A New Standard for Simulation Engineers
Agenda

- PSE Overview
- Certification, or an Educational Framework?
- How is the Program Used Today?
- Certification | How does it Work?
- Governance
- Foundation for NAFEMS Activities
- Q&A
PSE Overview
PSE Competencies

PSE (Professional Simulation Engineer) defines the competencies that good simulation engineers should possess.

- The scheme consists of a database of thousands of detailed competency statements
- Peer-reviewed over several years by experts

These competencies are the foundation for the PSE Competency Tracker and PSE Certification.
PSE Competence Statements

FEAco12 - Outline a common method employed to solve the large sets of sparse symmetric matrices common in FEA.

CFDco2 - Compare and contrast the finite difference, finite volume and finite element discretisation methods.

NGECco9 - Discuss the limitations of contact algorithms available in a finite element system.

MASco5 - Discuss the general issue of scatter in material properties relevant to your analysis and simulation and how this is allowed for.
PSE Background

- **CCOOPS** – Certification of Competencies in the Power and Pressure Systems Industry throughout Europe
  - Project launched with ½ Million Euro Funding under the EU Leonardo da Vinci Programme

- **EASIT²** – Engineering Analysis Simulation Innovation Transfer² European project 18 Technical Areas

- **PSE** – Professional Simulation Engineer
  - Officially launched at the 2013 Salzburg NAFEMS World Congress
  - 26 Technical Areas
Technical Areas

- Mechanics, Elasticity and Strength of Materials*
- Core Finite Element Analysis*
- Fundamentals of Flow, Mass & Heat Transfer*
- Core Computational Fluid Dynamics*
- Materials for Analysis and Simulation
- Fatigue
- Flaw Assessment and Fracture Mechanics
- Nonlinear Geometric Effects and Contact
- Beams, Membranes, Plates and Shells
- Dynamics and Vibration
- Optimisation
- Plasticity
- Thermo-Mechanical Behaviour
- General Analysis Management

- Verification and Validation
- PLM Integration and CAD-CAE Collaboration
- Simulation Process and Data Management
- Buckling and Instability
- Multi-physics Analysis
- Composite Materials and Structures
- Creep and Time-Dependency
- Multi-Scale Analysis
- Probabilistic Analysis
- Noise, Acoustics and Vibro-Acoustics
- Electromagnetics
- Multi-body Dynamics
Certification, or an Educational Framework?
Certification Scheme

Gain recognition for achievement of competency

- Independent Assessment by Industry Experts

Educational Framework

Plan, Track & Manage Competency

The Competency Tracker can be used to:
- Access PSE Competencies Online
- Browse Educational Resources
- Track & Manage Competency
How to Access the Competency Tracker

Register for Access: https://www.psecompetencytracker.org/

Complete Tracker Available to:

- PSE Certification Applicants
- NAFEMS Members
PSE Competency Tracker

[Image of the PSE Competency Tracker interface with various educational base competencies listed.]
### Competence Statement

**Competency statement:** Explain the terms Isotropic Hardening, Kinematic Hardening and Rate Independency.

**Code:** PLASco2  |  Cognitive area: Comprehension  |  NAFEMS level: Standard  |  EQF level: 7

---

**Resource References**

- Identify the extent to which your application software allows modification of nonlinear material solution parameters.
- Discuss solute features of the inelastic response of metals.
- Explain the terms Isotropic Hardening, Kinematic Hardening and Rate Independency.
- Discuss the role of the Hydrostatic and Deviatoric Stress Components in yield criteria for isotropic, polycrystalline solids.
- Explain the terms Limit Load and Plastic Collapse Load and explain why the latter is often a misnomer.
- Explain the terms First Yield Load, Ultimate Load and Plastic Instability Load.
- Discuss the use of the Twice Elastic Slope Criterion and explain why this is sometimes used.
- Explain the phenomenon of Shakedown and define the term Shakedown Load.
- Contrast the terms Ratchetting and Low Cycle Fatigue.
- Explain the Upper and Lower Bound Theorems.
- Discuss the effects of stress singularities at re-entrant corners on limit load.
- Explain how plastic effects in a Finite Element system are commonly handled as a series of incremental iterative linear analyses and contrast the Variable Stress...
PSE Competency Tracker

- PLA5co9 - Identify the extent to which your application software allows modification of nonlinear material solution parameters.
- PLA5co1 - Discuss salient features of the inelastic response of metals.
- PLA5co2 - Explain the terms Isotropic Hardening, Kinematic Hardening and Rate Independence.
- PLA5co3 - Discuss the role of the Hydrostatic and Deviatoric Stress Components in yield criteria for isotropic, polycrystalline solids.
- PLA5co4 - Explain the terms Limit Load and Plastic Collapse Load and explain why the latter is often a misnomer.
- PLA5co5 - Explain the terms First Yield Load, Ultimate Load and Plastic Instability Load.
- PLA5co6 - Discuss the use of the Twice Elastic Slope Criterion and explain why this is sometimes used.
- PLA5co7 - Explain the phenomenon of Shakedown and define the term Shakedown Load.
- PLA5co8 - Contrast the terms Ratchetting and Low Cycle Fatigue.
- PLA5co9 - Explain the Upper and Lower Bound Theorems.
- PLA5co10 - Discuss the effects of stress singularities at re-entrant corners on limit load.
- PLA5co11 - Explain how plastic effects in a Finite Element system are commonly handled as a series of incremental iterative linear analyses and contrast the Variable Stiff...
- PLA5co12 - Explain, in general terms, the function of the Moes Flow Rule or Prandtl-Reuss Equations, used in a finite element solver.
- PLA5co13 - Outline how the cumulative and incremental displacements, total strains, elastic strains, elastic stresses and plastic strains are related in the finite elemen...
- PLA5co14 - Illustrate typical examples of Local Plastic Deformation and Gross Plastic Deformation.

RESOURCE REFERENCES FOR THE COMPETENCY STATEMENT

<table>
<thead>
<tr>
<th>Type</th>
<th>Code</th>
<th>Resource</th>
<th>Reference</th>
<th>Link</th>
</tr>
</thead>
</table>
PSE Competency Tracker

Competence Statement | Resource References | Competence Record

Compeunity record: PLASCo2 - Explain the terms Isotropic Hardening, Kinematic Hardening and Rate Independency.

Status: Achieved | Method of achievement: Self evaluation

Comments:
Read publications found in the "Resource Reference" section and can discuss the terms confidently.
Also attended Vendor training course on Material Plasticity where this topic was covered.
PSE Competency Tracker

INDIVIDUAL PSE COMPETENCY REPORT

Name: Symington, Ian
Id: pse-127
Email address: ian.symington@nafems.org
Date: April 25, 2015

TECHNICAL AREA
Code: FEA
Title: Finite Elements Analysis (Core Module)

OVERALL COMPETENCY RECORD
Status: Achieved
Achievement method: Self-evaluation
Level: Expert
Date: 20/06/14 12:00

PROGRESS CHART

SHOW HIDE DETAILS

TECHNICAL AREA
Code: FEMM
Title: Mechanics, Elasticity and Strength of Materials

OVERALL COMPETENCY RECORD
Status: Not achieved

PROGRESS CHART

SHOW HIDE DETAILS
Independent Assessment of PSE Competencies Resulting in a Recognised Certificate

- Multi-level certification scheme that recognises achievement of PSE competencies
- Independently assessed by NAFEMS
- Online Application via NAFEMS website
Multi-Level Certification

Competencies can be claimed at Entry, Standard and Advanced Level

**Entry**
- Employs available software tools in an effective manner
- Able to work in a supervised capacity when provided with clear guidelines
- Doesn't take on general tasks without supervision
- Typically applies to trainees and/or technician level staff working under the supervision of a person(s) with appropriate competence who will sign off the results

**Standard**
- Has sufficient knowledge and comprehension of theory to employ available software tools in a safe and effective manner
- Able to work in an independent manner without supervision
- Conducts appropriate checks on results
- Is aware of their own limitations when faced with new or novel problems
- Observes professional practices

**Advanced**
- Can take on a range of complex, novel tasks without supervision
- Plans analysis strategies and validation studies
- Provides effective advice and guidance
How is the PSE being used today

By Individuals…

- Used to differentiate themselves
- Used for professional development
- Used as proof of competence to current and future employers
- Steady uptake in interest in PSE from individuals

By Companies…

- As an competence management system
- A clear way to demonstrate the company’s commitment to quality standards
- A formal record of employee competency and training satisfying the requirements of ISO 9001
- Creating and maintaining competitive edge
Examples of How PSE is being used today

- Individuals
  - Using ‘out of the box’ PSE

<table>
<thead>
<tr>
<th>PSE Competence Statements</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSE Competence Tracker</td>
<td>✓</td>
</tr>
<tr>
<td>PSE Certification Assessment</td>
<td>✓</td>
</tr>
</tbody>
</table>
Examples of How PSE is being used today

- High Tech Electronics Manufacturer
  - Managing Competence of Engineering Designers
  - Restrict access to simulation tools
  - > 80 engineers through process

<table>
<thead>
<tr>
<th>PSE Competence Statements</th>
<th>✔</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSE Competence Tracker</td>
<td>?</td>
</tr>
<tr>
<td>PSE Certification Assessment</td>
<td>✔</td>
</tr>
</tbody>
</table>
Examples of How PSE is being used today

- Large Aerospace Manufacturer
  - Managing Competence of Analysis Engineers
  - Incorporated into companies own Competency Management Process

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PSE Competence Statements</td>
<td>✓</td>
</tr>
<tr>
<td>PSE Competence Tracker</td>
<td>✗</td>
</tr>
<tr>
<td>PSE Certification Assessment</td>
<td>✗</td>
</tr>
</tbody>
</table>
Certification | How Does it Work?
Certification – Application

- Apply Online: http://www.nafems.org/professional_development/certification/
- Application Fee: £150 / $230 / €210
Certification – Guidance

- Guidance information is available to download from website
Certification – Application

- The application is stored online and can be saved and modified at a later date.
Certification – The Process

1. Online Application Form
2. Application Checked by PSE Certification Administrator
3. Referee Check
4. Application Assessed
5. Interview
Certification – The Interview

- Duration: 45 minutes
- Location: Webex
- Two PSE Assessors and the PSE administrator in attendance
- Open questions about the candidates background & simulation experience
- Specific questions relating to the PSE competencies
Governance
Governance

- PSE Board
- PSE Assessors
- PSE Administrator
- Applicants

Technical WGs
Education & Training WG
The Foundation for NAFEMS activities
Future developments

- PSE feeds into “Academic Course Approval”
  - Ensure that graduates possess the skills that industry require
- Associate all NAFEMS training courses with the competence statements
- Working groups tasked with developing the educational resources
Find out more at www.nafems.org