Latest trends in control system development using the model-based development (MBD) method and activity of Skill Management Association

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Working Coordination Group Co-Chairman,
Skills Management Association
Contents

- What is model-based development?
- Model-Based Development Phases and Tools
- Applications for the Energy Control Field
- Definition and Education of the Required Skills for Model-Based Development Engineers
- Summary
In embedded software development, software design, implementation, and testing make up more than 50% of all man-hours.

Approximately half of R&D costs are taken up by software development.

**Current Situation of Embedded Software Development**

![Pie chart showing the distribution of man-hours and costs in embedded software development.](image)

- **System Design** 4.2%
- **Software Design** 20.1%
- **Software Implementation/Test** 34.7%
- **System Test** 10.7%
- **Hardware Test** 5.1%
- **Hardware Design** 5.4%
- **Others** 19.8%

**Development Cost of Embedded Software Products**

- Development Cost of Software 49.0%
- Development Cost of Hardware (Machine Systems) 10.4%
- Development Cost of Hardware (Electrical Systems) 14.4%
- Development Costs not related to Embedded software products 21.5%
- Other Development Costs of Embedded related products 4.6%

2009 Ministry of Economy, Trade and Industry
Function Logic Code

```
Int16 x1, x2, y;
   /* declaration */
Int32 dummy;
   dummy = (Int32)x1 + (Int32)x2;  /* addition */
   if (dummy > 32767)  /* saturation */
       y = 32767;
   else if (dummy < -32768)
       y = -32768;
   else
       y = (Int16)dummy;
```

Function Logic Specifications

Function Name  Control
Input  a: Integer  b: Float
Output  c: Integer

Calculates according to the given inputs a and b and outputs the result.

\[ c = a \times 12.3 + b/256 \]

Reviewing of Software Specifications, Brainstorming

Testing, Instrumentation, Calibrations with Real Machines

By improving on conventional processes, can cost reduction be achieved?
Model-Based Development Flow

How can you design or carry out testing without using controllers or actual controllable machines?

Express the Function Logic and Controlled Object using a Formula. ⇒ Modeling
Calculate in virtual space. ⇒ Simulation

A method in which controller developments are efficiently carried out using models developed using modeling and simulations.

Model Based Development (MBD: Model Based Development)
Establishing Control Design using Matlab®/Simulink

Utilizing models which actually operate as per the specifications
V Cycle in Model-Based Development

Full utilization of models throughout entire V cycle ⇒ Planning the reduction of man-hours and shortening of the development period

Verifications using prototype hardware are performed, starting with model based design and continuing through verifications of system design on the computer. In addition mass production codes are generated based on models, and models are passed to simulations which perform system verifications.
Model-Based Development Phases and Tools
Relationship between Models and Real Machines in MBD

MBD: Model Based Development
RCP: Rapid Control Prototype
ACG: Automatic Code Generation
HIL: Hardware In the Loop
Implementing function logic in a real time environment

1. Replacing of input/output in Simulink controller model with RTI block set.

2. Downloading to general purpose controller using Real-time Workshop and compiler for dSPACE.

Execution of Control
Parameter Tuning in ControlDesk

Accessible to all Simulink block variables
Rapid Control Prototyping

- Control Design/Analysis
- Real time Test
- I/O Library
- RTI Implementation
- Monitoring, Tuning
- Modeling/Simulation

Instantly materializing functional evaluation of controller model → Cost reduction/Shortening of time period
- No need for experimental production of circuits
- No need for creation of programs (including I/O programing)
- Monitoring of status variables, Changing of parameters, Tuning
Automatic Generation of Mass Production Code

System Design

Control Design

Calibration & Measurement

RCP

HIL

ACG

Model

Model

Model

Real Machine

Model

Actual ECU

Int16 x1, x2, y;
/* declaration */
Int32 dummy;
dummy = (Int32)x1 + (Int32)x2;
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if (dummy > 32767)
/* saturation */
y = 32767;
else if (dummy < -32768)
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else
y = (Int16)dummy;
Data Transfer between Processes Using Specifications

Controller Model

Creating Simulink models of controlled objects and function logic
Verification of logic using simulations

Function Designer

Function Specification
Function Name: Control
Input: a: Integer, b: Float
Output: c: Integer

Calculates according to the given inputs a and b and outputs the result.

\[ c = a \times 12.3 + \frac{b}{256} \]

Function Logic Specifications

Source Code

Software Engineer

Creating of ECU code based on the specifications
Verifying that ECU code works as required in specifications

Controller Model
Utilizing Models as the Specifications

Function Logic Development

- Control Model = Specifications
- Automated Conversion
- TargetLink Block
- Code Generation
- Mass Production C Code

Rapid Prototype Controller

- Models become control specifications.
- Clear goal setting such as creation of programs which carry out the same calculations as control models

Development period shortened and improved quality of software achieved

```c
Int16 x1, x2, y;
declaration /*
Int32 dummy;
dummy = (Int32)x1 + (Int32)x2;
/* addition */
if (dummy > 32767) /* saturation */
y = 32767;
else if (dummy < -32768)
y = -32768;
else
y = (Int16)dummy;
```
# Code Efficiency

## Delphi, 2002

<table>
<thead>
<tr>
<th>ROM</th>
<th>RAM</th>
<th>Stack</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.96 – 1.1</td>
<td>0.97 – 1.2</td>
<td>1.2 – 1.25</td>
<td>0.75 – 1.2</td>
</tr>
</tbody>
</table>

Auto generated code is more efficient than hand code.

Source: Lev Vitkin, Delphi, USA

## German Tier-1 Supplier, February 2006:

<table>
<thead>
<tr>
<th>ROM [bytes]</th>
<th>RAM [bytes]</th>
<th>Run time [msec]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Code</td>
<td>TargetLink</td>
<td>Manual Code</td>
</tr>
<tr>
<td>2182 (100%)</td>
<td>88,5%</td>
<td>2,27 (100%)</td>
</tr>
<tr>
<td>104 (100%)</td>
<td>97,1%</td>
<td></td>
</tr>
</tbody>
</table>

![Bar chart comparing ROM, RAM, and Run time for Manual Code and TargetLink]
Verification using 3 kinds of Simulation Modes


Model-in-the-Loop
- Controller model

Software-in-the-Loop
- C Code on Host-PC

Processor-in-the-Loop
- C Code on target μC

Plant model or stimuli

Model Verification
- Effectiveness of Algorithm
- Preparation for Scaling
- Estimate of Overflow Possibility

Software Verification
- Influence of Quantization Errors
- Assurance of Model Behavior
- Determination of Implementation Option

Target Verification
- Compiler Test
- Measurement of Runtime
- Measurement of Stack Size
- Measurement of RAM/ROM
Verifying of ECU using Simulator

Control Design

System Design

Calibration & Measurement

RCP

HIL

ACG

MATLAB

Model

Model

Model

Real Machine

Model

Model

Model

Actual ECU

Model

Int16 x1, x2, y;
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else
y = (Int16)dummy;
What is HILS (Hardware In the Loop Simulator)?

- Arithmetic Unit which simulates controlled object (plant) in real time
- I/O Interface with ECU and Bus System
Merit of HILS

Although HILS can not completely replace a test using prototype vehicles...

✔ No Real Machine
  Tests can be carried out even in situations in which there are no real machines. No need to secure test courses or drivers.

✔ Automatic Test
  Stylized tests, such as OBD, are automated. Tests can be carried out 24 hours a day.

✔ Reproducibility
  Even complicated malfunctions can be reproduced without fail with parameter settings.

✔ Complete coverage
  Improved coverage of test with at will changes of environmental conditions or operating conditions

✔ Safety
  Even test scenarios related to test driver safety can be realized with HILS.

✔ Reusability
  Test scenarios and evaluation functions can be reused once made.
HILS Configuration

- **HILS Control**: Control Desk
  - Test Project Management
  - Simulation Control
  - Variables Monitoring

- **Plant**: ASM (Automotive Simulation Models)
  - Engine
  - Vehicle Dynamics Model

- **Implementation and Test**: Hardware
  - RTI (Real Time Interface)
  - FIU (Failure Insertion Unit)

- **Automated Test**: AutomationDesk
  - Test Scenario Creation Management
  - Test Automatic Execution

- **ECU Measurement & Calibration**: CalDesk
  - Access to RAM Value within ECU
  - Access to Diagnostic Code
The year 2000 saw the Nissan Sentra CA, The World’s First Zero Emission Vehicle (which complied with California’s regulations for zero emission vehicles).

TargetLink was adapted for new air-fuel-ratio controller development.

The project was completed in only 3 months, reducing the development period by 40%.


Modification work was completed within only one month.

Source: [2000 dSPACE News]
User Example: MITSUBISHI MOTORS CORPORATION

- Virtual Vehicle was introduced during the development of the new Outlander. dSPACE ASM (Automotive Simulation Models) was used as a vehicle model.
- 20 ECUs are connected to a network simulator.
- Malfunctions which two engineers could not reproduce even after a week could be reproduced in one night using HILS.

"Real time Virtual vehicle tests are essential to quality improvement of complicated ECU systems."

Mr. Sakai, MITSUBISHI MOTORS CORPORATION

Source: [2007 dSPACE User Conference]
User Example : SUZUKI MOTOR CORPORATION

Test Drive using Virtual Vehicle

Category :
HIL (Hardware-in-the-Loop Simulation)

Product Information :
dSPACE Simulator, ASM, ModelDesk, AutomationDesk, ControlDesk, MotionDesk

Application :
Distributed control function test of ECU network for SUZUKI Swift and SUZUKI Kizashi

Economic Effect :
Efficient validation of all control functions

Source : [2010/03 dSPACE Magazine]
### User Example : Ford Motor Company

**dSPACE HIL Simulator**

**Labor vehicle (body) real loads**

**HIL for Body Electronics, Power Train & Vehicle Dynamics**
- > 50 ECUs
- > 10 000 test cases
- about 1800 CAN signals

<table>
<thead>
<tr>
<th>Function</th>
<th>Number of test steps</th>
<th>Test duration (manually) [h]</th>
<th>Test duration (HIL) [h]</th>
<th>Improvement (factor)</th>
<th>Availability of test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door closure</td>
<td>937</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Window lifter</td>
<td>2612</td>
<td>100</td>
<td>66</td>
<td>1.5</td>
<td>2.5 days vs. 2.5 weeks</td>
</tr>
<tr>
<td>Exterior light</td>
<td>1300</td>
<td>80</td>
<td>5</td>
<td>16</td>
<td>1 day vs. 2 weeks</td>
</tr>
<tr>
<td>ESP</td>
<td>350</td>
<td>96</td>
<td>9</td>
<td>10.6</td>
<td>1.5 days vs. 2 weeks</td>
</tr>
</tbody>
</table>

Test engineer works 40 hours a week.

HIL simulator runs 24/7.
Application Examples for the Energy Field
A Concept Based on a View of Life

A sustainable autonomous energy system learning from nature

*Plant Cells have a high degree of autonomy.*

- Hard cell wall
- Photosynthesis in Chloroplast
- Integrated cycle of energy seen between chloroplast and mitochondrion
- Storage of water and nutritive substances within vacuole.

Create
Use Wisely
Store

Energy in small units
- "Create", "Store", "Use wisely"
Construct an autonomous energy system.
We think it is an effective measure to construct a self-sustaining energy system which has the capability to "create, save, and wisely use energy" in small scale, in the way of plant cell.
Being able to control at a constant level the amount of energy received from the grid means that the system has very stable load. At the same time, it works as a stable electric generation plant.

System concept: Smart Energy Research Laboratory
A House Which Has An Autonomous Cooperation Energy System

Utilizing Natural Energy

Wind Power Generation

Solar Power Generation

Smart Grid Grand Vision

System Design: Smart Energy Laboratory Co., Ltd.

~Power Failure Support System Configuration~

Meteorological Information
(Forecast Quantity of Solar Radiation)

Peak Cut/Leveling of Grid Electricity
* Management of Electric Power Consumption by Introducing All-Electric Housing

Smart Grid Grand Vision

System Design: Smart Energy Laboratory Co., Ltd.

*Operation using backup storage battery in time of emergency.
“4 Effects” of the Smart House

Create

Use Wisely

Store

Smooth introduction of natural energy
  * Solution to the grid reverse power flow problem

Grid power peak cutting and smoothing
  * Power consumption in all-electric home and introduction of electric vehicles

Energy control system required to bring benefits

Charging electric vehicles at home
  * Promote use of electric vehicles

Dealing with power outages
  * Automatic independent operation
  * Storage battery backup in emergencies

**Solution to the grid reverse power flow problem**

- DC/DC converter
- MPPT
- Bi-directional DC/DC converter
- Bi-directional DC/AC inverter
- Smart Power Manager Unit
- Trans
- V2H
- Parallel off at power outage
- Power sensor
- AC 100V
- In-home display
- ZigBee
- Data Center Cloud Service
- PLC
- Smart meter
- Home gateway
- OSGi
- Internet
- Remote monitoring and control

**Grid power peak cutting and smoothing**

- Storage battery
- Electric vehicle

**Dealing with power outages**

- Automatic independent operation
- Storage battery backup in emergencies
Summary of Smart Cell Project

Objective: Building a model house that embodies the concept of Yokohama Smart Community

Location: tvk Housing Plaza Yokohama
(Exhibition space: approximately 100 tsubo)
Visible from train on the Tokaido Line

Structure:
1st floor exhibition space: Approx. 40 m² (12 tsubo = 24 tatami mats)
2nd floor exhibition space: Approx. 20 m² (6 tsubo = 12 tatami mats)
Exhibition of smart technologies/PR (products, brochures, videos) of participating companies

Architectural design: Koji Abe Architect & Associates
3D CAD: Hazama Ando Corporation

The Yokohama Smart Community
Inauguration: June 14th 2011
Executive Officer:
Chairman: dSPACE Japan K.K. President Hitoshi Arima
Vice Chairman: Smart Energy Laboratory Co., Ltd. CTO/Founder Yoshimichi Nakamura
Secretariat: PALTEK Corporation
URL: http://www.smartenergy.co.jp/yokohama/
Yokohama Smart Cell Technology Lineup

**Passive technology**
- BASF: High-performance insulation material “Neopor”
- High-fluidity concrete “Smart Dynamic Concrete”
- Concrete protection material “Protectosil CIT”
- Permeable pavement “Elastopave”
- Sunlight illumination “Skylight Tube”
- High-performance glass “PAIRMULTI Low-E”
- Super-insulated door “Sweden Door”

**Active technology**
- Energy systems
- Smart distribution panel
- Wireless surveillance system
- Cloud services
- Outlet board for wireless LAN
- EV charger stand/solar battery
- Solar LED panel light

**Model-based development**
- Smart energy system development/inspection platform

**Architectural design**
- Koji Abe Architect & Associates

**3D CAD**
- Hazama Ando Corporation

**Construction**
- Okayama Corporation

**Construction site**
- tvk Housing Plaza Yokohama

**Solar cell mount/installation**
Yokohama Smart Cell Technology Lineup

**Passive technology**

Passive is an antonym for active. In a narrow sense, passive technology means a method to limit the amount of energy required to maintain habitability by non-motorized natural power (such as through the use of insulation and natural drafts). In a broad sense, it means an approach to limit energy consumption by actively reconciling with the environment, such as adhering to an environment-friendly lifestyle by adapting to the characteristics of a region.

**Active technology**

Active technology is an approach whereby you try to obtain the same output to maintain a living environment/status such as illumination, temperature and humidity using less energy. Methods to limit energy consumption include use of high-efficient or power-saving equipment as well as the generation or flexible sharing of energy.

**Model-based development**

This is a method used to develop systems that are complicated and require a high degree of safety, such as automobiles and aircraft. It is now applied also to supporting the development of the latest and most environmentally-friendly energy systems.
"Model Based Development (MBD)" provides a new power development environment which has a high degree of efficiency and traceability in the "Energy System Development" which integrates solar batteries, storage batteries, and grid electricity within the same system.
In order to support the idea of "wanting to develop an energy system which can be used highly efficiently by combining clean energy such as natural energy and fuel cells" a development/test/verification platform which is best suited for energy system development is proposed.

In particular, both a simulation environment using numerical calculation tools of the MATLAB/Simulink and SCALE+ power supply simulators, as well as a prototype development environment using dSPACE tools are essential to shorten the development period and support the development of highly reliable software.
Definition and Education of the Required Skills for Model-Based Development Engineers
About the Skill Management Association

- **Aim of Activities**
  - To contribute, in particular to Japan and in a broader sense to international society, by training up personnel, developing skill management methods, skill analysis methods, and visualization of skills according to the management index based on ETSS.

- **Area of Activity**
  - Establishing skill management practically suited to embedded software development.
  - Improvement of skill management capabilities of small and medium sized businesses.
  - Support for personnel training for small and medium sized business based on ETSS.
  - ETSS introduction support and support for training of personnel who promote the introduction of ETSS.
  - Application of skill management to corporate management
  - Support for skill development activities for university teaching staff by promoting exchanges between academia and the business community.
  - Promoting the dissemination of skill management and ETSS
About Section Activities

- **ETSS Introduction Promotion Section**
  - Create a scheme beneficial in promoting the introduction/operation of ETSS.

- **Development Section for Formal Skill Evaluation Methods**
  - Develop a method able to objectively perform ETSS skill evaluation.

- **Workshop for Studying Model Based Engineer Training Environment**
  - Defines ideal learning materials and training environments to educate model based engineers and constructs an environment in which member companies can provide training.

- **Model Based Design Verification Technical Section**
  
  **ETSS: Embedded Technology Skill Standard**
  Standard skills for embedded software development engineers. These were standardized by Software Engineering Center of the Information Technology Promotion Agency, Japan.
Purpose of the Model Based Design Verification Technical Section

To define the skills required for Model-Based design verification Engineers and to develop a method allowing the measurement of skills.

Achievement of Activity Aims
1. To lay out skills in design and verification, which are required for Model-Based development.
   - To pay attention to both required skills different from those of code based development engineers as well as common skills for each application domain, which are not dependent on specified methods.

2. Creation of guidelines of requirements for obtaining model based development skills.
   - Standard documents, basic tools, and learning materials, and skills.

3. Assessment methods for model based development skills
   - Establishing evaluation methods
Schedule of Activities (Fiscal 2010 – 2012)

2010

- 4 5 6 7 8 9 10 11 12 1 2 3
- IPA study on skill systematization
- Common requirements of skill standards
- Requirements

2011

- 4 5 6 7 8 9 10 11 12 1 2 3
- ESEC
- Domain-specific requirements.
- Formulation of model-based technician skill standards
- Demonstration evaluation of skill standards
- Skill standards draft
- Skill standards

2012

- 4 5 6 7 8 9 10 11 12 1 2 3
- ▼ET2010
- ▼ET2011
- ▼ET2012
- Drafting of guidelines for skill acquisition and establishing skill assessment
- Management and improvement

Denotes deliverables of each stage.

- Overall Flow
- Presentation of skills required for model-based design and verification
- Drawing up guidelines necessary for acquiring model-based development skills
- Collect and maintain specific curriculums of each company
- Analyze study results, such as in deficient areas, and examine approach methods
- To action to make up for deficient areas
- Classification of design and verification methods and develop guidelines
- Management of guidelines and implementation tests
- Management and improvement
## Schedule of Activities (Fiscal 2013 – 2015)

### 2013

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<tr>
<th>4</th>
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**Overall Flow**

- **ET2013**
  - Drafting of skill standards and Compilation of guidelines for skill acquisition
  - Formulation of draft of skill standards Control System/Information System
  - Investigation of conventional specific curriculums for each company Completion of MBD engineer education examples
  - Assessment of model-based design and verification technology
  - Presentation of skills required for model-based design and verification

### 2014

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**MBD Skill Standard and Guidelines for Skill Acquisition**

- Evaluation of skill standard and guideline for skill acquisition
- Conclusion of activities
- Formulation of methods for skill assessment

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**Demonstrative evaluation of skill standards by each member company**

- Usability evaluation of guidelines for skill acquisition by each of the member companies
- Guidelines for skill acquisition and Compilation
- Conclusion regarding guidelines for skill acquisition

### 2015

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<tr>
<th>4</th>
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</table>

**Market deployment of skill standards**

- Operational evaluation of guidelines for skill acquisition
- Operational evaluation of skill assessment

**Activities relating to Market Deployment**

- Renewal of guidelines for skill acquisition
- Renewal of skill standard

### Denotes deliverables of each stage.
Achievement for Fiscal 2010 through 2011

- Status survey of the situation for model based development in the related fields of section members
- Review of IPA skill systematization survey
- Discussion of methods for defining skill standards (domain independence/dependence)
- Definition/understanding of modeling processes
- Definition/discussion of skills for each modeling process

- Survey of conventional MBD related education in each of the section member companies
- Confirmation with the expectation for the achievement of section.
- Discussion of methodology leading from skill definition to education
Definition of Modeling Skills

- To be discussed and based on definitions made by IPA/SEC model based engineers skill study working group
  - Modeling: A process in which the character of objects are abstracted (simplified) and mapped according to the relationship between objects whose function was defined.
  - Model: Deliverable product obtained through modeling

![Diagram of modeling process and skills](image-url)

- Modeling (create models)
- Utilizing models
  - MILS
  - RCP
  - HILS
  - Automatic Code Generation
  - Performance Evaluation
  - ...
Shift of Skills for MBD Engineer Education

- Searching for designation of skills required for modeling
  ⇒ Determine skills which are easy to introduce to MBD engineer education

- Shift in viewpoints regarding the skills which need to be laid down

  Scheme for general-purpose skills, which cover all areas

  Designation of skills focused on MBD engineer development
Achievements in Fiscal 2012

- Activities took place in 2 groups.
  - Key Words for Group 1:
    - CASE/Non-Control System/Discrete System/Requirement/Upperstream
    - Computer Aided Software Engineering
  - Key Words for Group 2:
    - CACSD/Control System/Continuous System/Implementation/Downstream
    - Computer Aided Control Software Design

- Outlining skills required for various carriers of control system/information system.
- Associating required skills with conventional education courses.
- Releasing the first edition of the skill map.
- Compiling and issuing a 3 year activity interim report (total of 6 chapters).
### Achievement

<table>
<thead>
<tr>
<th>Type</th>
<th>Specialization of Engineer</th>
<th>Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant</td>
<td>Plant Model Design Engineer</td>
<td>Designs plant models which are controlled objects. Can only design plant models in skill level 1 of Simulink model. The engineers who are in charge of creating the base part of function models and packaging design models. For upper ranks, not only Simulink but also plant modeling tools such as Dymola and MapleSim are required.</td>
</tr>
<tr>
<td>Control System</td>
<td>Control System Design Engineer</td>
<td>Engineers who design the function model in control model. Designs function model using MILS. Designs models which can be run in RCP.</td>
</tr>
<tr>
<td></td>
<td>Implementation Model Design Engineer</td>
<td>Engineers who adjust models so that C codes for embedded software products can be automatically generated based on function models.</td>
</tr>
<tr>
<td>HILS System</td>
<td>HILS System Design Engineer</td>
<td>Designs input/output signal and model configuration of HILS. Connection part of ECU and HILS. Understands software items and judges what kind of functions are required and determines specifications.</td>
</tr>
<tr>
<td></td>
<td>HILS Model Design Engineer</td>
<td>Engineers who design other models of HILS equipment apart from plant models. Designs communications using CAN signal and automatic tests.</td>
</tr>
<tr>
<td>Development Environment</td>
<td>MBD Development Environment Engineer</td>
<td>Improves development environment for design processes using Simulink, utilizing Simulink API. Is in charge of setting up guidelines, designing tools and establishing regulations and operational assistance for the development processes in order to ensure quality in the automation of simple work and automatic code generation.</td>
</tr>
</tbody>
</table>
### Examples of Skill Framework for Control System MBD Engineers

<table>
<thead>
<tr>
<th>Skills</th>
<th>Level of Job Description</th>
<th>Job Description</th>
<th>Control System Design Engineer</th>
<th>Implementation Model Design Engineer</th>
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<td>Simulink Model Language/Tool</td>
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**Target Value of Skills**
Future Activities

- Improvement of Skill Map
  - Information System
  - Control System
- Corroborative activities by each member company applying skill map
- Formulation of Guidelines for Skill Acquisition
  - Survey regarding Educational Courses for MBD Engineers
  - Collection of Examples of MBD Applications and MBD Engineer Education
- Conclusion of MBD Skill Standards and Guidelines for Skill Acquisition (Printed Book)
- Review of Skill Assessment Methods for MBD Engineers
Announcement : ET 2013 (Embedded Technology 2013)

- SMA Panel Session
  - November 21st (Thurs) 10:00 - 13:00
  - Annex Hall, Pacifico Yokohama
  - Theme : Practical Model Based Development Engineer Development
  - Overview : Discussion of points regarding the professional development of MBD engineers by the leaders in each field who practice MBD.
  - Panelist Companies :
    - Honda R&D Co., Ltd.
    - DENSO CORPORATION
    - AISIN AW CO., LTD.
    - Toshiba Solutions Corporation
    - SEIKO EPSON CORPORATION
    - Smart Energy Laboratory
Summary

- Model based development is a method enabling the efficient proceeding of controller development utilizing modeling and simulation.

- Effects of Model Based Development
  - Reduction of development man-hours, shortening of the development period.
  - Quality Improvement: Verified by simulations in early stage of development.

- Merits of Applying HILS
  - Automatic Test without Real Machines
  - Reproducibility, Coverage, Safety, Reusability

- Deep penetration into the Automobile Industry, expanded widely.

- Active application for the Energy field

- Efforts toward development of model based engineers at Skill Management Association