How to build a website powered by MATLAB

David Willingham
Senior Application Engineer – Data Analytics
Case Study – Mining Economics

forecasting the profitability & financial risk of a mine
Case Study - Background

- **Business Issues**
  - An analyst has developed the forecasting models
  - Only he/she can run it
  - Turn around for simulating scenarios is slow
  - IP is lost if the analyst leaves
  - Concern about manual re-coding for deployment
  - Needs to be quick

- **Business Solution**
  - Automatically deploy the models to the web with MATLAB Compiler products
  - Other users can now interact and run various scenarios
  - From any laptop/PC or mobile device, instantly
  - IP will exist long after the analyst has developed it
  - No recoding of models necessary
Share Programs Outside of MATLAB

Deploy your MATLAB code to people who don’t need MATLAB
Benefits of Deploying MATLAB Code

- Domain experts maintain ownership of ideas, algorithms, and applications
- Flexibility to integrate with different programming languages
- Implement a common algorithm on different platforms
- Avoid time consuming and error prone re-coding
- Easily adopt algorithm improvements throughout lifecycle
A Primer on Sharing MATLAB Programs

- Royalty-free
- Encryption to protect intellectual property
The Range of Application Platforms

- **Standalone Applications**
- **Web and Enterprise Applications**

| Scale of Distribution | Application Complexity | Enterprise Integration |
Which Product will Fit Your Needs?

**MATLAB Compiler** for sharing MATLAB programs without integration programming

**MATLAB Compiler SDK** provides implementation and platform flexibility for software developers

**MATLAB Production Server** provides the most efficient development path for secure and scalable web and enterprise applications
Using MATLAB Compiler

Compiled applications can be shared as:
- Standalone desktop applications
- Add-ins for integration with Microsoft Excel® spreadsheets
- Components that run MATLAB code against Hadoop

Create professional software with customizable installers, icons, and splash screens … without integration programming
Sharing Standalone Applications

1. Application Author

2. MATLAB Compiler

3. End User

MATLAB
Toolboxes

1. MATLAB Application

2. Standalone Application, Excel Add-in, Hadoop

3. MATLAB Runtime

Application Author

End User
Using MATLAB Compiler SDK

Flexible toolkit for software developers

- Integrate with applications written in C/C++, .NET, Java
- Develop applications for MATLAB Production Server

Develop a custom application server or deploy with MATLAB Production Server
Integrating MATLAB-based Components

Application Author

MATLAB
Toolboxes

MATLAB Compiler SDK

C/C++, Java, .NET, MATLAB Production Server

Software Developer

Application author and software developer *might* be same person
Scale up with MATLAB Production Server

Most efficient path for creating enterprise applications

Deploy MATLAB programs into production
- Manage multiple MATLAB programs and versions
- Update programs without server restarts
- Reliably service large numbers of concurrent requests

Integrate with web, database, and application servers
Enterprise Use Case Workflow

**Analytics developers**  
*MATLAB + toolboxes*

**Centralized Analytics Server**  
*MATLAB Production Server*

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**Compiled Server Based Analytics**

- **Request Broker & Program Manager**
- **Java**
- **NET**

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**End Users**  
*Royalty Free Deployment*

- **Real Time Dashboards**
- **Dynamic Reporting**
- **Graphical Analysis**
- **Desktop Apps**
- **Web Front Ends**

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**Database**

**SAP**  
**P2P**  
**PI**

**Other Sources**

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**Visualizations**

**Analytics**

**Statistics**

**Reporting**

**Data Combining**

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**Analytics developers**  
*MATLAB + toolboxes*
Website deployment – Hello World

- Two Hello World Examples:
  1. Output a matrix
  2. Output a MATLAB figure
Case Study – Mining Economics

- **Inputs**
  - Table of Mining Production Values
  - Type of model
  - Number of Simulations

- **Outputs**
  - Monte Carlo Simulation of Iron Ore Price Forecast
    - With MATLAB Figures
  - Net Present Value Cashflow and Risk profile
    - With 3rd party interactive web charts
MATLAB Application Deployment

- Share MATLAB programs with people who do not have MATLAB
  - Royalty-free distribution
  - Encryption to protect your IP

- Create both standalone applications and components for integration

- Deploy to desktop, web, and enterprise applications
Learn more …

Product and Solutions home pages


Other useful links

- [http://www.mathworks.com/examples/](http://www.mathworks.com/examples/)
Thank you

Customer stories and supplemental information on following slides
Customer Stories
UniCredit Bank Austria Develops and Rapidly Deploys a Consistent, Enterprise-Wide Market Data Engine

**Challenge**
Improve risk management operations throughout a multinational financial institution

**Solution**
Use MATLAB, MATLAB Compiler, and MATLAB Compiler SDK to build and rapidly deploy a consistent enterprise-wide data warehouse into J2EE Web Architecture

**Results**
- Development time reduced by 50%
- Risk management improved across the bank
- Operational, audit, and maintenance costs reduced

“With MATLAB, we can focus on business logic instead of implementation details. We can deploy an algorithm in a Java environment the same day, without any additional coding. This approach enabled us to cut our development time in half, if not more weeks, instead of months.”

Peter W. Schweighofer
UniCredit Bank Austria
A2A Develops Comprehensive Risk Management Solution for Energy Markets

Challenge
Manage and mitigate risk across markets in a large utility company

Solution
Use MATLAB and companion toolboxes to process data, develop risk and pricing models, and deploy an interactive dashboard for analysts

Results
- Hour-long calculations completed in 30 seconds
- Development time halved
- Pricing model development accelerated

“When you deal with numbers all day and work with sophisticated analytical models, having an integrated environment is invaluable. With MATLAB we visualize data, conduct back-testing, and plot graphs to see the results of changes we make, all in one environment, and that saves time.”

Simone Visonà  
A2A
Commerzbank Develops Production Software System for Calculating Derived Market Data

Challenge
Compute a variety of derived market data from raw market data

Solution
Use MATLAB to read data from a data management system in a Windows and Linux architecture, perform analyses and optimizations, visualize results, and deploy mission-critical calculations

Results
- Integration with existing system simplified
- Implementation time reduced by months
- Updates made in days, not weeks

“Our solution required a Windows client and Linux server software. We used MATLAB to rapidly develop both by taking advantage of distributed computing, a MEX-file interface to access our financial data, and fast, built-in functions for optimization, regression, and more.”

Julian Zenglein
Commerzbank

Link to user story
Fulcrum Asset Management Develops Custom Quantitative Risk Management System

Challenge
Develop an accurate, scalable, and fast risk engine for fund management

Solution
Use MATLAB to import financial data from multiple sources, develop sophisticated risk models, and run optimizations and scenarios analysis on multicore processors

Results
- Optimizations and calculations accelerated
- Risk measurement accuracy improved
- Integration with databases and datafeeds streamlined

“With MATLAB we developed a risk management system that helps us implement our strategies, hedge our risks more efficiently, and respond rapidly to changes in the market. MATLAB enables us to incorporate our ongoing research and the experience of our fund managers into the risk engine.”

Athanasios Bolmatis
Fulcrum
Microtech Develops and Tests Implantable Blood Pressure Sensor

Challenge
Create and test an implantable blood pressure sensor

Solution
Use MATLAB to develop algorithms for generating and analyzing ultrasound waves, create standalone analysis software, and control lab equipment for automated testing

Results
- Development time halved
- Hardware updates streamlined
- Productivity increased by 20%

“Using MATLAB to develop both real-time ultrasound signal processing algorithms and automated measurement software eliminates the need for a dedicated C/C++ programmer as well as the risk of introducing bugs when the algorithm is rewritten.”

Dr. Yonathan Kozlovsky
Microtech

Link to user story
Halliburton Makes Oil Exploration Safer Using MATLAB and Neural Network Toolbox

**Challenge**
To improve the ability to detect detonation of explosives used to perforate the well bore

**Solution**
Use MathWorks products to develop an adaptive, predictive neural network filter that cleanses the detonation signal of contaminating noise from onsite machinery

**Results**
- Authentic simulation on the desktop
- An accurate, production-standard algorithm
- Dramatic time savings

“Using MATLAB and MATLAB Compiler, I can develop an application at least 100 times faster than I could with Visual Basic or C. The time we saved on the very first application that we wrote in MATLAB more than paid for the software.”

Roger Schultz
Halliburton Energy Services

[Link to user story]
STIWA Increases Total Production Output of Automation Machinery

Challenge
Apply sophisticated mathematical methods to optimize automation machinery and increase total production output

Solution
Use AMS ZPoint-CI to collect large production data sets in near real time and use MATLAB to analyze the data and identify optimal trajectories

Results
- Total cycle time reduced by 30%
- Large data sets analyzed in seconds
- Deployment to multiple machines streamlined

“Our shopfloor management system AMS ZPoint-CI collects a huge amount of machine, process, and product data 24 hours a day. By analyzing this data immediately in MATLAB and AMS Analysis-CI we have achieved a tenfold increase in precision, a 30% reduction in total cycle time, and a significant increase in production output.”

Alexander Meisinger
STIWA
Ruukki Metals Improves Steel Manufacturing Processes with Standalone and Web-Based MATLAB Applications

Challenge
Enable operators to correctly set up steel coil processing lines in the manufacturing plant.

Solution
Build applications in MATLAB that enables operators to select and apply the proper settings, analyze production metrics from multiple databases, track individual coils, and refine the process.

Results
- Off-gauge coil length reduced from several meters to less than 50 centimeters
- Process efficiency increased
- Waste reduced

“Since deploying this application and the standalone executable that we created with MATLAB and MATLAB Compiler, we have seen fewer misalignments, less scrap, and significant increases in efficiency and consistency at the plant.”

Mika Judin
Ruukki Metals

Link to article
Supplemental Material
Typical Workflows for Coder and Compiler

**Technical Computing: MATLAB Compiler process**

Quants, researchers, scientists, engineers …

… use MATLAB algorithms, graphics, and UI’s …

… to create a software application …

… used by a person.

**Model-based Design: MATLAB Coder process**

Algorithm or embedded engineers …

… generate C code from MATLAB algorithms …

… to create prototypes for system simulations…

… eventually integrated in a machine.

NOTE - Several images come from Google. Need legit source.
Advising on Deployment or Code Generation

- MATLAB Compiler
- MATLAB Compiler SDK
- MATLAB Runtime
- MATLAB

MATLAB products
- C/C++ (.c, .cpp)
- Integrate algorithms with custom software
- Prototype algorithms on PC’s
- Accelerate algorithm execution
- Implement algorithms on embedded processors
# MATLAB Compiler SDK and MATLAB Coder

<table>
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<th>Feature</th>
<th>MATLAB Compiler SDK</th>
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<td>Output</td>
<td>Software components</td>
<td>Portable and readable C source code</td>
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<td>MATLAB language support</td>
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Options for Web/Enterprise Application Servers

MATLAB Compiler SDK gives you the flexibility to create your own application server infrastructure or deploy using MATLAB Production Server.
Production Deployment Workflow

Development

MATLAB Developer

Initial Test Application

Verify data handling and initial behavior

MATLAB Algorithm

Debug Algorithm

New in R2015a

MATLAB Compiler SDK

Deployable Archive

Enterprise Application Developer

Web Application

Client Library

Function Call

MATLAB Production Server

Production

MATLAB Production Server

Function Calls

Deployable Archives

Web Application

Client Library
Typical Process for Standalone Applications

1.) Create MATLAB algorithms
2.) Define the user interface
3.) Package the application using MATLAB Compiler
4.) Give the application installer to someone

They will install the application … and run it on their desktop
Typical Process for Integrated Applications

1.) Create MATLAB algorithms
2.) Package component libraries using MATLAB Compiler SDK
3.) Use an external development environment to develop integrated application, including user interface
4.) Give the final application to someone

They will install the application on desktops or servers … for their own use or for use by others
Customizations for your Applications

- Metadata
- Graphics for splash screen
- Icons
- Installed applications accessible from Windows Start menu and Add/Remove Programs
- Graphics for installer
End Customer sees a Professional Application

Installer

Application in Start menu

Splash Screen

Icon
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