

# Enterprise Infrastructure for Model-Based Design

Good to Great

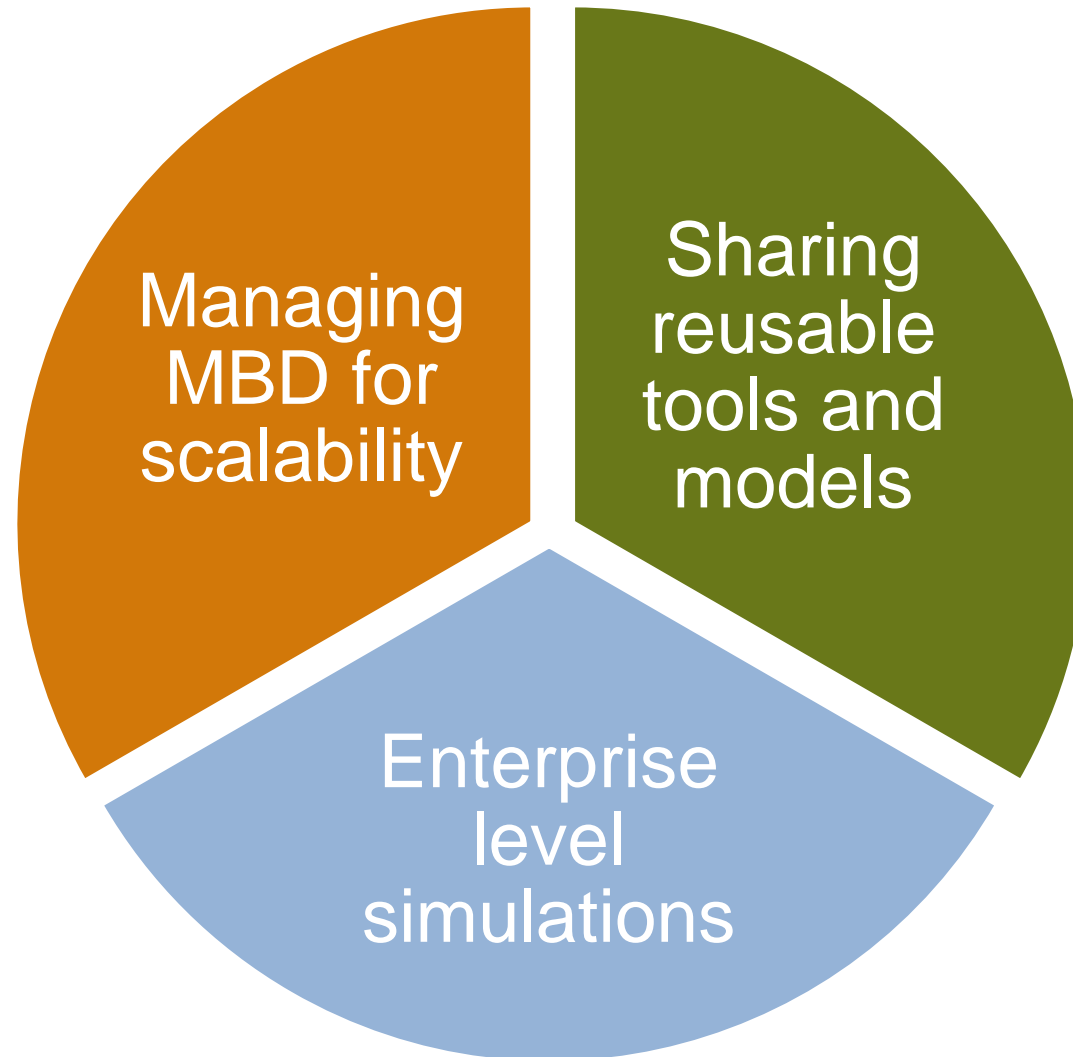
Dave Hoadley, PhD  
9 May 2017

# Opportunities of Enterprise-level Model-Based Design

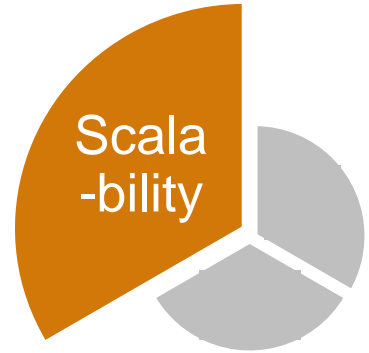
- Enabling scalability
  - Inter-team collaboration
  - Multi-component simulation
- Empowering reuse
  - Designing for reuse
  - Publishing
- Expanding simulations and analysis
  - Parallel
  - Distributed



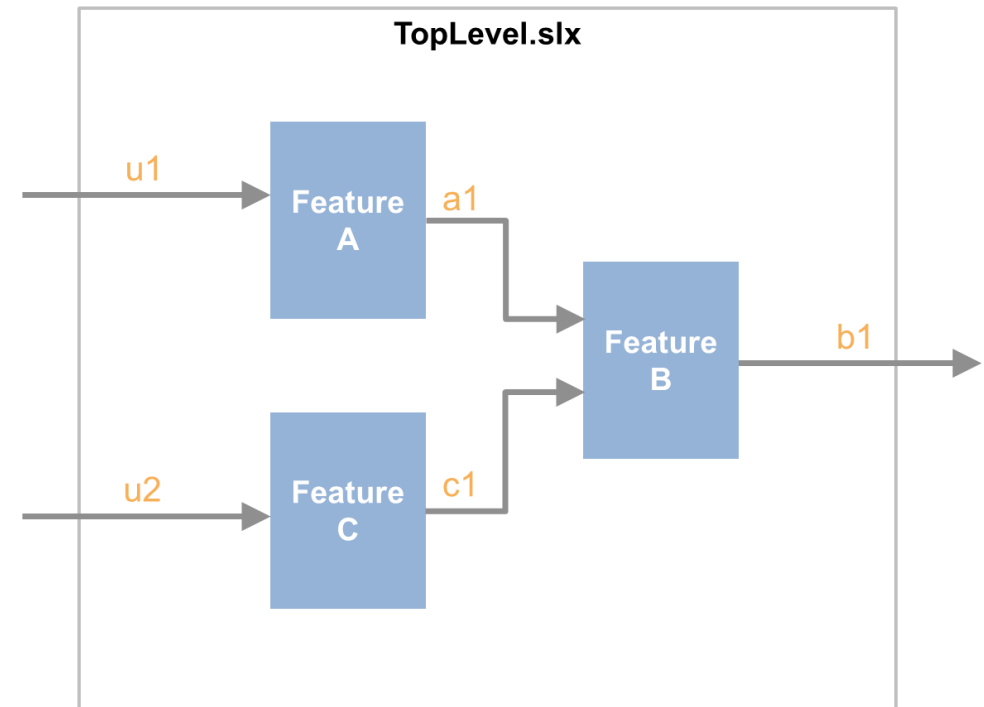
# Agenda



# Managing Model-Based Design for Scalability



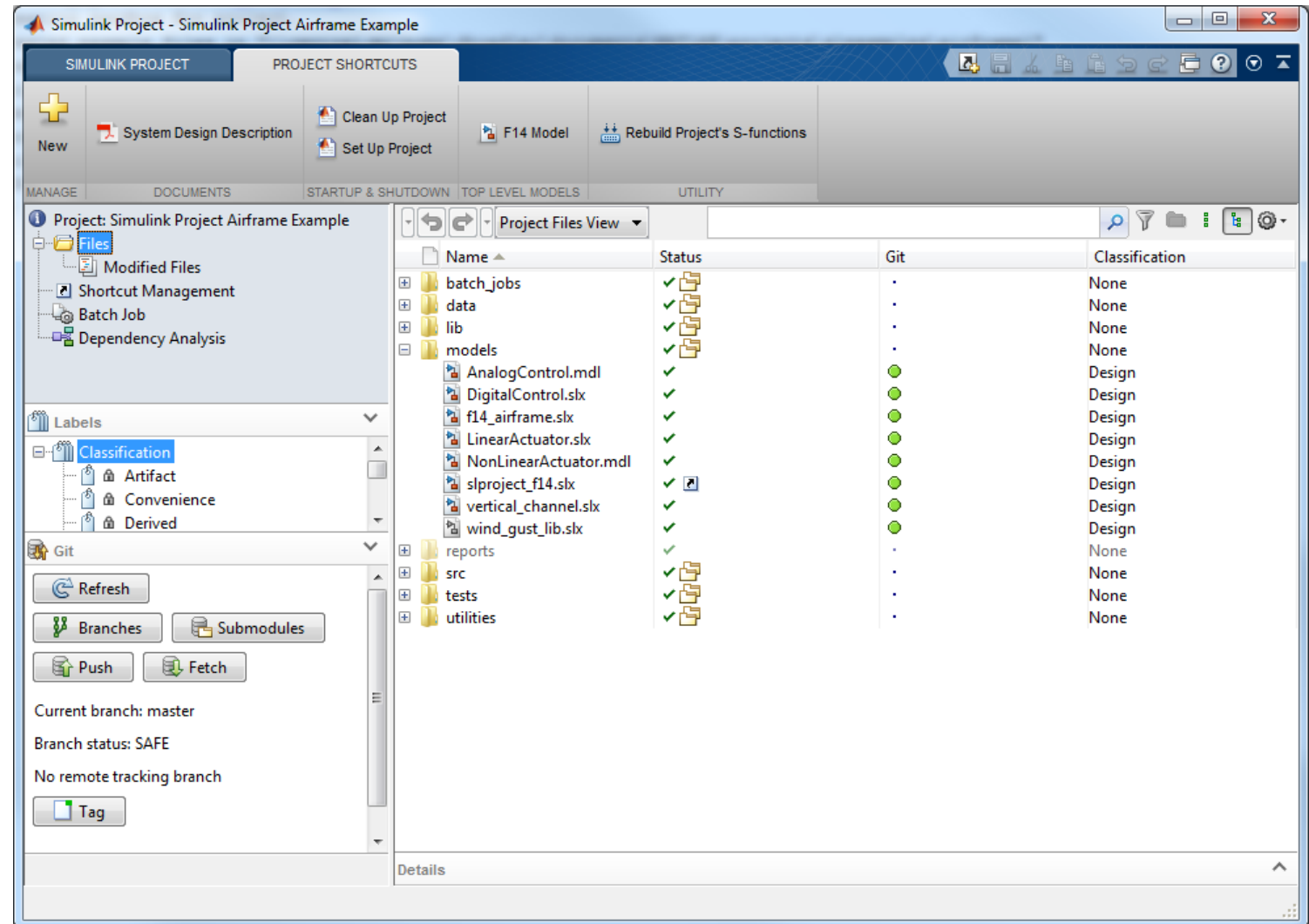
- Key to scalability is careful management
  - Model reference
  - Interface definition (buses, ARXML import)
  - Simulink Data Dictionaries
  - Simulink Projects
  - Configuration Management integration





# Simulink Projects for teams: Collaborate, automate, integrate

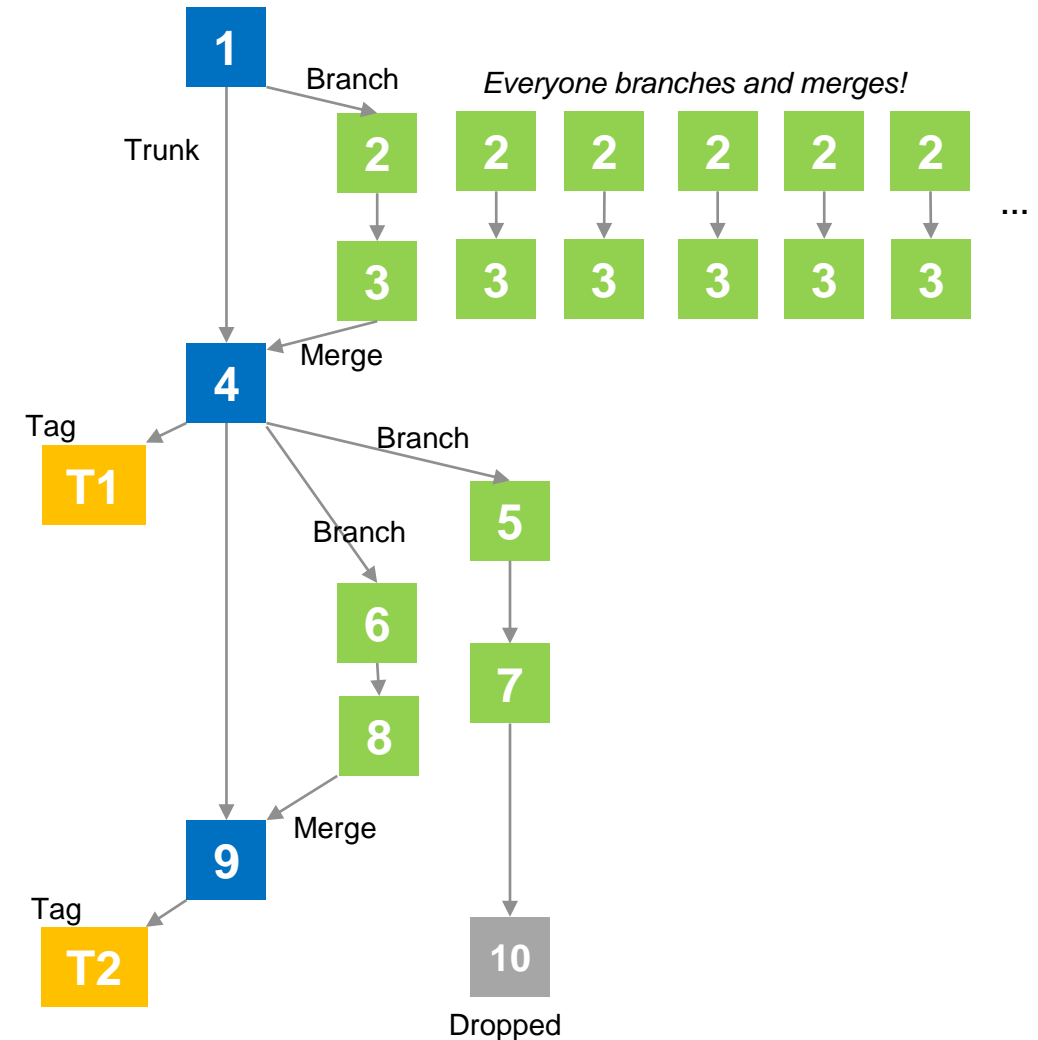
- Find and group files
- Standardize tasks
- Promote commonality with templates
- Label items for workflow support
- Share with SCM tools
- Project referencing for scalability



# Source Control Management example: Git



- Common SCM features
  - Shared location
  - All versions stored
  - Branches, labels, tags
- Git difference
  - Designed for distributed development
  - Favors branch & merge over fetch/lock/update
- For models, data dictionaries, .mat files this is tricky

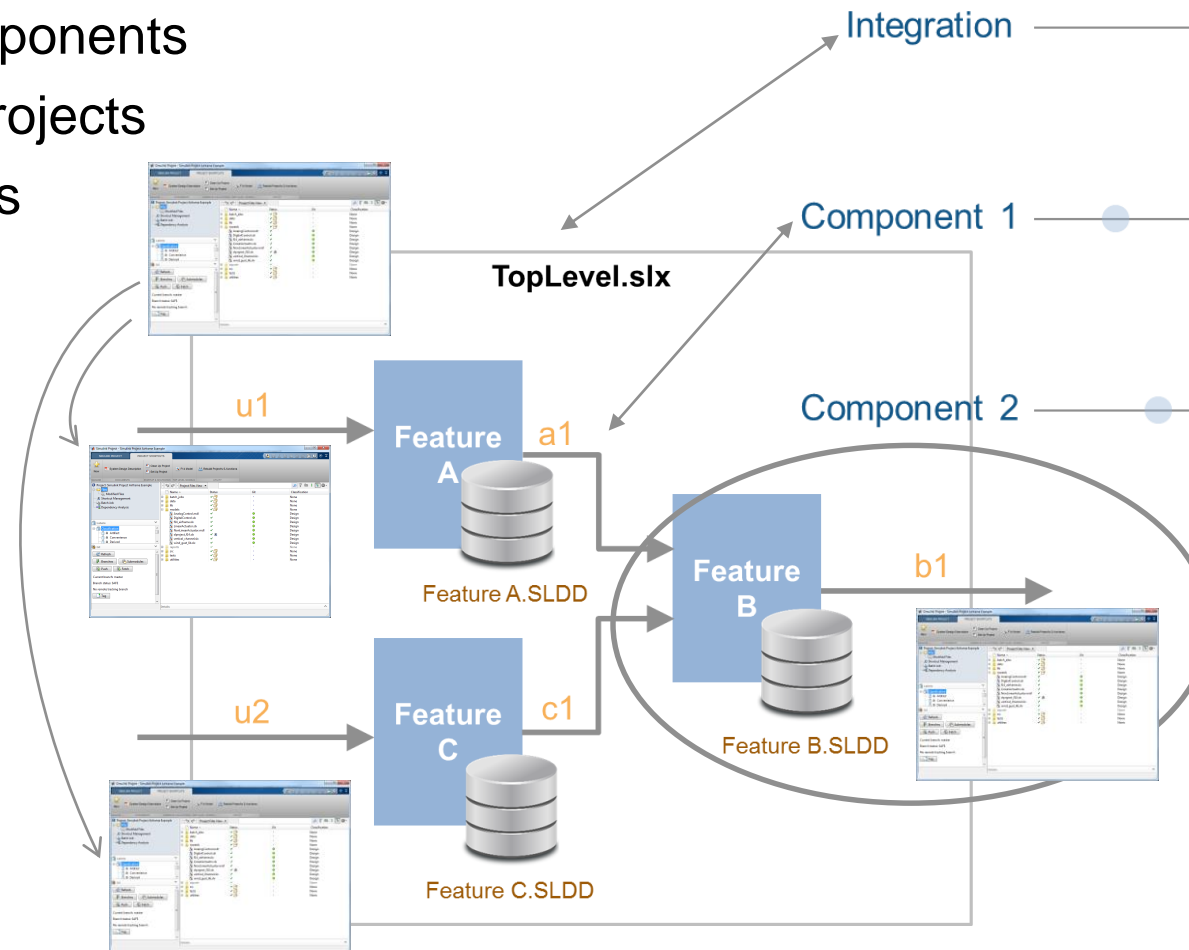


# Scalable component management strategy

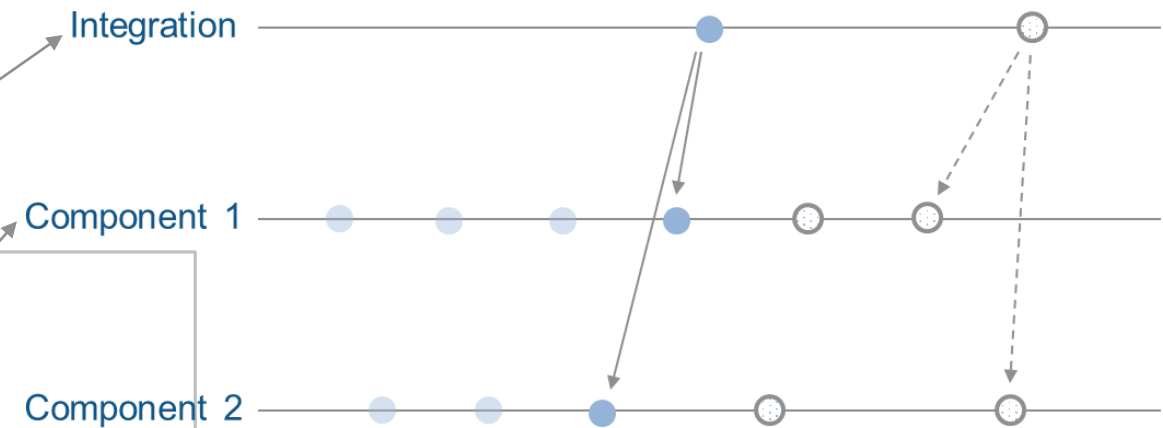


## ■ Align logical views of the system

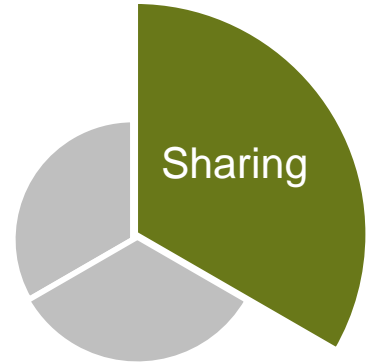
- Model components
- Simulink Projects
- Git modules
- Data



## Git submodule referencing



# Managing for reuse



- Challenges to reuse

- Location
  - Clarity
  - Status
- Simulink Projects, design templates, SCM integration
- Awareness
  - Interoperability
  - Trust
- ??

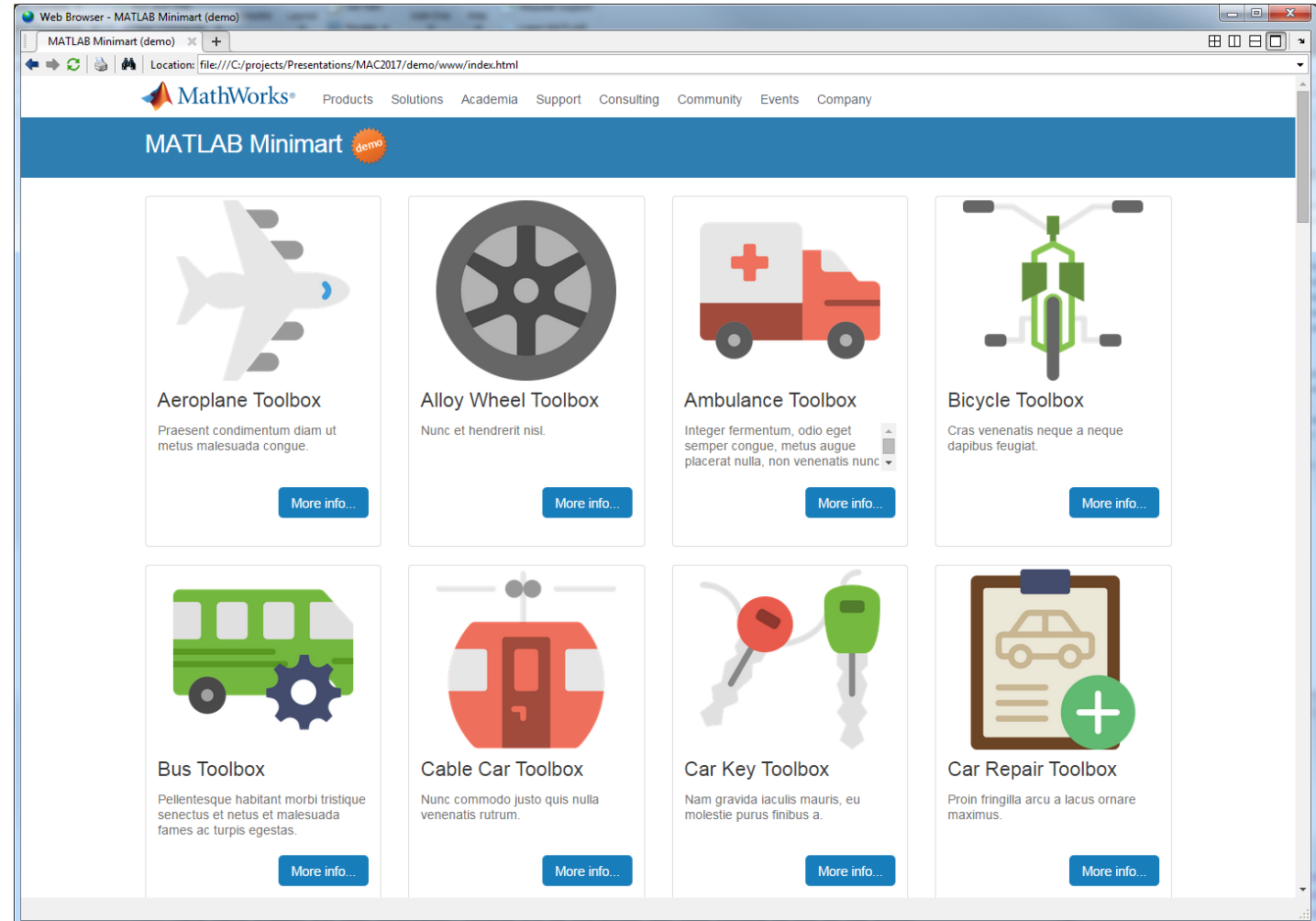
- Can we go further for sharing than just SCM?



# Challenge of discovery



- Discovering what?
  - Your own apps
  - Engineering data
  - Models
  - Automation tools
  - Templates
- MATLAB Minimart add-on
  - Package and publish
  - Download and install
  - Versioning
  - Compatibility



## Socializing this idea → MATLAB App Store



- Search/filter
- Scope
- Approval workflow
- Component interdependencies
- Ownership
- Download tracking
- Notifications
- User ratings
- Comments
- Recommendations



*You might also like ...*

# MATLAB Store at Jaguar Land Rover



- After 18 months
  - 100 internally authored apps and toolboxes
  - downloaded 6000 times
  - almost 1000 users
- Reduce duplication
- Encourage and recognize sharing
- Engineering productivity increased

**MATLAB Store**

Control Panel: Administrator Recommender

Pages: 1 2 3 4 5 6 7 8 9 10 11 Clear filters - Sort by: Title Add-ons per page: 10

**Vehicle Feedback XML Analyser Application** Version 1.0  
by Simulation Group  
This application is intended to import Vehicle Diagnostic Data (DTCs/DIDs) from various XML file formats from around the business  
1 rating ★★★★★ 0 comments - 4 tags 194 downloads

**Engineering Data Toolbox** Version 1.3.0 1.2.0 more ...  
by Simulation Group  
Toolbox providing importers for JLR engineering data files and a set of common data preparation methods. Type edtDoc to get started.  
3 ratings ★★★★★ 5 comments - 4 tags 144 downloads

**App Manager** Version 3.4 3.3 more ...  
by Mathworks  
Tool for managing installed apps and toolboxes  
3 ratings ★★★★★ 1 comment - 1 tag 162 downloads

The App Manager allows you to:

- Connect to a MATLAB Store, either local or in a SharePoint site
- Check for new versions of installed apps and toolboxes
- Check for app and toolbox recommendations
- Update and downgrade apps and toolboxes to a specified version

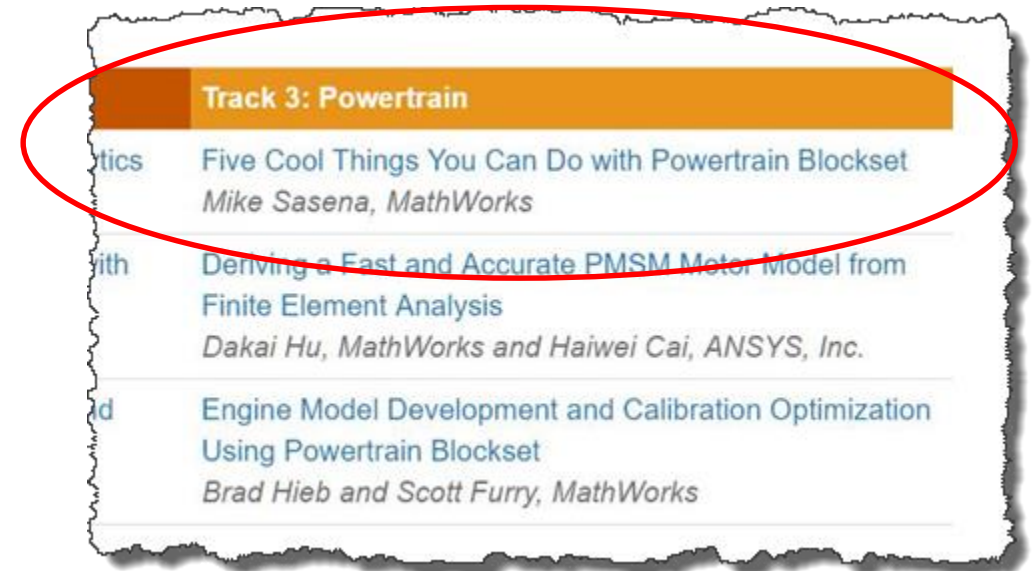
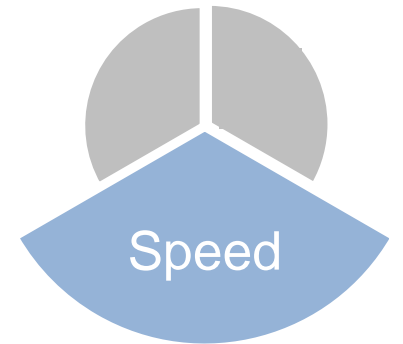
The App Manager uses MATLAB release compatibility information when suggesting and displaying add-on versions, if this information is provided by the store.

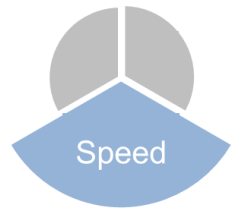
Owner

Packaged in: R2015a  
Uploaded: 2016-02-05  
Compatibility: Works with MATLAB from R2012b to R2015a  
Recommended as 'Latest Version' to:

# Challenge of growth of simulations and analysis

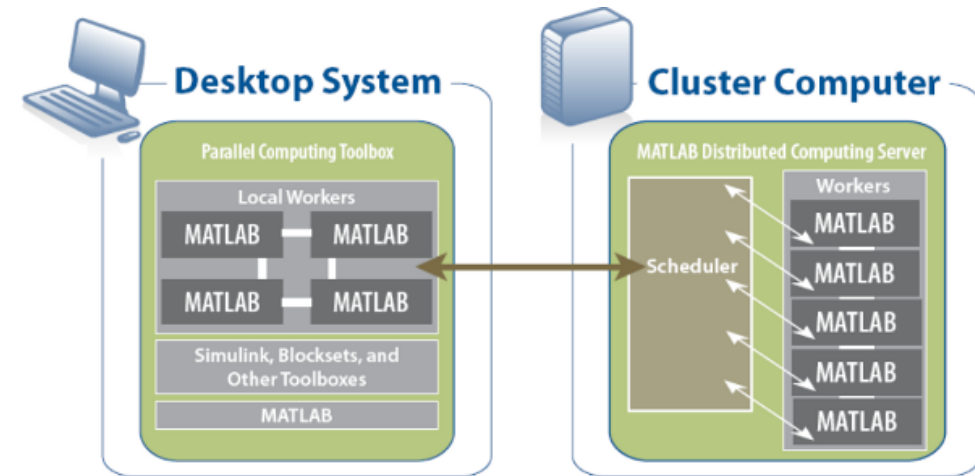
- Scope
  - component – subsystem – vehicle – fleet
- Types of tasks
  - Design of experiments
  - Controller/system optimization
  - Parameter sensitivity analysis
  - Training machine learning algorithms
  - System validation





# MathWorks solutions

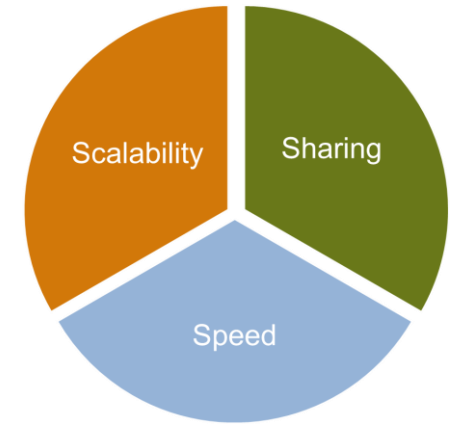
- Parallel Computing Toolbox
  - Multiprocessor/Multicore
  - GPU
- MATLAB Distributed Computing Server



	Track 1: Automated Driving	Track 2: Data Analytics	
2:30 p.m.	Introduction to Automated Driving System Toolbox <i>Mark Corless, MathWorks</i>	What's New in MATLAB for Engineering Data Analytics <i>Will Wilson, MathWorks</i>	T F M
3:05 p.m.	Deep Learning: New Tools for Algorithm Design and Validation <i>Arvind Jayaraman, MathWorks</i>	Building a Digital Twin of Your Vehicle Powertrain with MATLAB and Simulink <i>Arvind Hosagrahara, MathWorks</i>	D F D
3:40 p.m.	Case Study: Vision and Radar-Based Sensor Fusion <i>Seo-Wook Park, MathWorks</i>	Developing Prognostics Algorithms: Data-Based and Model-Based Approaches <i>Seth DeLand, MathWorks</i>	E U B

# Conclusion

- Optimize your adoption for enterprise
  - Scalability
  - Sharing
  - Speed
- Companies are improving in some dimensions
- Tackling all will lead to a world-class state





## For further information

- Large scale modeling

<https://www.mathworks.com/help/simulink/large-scale-modeling.html>

- Git integration

<https://www.mathworks.com/help/simulink/examples/using-a-simulink-project-with-git.html>

- Jaguar Land Rover User Story

[https://www.mathworks.com/company/user\\_stories/jaguar-land-rover-standardizes-on-matlab-for-developing-packaging-and-sharing-engineering-tools.html](https://www.mathworks.com/company/user_stories/jaguar-land-rover-standardizes-on-matlab-for-developing-packaging-and-sharing-engineering-tools.html)

- MATLAB Distributed Computing Server

<https://www.mathworks.com/products/distriben.html>

- Amazon EC2 early adopter program

<https://www.mathworks.com/campaigns/products/offer/mdcs-cloud.html>