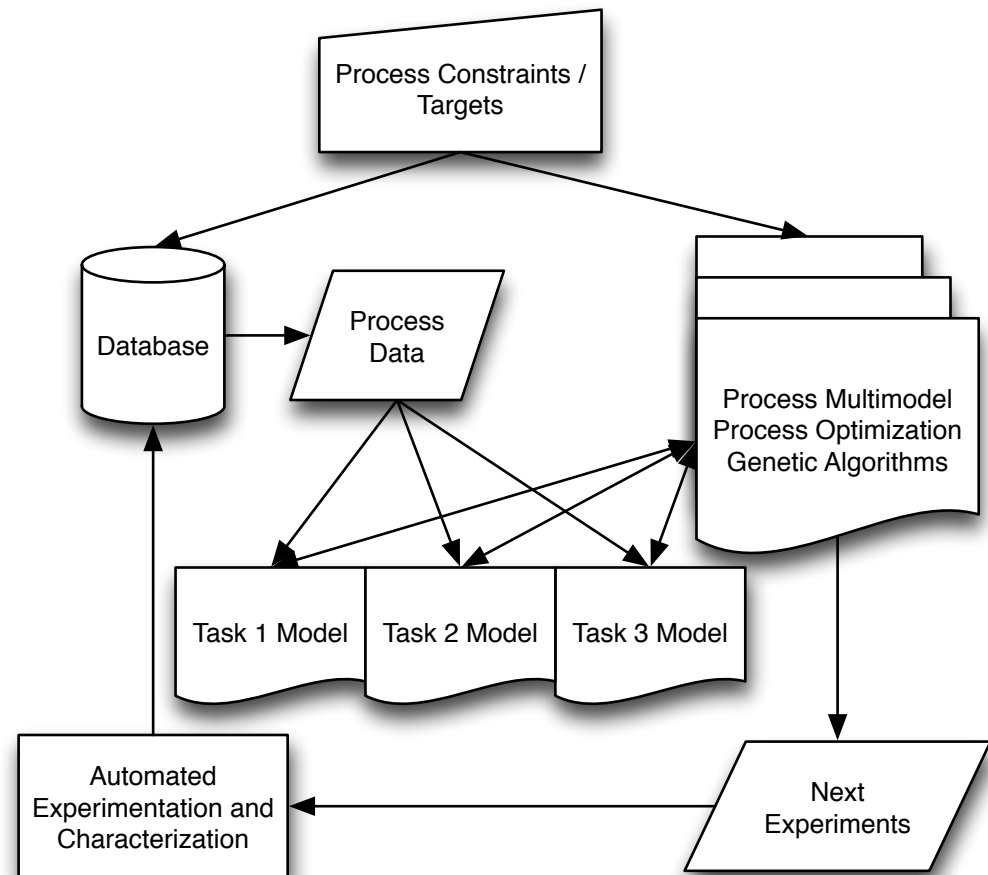
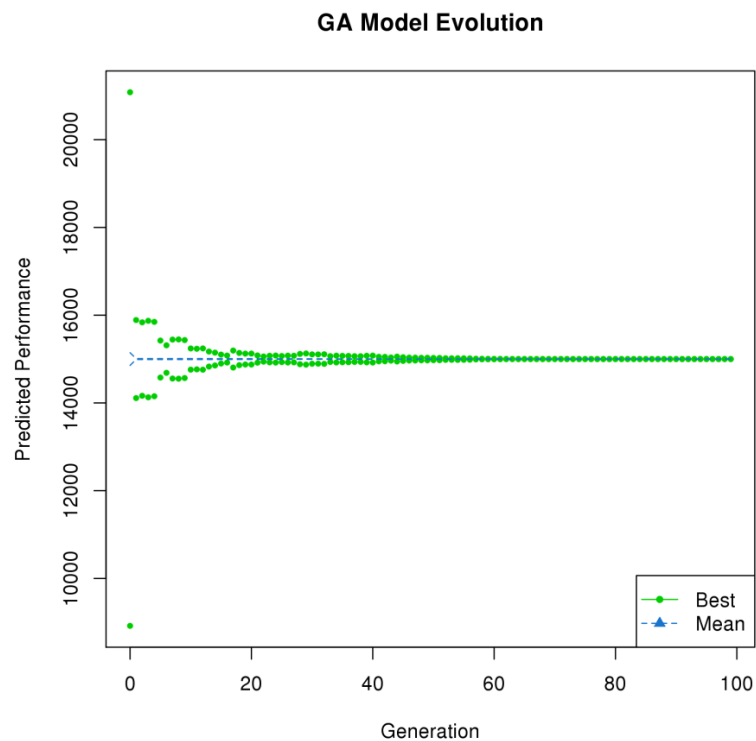


Graphic courtesy of Pavel
Nikolaev - AFRL

Autonomous Process-Structure-Property Navigation

Next Steps

- Improve model realism
- Tighter integration with experimental platforms



Thank you



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