Four recent National Academy studies of materials and manufacturing [1-4] have identified the recently established field of Integrated Computational Materials Engineering (ICME) as the greatest opportunity in materials technology. Responding to the education recommendations of the 2008 ICME study[4] with a focus on the best industry practices identified in the 2004 ATT study[3], the Northwestern University MSE department has organized an MS Concentration in ICME technology operating within the department's existing courses-only MS program. Led by Professors Greg Olson and Chris Wolverton, pioneers in ICME technology, the initiative builds on Northwestern's unique research and education achievements in computational materials design and the new education infrastructure of our doctoral cluster in Predictive Science & Engineering Design (PSED).
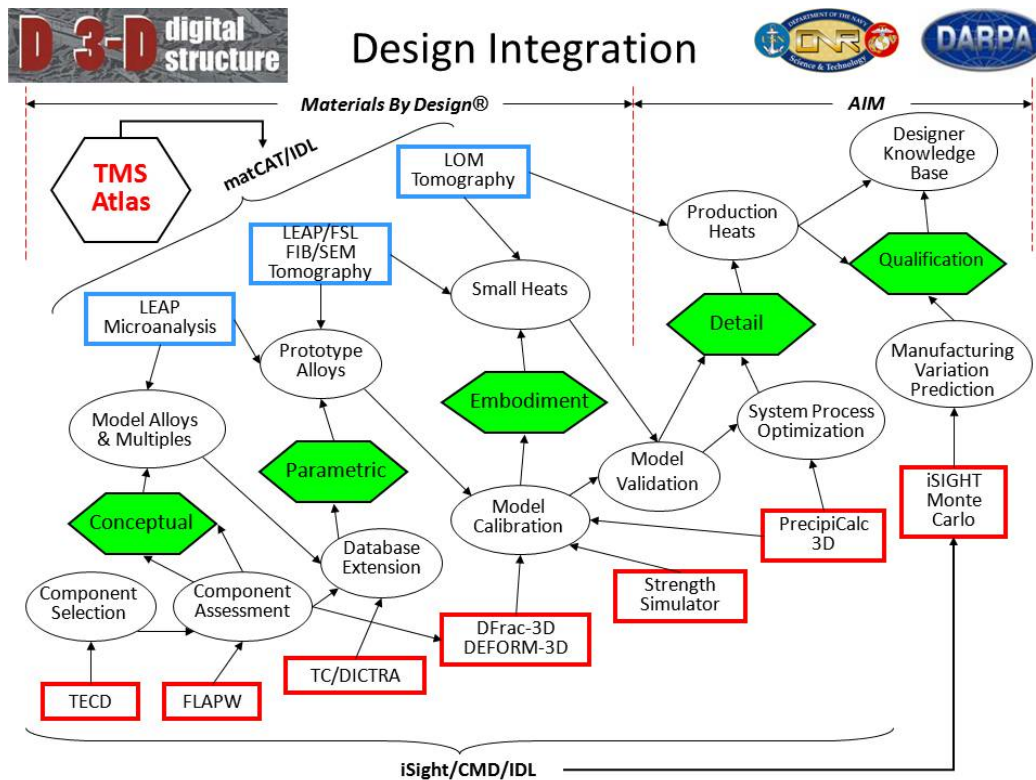
As summarized in the table below, the concentration requires five units of specified core courses and seven electives, some chosen from the recommended list, culminating in a computational materials design team project in MSc390 Materials Design.

	F	W	S
Core	MSc 401 Analytical & Statistical Thermodynamics PSED 510-1 (0.5) ICME Seminar MSc 458 Computational Materials	MSc 408 Phase Transformations in Materials	MSc 390 Materials Design PSED 510-2 (0.5) ICME Seminar
Electives	MSc 391 Process Design MSc/ESAM 495 Modeling of Soft Materials CEE327/ME 365 Introduction to FEM ME 341 Computational Methods for Engineering Design (or ME 441 Engineering Optimization for Product Design & Manufacturing)	MSc/ESAM 495 Introduction to Statistical Mechanics ME/CEE 426-1 Computational Mechanics I ME 366 Finite Elements for Design & Optimization	MSc 406 Mechanical Properties of Materials ME/CEE 426-2 Computational Mechanics II Phys 450 Advanced Computational Condensed Matter Physics

[1] NRC 2003, Materials Research to Meet 21st Century Defense Needs
[2] NRC 2004, Retooling Manufacturing: Bridging Design, Materials and Production.
[3] NRC 2004, Acceleration Technology Transition: Bridging the Valley of Death for Materials and Processes in Defense Systems.
[4] NRC 2008, Integrated Computational Materials Engineering: A Transformational Discipline for Improved Competitiveness and National Security.

Faculty

Greg Olson, FTMS, FASM, is Walter P. Murphy Professor of Materials Science and Engineering at Northwestern. Founder of the SRG materials design consortium in 1985, he currently directs the Materials Technology Laboratory at Northwestern , and has served since 1997 as a Founder and Chief Science Officer of QuesTek Innovations LLC, the first computational materials design company, selected for Fortune magazine's list of the 25 breakthrough companies of 2005. He is a member of the National Academy of Engineering, cited for "research, development, implementation and teaching of science based materials by design." With the late Martin Blackburn, he organized and led the modeling effort of the Pratt & Whitney team of the DARPA-AIM program, demonstrating the AIM methodology of accelerated materials qualification, which has culminated in the historic flight qualification of QuesTek's Ferrium S53 landing gear alloy, the first fully computationally designed and qualified material. He has authored more than 250 publications, holds 17 patents for computationally designed materials and processes, and has given over 470 invited lectures. He received a BS and MS in 1970 and ScD in 1974 in materials science from MIT, joining the faculty of Northwestern in 1988. Beyond materials design, his research interests include phase transformations, structure/property relations, and applications of high resolution microanalysis. Recent awards include the ASM Campbell Memorial Lectureship, the TMS-SMD Distinguished Scientist/Engineer Award, the Cambridge University Kelly Lectureship, and the ASM Gold Medal.

Chris Wolverton is Professor of Materials Science in the MSE Department at Northwestern. Before joining the Northwestern faculty, he served as group leader for the Hydrogen Storage and Nanoscale Modeling Group at the Research and Innovation Center of Ford Motor Company, where he played a leading role in the modeling component of the Virtual Aluminum Castings program, Ford's highly successful implementation of ICME. He received his BS in Physics from the University of Texas at Austin and PhD in Physics from the University of California at Berkeley, followed by postdoctoral research at the National Renewable Energy Laboratory (NREL). His research interests include computational studies of a variety of energy-efficient and environmentally friendly materials via first-principles atomistic calculations and "multiscale" methodologies for linking atomistic and microstructural scales. Current research projects include high-throughput calculations, materials discovery, and data mining applications as well as phase transformations in light-weight Mg alloys, Li battery materials, thermoelectric materials, new oxide materials for solar thermochemical production of fuels, novel hydrogen storage materials, and surface ordering in metal alloy catalysts. Wolverton has authored or co-authored more than 180 peer-reviewed publications, holds eight patents (several others pending), and has given more than 150 invited talks. Wolverton is a Fellow of the American Physical Society, has won the Walder Award for Research Excellence, a Ford Motor Company Technical Achievement Award, and gave the John Dorn Memorial Lecture at Northwestern in 2003.

Northwestern University

In the tradition of the Chicago School, Northwestern has a unique record of innovation, inventing Materials Science in the 1950's and Materials Design in the 1990's. Home to one of the first Interdisciplinary Research Laboratories, Northwestern's continuing innovation is fostered by a long tradition of multidisciplinary collaboration in materials research. A leading role in numerical continuum mechanics methods and their materials applications is represented by Professors Ted Belytschko and Wing Liu of Mechanical Engineering. Leadership in computational quantum mechanics acknowledged by the 1998 Nobel Prize of the late John Pople is continued by Professor Art Freeman of Physics, whose FLAPW method has shown the highest accuracy in materials design. Important education innovations include the "Engineering First" initiative in undergraduate design education, bolstered by the new Segal Design Institute, and the recent doctoral cluster initiative in Predictive Science & Engineering Design, upon which this ICME Concentration is based.

To Apply:

The MSE program takes new MS students each fall. Applications must be received before **July 15** but applications received by **February 28** will receive first consideration. Application to The Graduate School at Northwestern University must be completed online. All applicants must have the results of the Graduate Records Examination (GRE) General Test (verbal, quantitative, and analytical writing) sent to the Graduate School (school code 1565, no department code necessary). Students who have taken subject tests (e.g. physics or chemistry) are encouraged to report those scores as well. More details about applying may be found at: http://www.matsci.northwestern.edu/gradinfo.html