Mutual recognition between PSE and JSME senior analyst

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1. Introduction

Effective use of simulation technology provides benefit of time and cost reduction in product development. To ensure the economic result by such simulation usage, competent simulation engineers are required.

Japan Society of Mechanical Engineers (JSME) launched the Certification Program for Computational Mechanics Engineer in 2003 and there are currently 11 types of certification. NAFEMS had promoted Registered Analyst Scheme since the 1990’s and then launched PSE (Professional Simulation Engineer) in 2013.

JSME and NAFEMS confirmed that the highest level senior analyst and PSE are equivalent and now the mutual recognition framework is being discussed. In this presentation, I’m going to introduce the content of JSME Certification Program for CM Engineer, and explain the outline of the framework for international mutual recognition between JSME senior analyst and NAFEMS PSE.
2. JSME Certification Program for Computational Mechanics Engineer

2.1 JSME, CMD（The computational mechanics division of JSME）, Innovation Center

◇ JSME : Established in 1879, 37000 members, 21 divisions.

◇ CMD : Established in 1988. 6000 members.

◇ Innovation Center : Supporting engineers human resource development, engineers certification programs, and technical developments and productive activities. Leading innovation. Enhancement of industry-academia-government collaboration.

JSME Certification Program for Computational Mechanics Engineer is promoted by JSME Certification Program Committee in the innovation center and many members of different JSME divisions including CMD support it.
2.2 JSME Certification Program for Computational Mechanics (CM) Engineer

Field: FEM analysis engineers in solid mechanics field
Analysis engineers in thermal fluid mechanics field
FEM analysis engineers in vibration engineering field

Level: Senior Analyst
Grade 1
Grade 2
Basic Grade

http://www.jsme.or.jp/cee/cmnintei.htm

-In cooperation with:
The Japan Machinery Federation (JMF), The Japan Society of Industrial Machinery Manufacturers (JSIM), The Japan Electrical Manufacturers' Association (JEMA), JSME Center for Cooperation of Industries, Government and Academia, Center for Codes and Standards and other 8 divisions and 4 branches, 54 associations related to computational mechanics including JACM (Japan Association for Computational Mechanics) and JSCES (The Japan Society for Computational Engineering and Science) in Japan
2.3 History of JSME’s actions

2000   Discussion about the certification started as future activities in CMD.
Mar, 2002  Engineering Training Center “Exploratory Committee for standard and certification of computational mechanics engineers” was established.

Apr, 2003  Trial run of certification of FEM analysis engineers in solid mechanics field
Dec, 2003  Launch of 2nd grade CM engineers in solid mechanics field
Dec, 2004  Launch of 1st grade CM engineers in solid mechanics field
Dec, 2005  Launch of 2nd grade CM engineers in thermal fluid mechanics field
Apr, 2006  Organization for Promoting ability development “Committee of Certification Program for Computational Mechanics Engineer”
Apr, 2006  Launch of basic grade CM engineers in solid mechanics and thermal fluid mechanics field
Dec, 2007  Launch of 1st grade CM engineers in thermal fluid mechanics field
2008  Started the renewal procedure of the certification
Apr, 2009  Innovation center “Committee of Certification Program for Computational Mechanics”
Sep, 2009  Launch of senior analyst in thermal fluid mechanics field
Jul, 2010  Holding the first networking event for certificated CM engineers
Dec, 2012  Launch of 2nd grade of vibration field
Dec, 2013  Launch of 1st grade of vibration field
2.4 2nd Grade Certification Level

◇ Solid mechanics field
Engineers who have basic knowledge and skill for linear stress analysis, perform analysis appropriately, and can verify the reliability of the analysis result by oneself.

◇ Thermal fluid mechanics field
Engineers who have basic knowledge and skill for “single-phase incompressible flow, compressible flow, laminar flow, and turbulent flow analysis”, perform analysis appropriately and can verify the reliability of the analysis result by oneself.

◇ Vibration engineering field
Engineers who have basic knowledge and skill for “natural frequency, frequency response, and transient response analysis”, perform analysis appropriately and can verify the reliability of the analysis result by oneself.
2.5 1st Grade Certification Level

◇ Solid mechanics field
Engineers who have basic knowledge and skill for FEM analysis dealing with nonlinearity, and linear fracture mechanics, perform analysis appropriately and can verify the reliability of the analysis result by oneself.

◇ Thermal fluid mechanics field
Engineers who have basic knowledge and skill for analysis dealing with one of single-phase flow/multiphase flow/combustion flow, perform analysis appropriately, and can verify the reliability of the analysis result by oneself.

◇ Vibration engineering field
Engineers who have basic knowledge and skill for FEM analysis dealing with flow-induced vibration and vibro-acoustic problems, perform analysis appropriately, and can verify the reliability of the analysis result by oneself.
2.6 Senior Analyst Certification Level

◇In solid mechanics, thermal fluid mechanics, and vibration engineering fields, with respect to theories and practical works, engineers who;

① have wider and deeper knowledge and analysis experience (covered by 1st grade and 2nd grade),

② can plan and manage†CAE analysis projects,

③ have high ethical standards and

④ can present to customers and society.

†In case of management of CAE analysis projects, management for scope (purpose and coverage of projects), schedule, cost, quality, human resource, communication, risk, and procurement is required. Human resource management includes coaching and training of members.
2.7 Characteristics of the examination of thermal fluid mechanics field

◇ Thermal-fluid phenomenon is essentially nonlinear and multi-scale. So in practice, introduction of physical model is necessary. (Turbulence flow, multiphase, reaction, combustion, interface, etc.)

◇ CFD has been developed depends on each field. (incompressible flow, compressible flow, multiphase flow, combustion flow, etc.)

◇ Factually, no standard code: requires different test for each field

◇ Problem on the quality assurance: can’t assure quality based on standard code

◇ Test if engineers have knowhow to use physical model and discretization scheme which are embedded in CFD codes for each filed. (2nd grade: general, 1st grade: field specific)

◇ Based on above ideas, for each specific field, certify an ability not to produce results with faults.
2.8 Certification Process

◇2nd Grade: Engineers who have more than 1 year analysis experience or have completed collateral technical course or authorized CAE technical course and accomplished predefined results in the 2nd grade certification tests.

◇1st Grade: Engineers who have 2nd grade certification and accomplished predefined results in the 1st grade certification test.

◇Senior Analyst: Engineers who
- have 1st grade certification
- have more than 7 years analysis experience
- submitted paper related to “typical analysis work experience” and “typical planning and management experience of CAE analysis project”
- passed a documentary examination (first stage test)
- make a presentation and interview based on the submitted document
2.9 Result of CM engineer certification program  2003-2012

From Y 2003 to Y 2012

<table>
<thead>
<tr>
<th>Year</th>
<th>Solid mechanics</th>
<th>Thermal fluid mechanics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>basic</td>
<td>2nd</td>
</tr>
<tr>
<td>2003</td>
<td>124</td>
<td>2526</td>
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<tr>
<td>2008</td>
<td>124</td>
<td>987</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>39.1</td>
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<tr>
<td>2009</td>
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<td>534</td>
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<tr>
<td></td>
<td>100</td>
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<tr>
<td>2010</td>
<td>90</td>
<td>566</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>29.0</td>
</tr>
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<td>2011</td>
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<td>596</td>
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<td></td>
<td>100</td>
<td>36.1</td>
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<tr>
<td>2012</td>
<td>101</td>
<td>616</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>30.8</td>
</tr>
</tbody>
</table>

Total applicants = 4542

Successful applicants of CM engineer in Solid mechanics, thermal fluid mechanics and vibration engineering fields = 52

Successful applicants of senior analyst in Solid mechanics and thermal fluid mechanics fields = 52
2.10 Distribution of industrial affiliation of applicants

- **Manufacturing**: 64.1%
- **Software computation, development/sales**: 21.0%
- **Educational/Research Institute**: 3.6%
- **Architectural**: 2.8%
- **Other**: 8.4%

**Distribution**

- **No response on employment**: 0.7%
- **Other companies**: 1.6%
- **Educational**: 2.9%
- **Research institutes**: 16.6%
- **Commissioned software computation**: 14.1%
- **Software development/sales**: 6.9%
- **Manufacturing/materials**: 6.9%
- **Manufacturing/automobiles**: 24.5%
- **Manufacturing/electrical**: 16.1%

**Y 2008 ~ Y 2012**
2.11 Concept of CM engineer certification program

Objectivity・Credibility・Individual respect

CM engineers

- Human resource providing training (Theory/Programming)
- Human resource providing training (OJT) Practical experience
- Training (Software) How to use software
- Training program (Standard test / Training course for test-preparation)
- Application-Certification

Universities

Companies

Research centers

CAE vendors

Academic Societies

JSME

CM engineer certification program committee
- CM engineer certification program accreditation test
- Basic, 2nd grade, 1st grade, Senior analysts
- Total training program

Official CAE technical training course

Overseas deployment
Mutual recognition

Japan standard

Overseas deployment
Mutual recognition

Japan standard
3. Mutual recognition between PSE and JSME senior analyst

3.1 Discussion between NAFEMS and JSME

Aug, 2011  
JSME visited NAFEMS in Cheshire, UK. NAFEMS and JSME introduced own computational mechanics engineer certification programs each other.

Jun, 2012  
“International Symposium for quality assurance of computational mechanics” was organized in cooperation of NAFEMS, JSME, JSCES, and JACM. Equivalence of RA and senior analyst was checked in a following meeting.

Jun, 2013  
NAFEMS launched PSE in NAFEMS WORLD CONGRESS 2013

Jul, 2013  
The practical discussion between NAFEMS and JSME regarding the equivalence between NAFEMS PSE and JSME senior analyst started.

Aug, 2013  
Confirmed the equivalence of NAFEMS PSE and JSME senior analyst. Following discussion about the certification process started.
3.2 Process of Mutual recognition between PSE and JSME senior analyst

◇Basically, NAFEMS PSE Advanced and JSME senior analyst are thought to be equivalent, because the requirement of senior analyst covers the requirement of PSE Advanced.

◇However, Regarding one of the PSE requirement “Analysis Type Competency”, senior analysts need to refer the content of “Educational Base Module”, check if himself/herself is Advanced or Standard for each analysis type and apply the analysis type. This is because the understanding of analysis competency is different between NAFEMS and JSME. JSME checks the project essay, work experience and the propriety of the applied analysis types which are provided by senior analysts to JSME.

◇NAFEMS and JSME will continue the consideration of detail of mutual recognition.
3.3 Possible Analysis Type Competency that senior analysts can apply

Choosing following Analysis Type Competency

| Core Finite Element Analysis | （固体） |
| Core Computational Fluid Dynamics | （熱流体） |
| Mechanics, Elasticity and Strength of Materials | （固体） |
| Beams, Membranes, Plates and Shells | （固体） |
| Fundamentals of Flow, Heat and Mass Transfer | （熱流体） |
| Materials for Analysis and Simulation | （固体） |
| Composite Material and Structures | （固体） |
| Fatigue | （固体） |
| Flaw Assessment and Fracture Mechanics | （固体） |
| Thermo-Mechanical Behaviour | （固体） |
| Buckling and Instability | （固体） |
| Dynamics and Vibration | （振動） |
| Noise and Acoustics | （振動） |
| Multi-body Dynamics | （振動） |
| Nonlinear Geometric Effects and Contact | （固体） |
| Plasticity | （固体） |
| Creep and Time-Dependency | （固体） |

※Regarding vibration, it is held until senior analyst certification starts.
4. Advantage of the mutual recognition

◇ Senior Analysts
By obtaining PSE developed in Europe, JSME senior analysts can gain certification as world class professional competency and confidence. In addition, they can participate in the global computational mechanics engineers community.

◇ JSME
By taking the opportunity of international mutual recognition, JSME senior analysts will be accepted internationally and an increase of the number of senior analyst applicants can be expected.

◇ NAFEMS
By this mutual recognition, it produces PSE registrants in Japan. As a result, it raises the profile of NAFEMS. The new PSE registrants in Japan can create NAFEMS community together with the existing NAFEMS members.
5. Conclusion

This presentation introduced the content of JSME Certification Program for CM Engineers, and explained the outline of the framework for international mutual recognition between JSME senior analyst and NAFEMS PSE.

This international mutual recognition is an opportunity for JSME senior analysts to gain certification as world class professional competency and confidence, and to participate in the NAFEMS community.

JSME can expect a higher reputation of senior analysts and increase of the number of senior analyst applicants. NAFEMS can expect an opportunity for increase of PSE registrants and a new NAEFMS community in Japan.

I strongly expect that this interaction of simulation technology between Europe and Japan by taking the opportunity of international mutual recognition, activates the Japanese simulation industry and produces an additional effect of leading simulation technology in the manufacturing industry in Japan.