

Manufacturing Engineering Technology

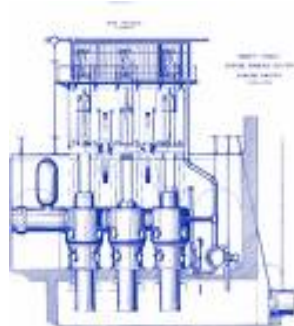
A Statewide Partnership Articulating Education for Career Pathways

Presented by

Mike Mattson, Clackamas Community College

Margi Lee Smith, Oregon Institute of Technology

Susan Boyanovsky, Oregon Department of Community Colleges and Workforce
Development

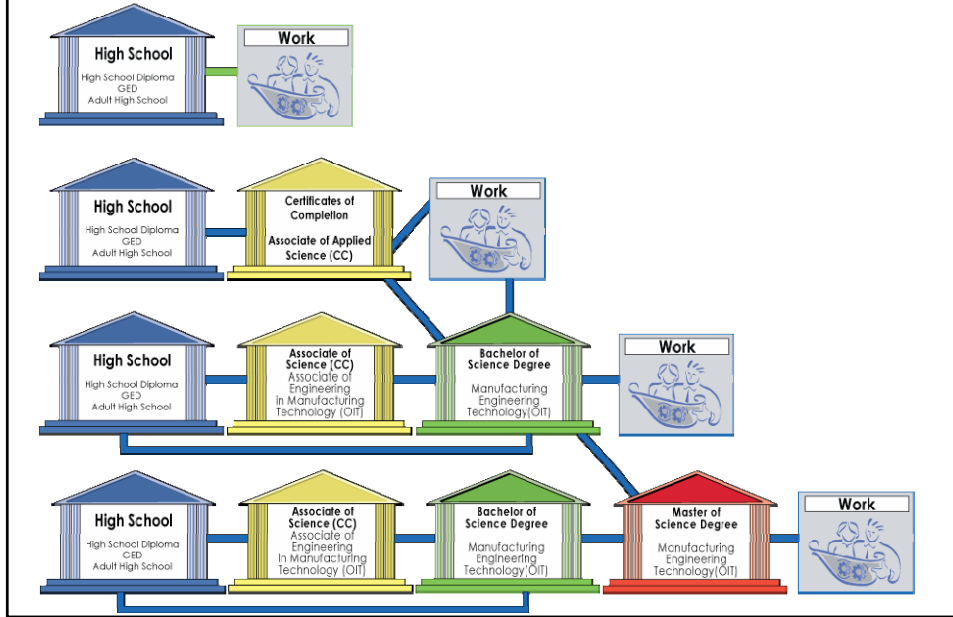


Manufacturing-Based Trades, Technical and Engineering Careers : An Overview

- What do Manufacturing-Based Engineering Tradesmen, Technicians and Engineers do in the workplace?
- What can they expect to earn with each credential?
- Will there be jobs for them?
- What are the career pathways for Manufacturing-Based Engineering Tradesmen, Technicians and Engineers ?
- How can a student get started earlier, save tuition, and improve time to degree?

MANUFACTURING-BASED TRADES, TECHNICAL AND ENGINEERING CAREERS

ARTICULATED EDUCATION PATHWAYS



Top 20 Demand (2004-2014) - Manufacturing-Based Trades, Technical & Engineering Occupations

SOC Title/Occupation	Total Openings	Starting Wages*	2006 Median Wage	Step on Pathway
First-Line Supervisors/Managers of Production and Operating Workers	2,637	\$ 13.84	\$ 23.58	2
Production Helpers	2,170	\$ 8.08	\$ 12.19	1
Welders, Cutters, Solderers, and Brazers	2,092	\$ 10.31	\$ 15.54	1
Inspectors, Testers, Sorters, Samplers, and Weighers	1,952	\$ 9.26	\$ 15.14	1
First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	1,906	\$ 15.63	\$ 26.01	2
Engineering Technicians, Except Drafters, All Other	1,585		n/a	2
Semiconductor Processors	1,424	\$ 11.02	\$ 15.41	2
Industrial Machinery Mechanics	1,406	\$ 14.73	\$ 20.33	2
Machinists	1,172	\$ 13.69	\$ 19.61	1
Engineering Managers	922	\$ 35.52	\$ 51.04	3
Computer and Information Systems Managers	901	\$ 27.67	\$ 45.52	3
Industrial Production Managers	691	\$ 23.08	\$ 38.55	3
Computer-Controlled Machine Tool Operators, Metal and Plastic	453	\$ 10.88	\$ 15.93	1
Mechanical Drafters	346	\$ 15.22	\$ 22.34	2
Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	271	\$ 9.24	\$ 14.58	1
Mechanical Engineering Technicians	240	\$ 15.80	\$ 35.97	2
Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	138	\$ 12.21	\$ 19.78	1
Electrical and Electronics Drafters	137	\$ 14.56	\$ 19.75	2
Materials Engineers	89	\$ 24.66	\$ 35.32	3
Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	87	\$ 12.39	\$ 14.58	1
Logisticians	75	\$ 19.33	\$ 28.61	3
Numerical Tool and Process Control Programmers	58	\$ 15.75	\$ 23.01	2

*2006 10th Percentile Hourly Wage (Proxy for starting wage**)



Top Starting Wages for Manufacturing-Based Trades, Technical and Engineering Occupations

SOC Title/Occupation	Total Openings	Starting Wages*	2006 Median Wage	Step on Pathway
Engineering Managers	922	\$ 35.52	\$ 51.04	3
Computer and Information Systems Managers	901	\$ 27.67	\$ 45.52	3
Materials Engineers	89	\$ 24.66	\$ 35.32	3
Industrial Production Managers	691	\$ 23.08	\$ 38.55	3
Logisticians	75	\$ 19.33	\$ 28.61	3
Mechanical Engineering Technicians	240	\$ 15.80	\$ 35.97	2
Numerical Tool and Process Control Programmers	58	\$ 15.75	\$ 23.01	2
First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	1,906	\$ 15.63	\$ 26.01	2
Mechanical Drafters	346	\$ 15.22	\$ 22.34	2
Industrial Machinery Mechanics	1,406	\$ 14.73	\$ 20.33	2
Electrical and Electronics Drafters	137	\$ 14.56	\$ 19.75	2
First-Line Supervisors/Managers of Production and Operating Workers	2,637	\$ 13.84	\$ 23.58	2
Machinists	1,172	\$ 13.69	\$ 19.61	1
Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	87	\$ 12.39	\$ 14.58	1
Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	138	\$ 12.21	\$ 19.78	1
Semiconductor Processors	1,424	\$ 11.02	\$ 15.41	2
Computer-Controlled Machine Tool Operators, Metal and Plastic	453	\$ 10.88	\$ 15.93	1
Welders, Cutters, Solderers, and Brazers	2,092	\$ 10.31	\$ 15.54	1
Inspectors, Testers, Sorters, Samplers, and Weighers	1,952	\$ 9.26	\$ 15.14	1
Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	271	\$ 9.24	\$ 14.58	1
Production Helpers	2,170	\$ 8.08	\$ 12.19	1
Engineering Technicians, Except Drafters, All Other	1,585	n/a	n/a	2

*2006 10th Percentile Hourly Wage (Proxy for starting wage**)




Top Demand Manufacturing-Based Occupations by Step on Pathway

SOC Title/Occupation	Total Openings	Starting Wages*	2006 Median Wage	Step on Pathway
Engineering Managers	922	\$ 35.52	\$ 51.04	3
Computer and Information Systems Managers	901	\$ 27.67	\$ 45.52	3
Industrial Production Managers	691	\$ 23.08	\$ 38.55	3
Materials Engineers	89	\$ 24.66	\$ 35.32	3
Logisticians	75	\$ 19.33	\$ 28.61	3
First-Line Supervisors/Managers of Production and Operating Workers	2,637	\$ 13.84	\$ 23.58	2
First-Line Supervisors/Managers of Mechanics, Installers, and Repairers	1,906	\$ 15.63	\$ 26.01	2
Engineering Technicians, Except Drafters, All Other	1,585	n/a	n/a	2
Semiconductor Processors	1,424	\$ 11.02	\$ 15.41	2
Industrial Machinery Mechanics	1,406	\$ 14.73	\$ 20.33	2
Mechanical Drafters	346	\$ 15.22	\$ 22.34	2
Mechanical Engineering Technicians	240	\$ 15.80	\$ 35.97	2
Electrical and Electronics Drafters	137	\$ 14.56	\$ 19.75	2
Numerical Tool and Process Control Programmers	58	\$ 15.75	\$ 23.01	2
Production Helpers	2,170	\$ 8.08	\$ 12.19	1
Welders, Cutters, Solderers, and Brazers	2,092	\$ 10.31	\$ 15.54	1
Inspectors, Testers, Sorters, Samplers, and Weighers	1,952	\$ 9.26	\$ 15.14	1
Machinists	1,172	\$ 13.69	\$ 19.61	1
Computer-Controlled Machine Tool Operators, Metal and Plastic	453	\$ 10.88	\$ 15.93	1
Multiple Machine Tool Setters, Operators, and Tenders, Metal and Plastic	271	\$ 9.24	\$ 14.58	1
Lathe and Turning Machine Tool Setters, Operators, and Tenders, Metal and Plastic	138	\$ 12.21	\$ 19.78	1
Milling and Planing Machine Setters, Operators, and Tenders, Metal and Plastic	87	\$ 12.39	\$ 14.58	1

*2006 10th Percentile Hourly Wage (Proxy for starting wage**)



High School Diploma Requirements

Subject	Class of 2009	Class of 2010	Class of 2012	Class of 2014
English, Language Arts	3	4 (required by HB 3129)	4	
Mathematics	2	3 (required by HB 3129)	3	Algebra I or higher
Science	2	2	3	Lab Experience Scientific Inquiry*
Social Sciences	3	3	3	
Physical Education	1	1	1	
Health	1	1	1	
Second Language Arts				
Career and Technical Education	1	1		
Focused Electives	9	9	6	
Total Credits	22	24	24	

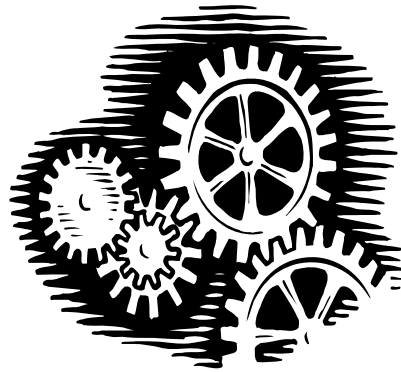
* Definition under discussion

Draft Statewide Articulation Agreement

Oregon of Institute of Technology articulation with Oregon Community Colleges: Manufacturing Engineering Technology updated April 5, 2007 v9												
Course Description	Notes/Guidance	OS Oregon Tech	Central Oregon	Chemeketa	Clatsop	Lincoln Benton	MHCC	Umpqua	Portland	Rogue	SOCC	PLTW
Manufac. Intro to/Orientation I		2 MET 111	GE101	GE101	MET111	ENGR 111	GE101(4)		CMET 111		ENGR 111	
Manufac. Intro to/Orientation II		2 MET 112	GE102	GE102	MET112	ENGR 111	GE 101 (4)		MCH102		ENGR 112	
Manufacturing Processes I		4 MFG 120	MFG112/MFG113	CAM130	MFG 111	MA3.423	MFG110/111		MCH 121	MFG 121	MFG 4101	
Intro Welding Processes		3 MFG 103	MFG 103	WLD051	WLD 150	WD4.151(2)	WLD116	WLD101	WLD 101	WLD 101	WLD 4010	ENGR 245 OR DRPT 110
CAD for Mechanical Design I		2 MET 241	CIS 125A1	DRF131	CDT103	EG4.421*	ET161		CMET 113			
Statics	Non-calculus based	4 ENGR 211	ENGR 211	EGR 211	GE 211	ENGR 211	ENGR 211	ENGR211	CMET 110	Will get from OIT or SOU	ENGR 211	
Safety Dimension & Tolerancing		2 MFG 314	MFG101	CAM 115	MFG 106	EG4.420			MCH 115	MFG 114	NDE	
CAD for Mechanical Design II		2 MET 242	CIS 125A2	DRF132	CDT106	EG 4.421	GE 115		MCH 222		DRPT 111	
Strength of Materials	Non-calculus based	4 ENGR 213	ENGR 213	EGR213	GE 213	ENGR 213	ENGR 213	ENGR213	CMET 121	Will get from OIT or SOU	ENGR 213	
Intro Processes of Mfg	machine shop	3 MFG 112	MFG102/MFG110	CAM110A	MET170	MA3.424			MCH 105		MT 101	
Materials I		3 MET 160	MFG123/MET 160	CAM160	MFG 221	MA3.437	MFG134/135		MCH107	MET 160	MFG 4102	
General Education												
Humanities Soc Electives		16	From these credit courses from the following: ART, ENG II or III, HUM, MUS, PHIL, ANTH, ECO, HIST, PSCL, PSY, SOC, GEOG.									
English Composition		3	WR1 121	WR 231	WR 121	WR 122	WR 121	WR121	WR121	WR 121	WR 121	WR 121
English Composition	8 credits of college transfer level writing with at least one technical writing class, WR 121 and higher	3	WR1 122	WR 122	WR122	WR 122	WR 122	WR122	WR122	WR 122	WR 122	WR 122 or WR 214T or WR 227
Technical Report Writing		3	WR1 227	WR 227	WR227	WR 227	WR 227	WR227	WR 227	WR1 227	WR 227	WR 227
Fund of Speech		3	SP1 111	SP 111	SP111	SP 111	SP 111	SP111	SP 111	SP 111	SP 111	SP 111
College Algebra		4	MATH 111	MTH 111	MTH111	MTH 111	MTH111	MTH 111	MTH111	MTH 111	MTH 111	MTH 111
Trigonometry		4	MATH 112	MTH 112	MTH112	MTH 112	MTH 112	MTH 112	MTH 112	MTH 112	MTH 112	MTH 112
Anal Geom & Diff Calc		4	MATH 251	MTH 251	MTH251	MTH 251	MTH251	MTH 251	MTH251	MTH 251	MTH 251	MTH 251
Integral Calculus		4	MATH 252	MTH 252	MTH252	MTH252	MTH252	MTH252	MTH252	MTH252	MTH252	MTH252
Statistical Methods I		4	MATH 361	MTH 243	MTH243	MTH 243	MTH 243	MTH 243	MTH 243	MTH 243	MTH 243	MTH 243
Statistical Methods II		4	MATH 362	MTH 244	MTH244	MTH 244	MTH 244	MTH 244	MTH 244	MTH 244	MTH 244	NDE
Elementary Chemistry	100 level chemistry course or higher	3	CHE 101	CH 221	CH121	CH 104	CH 150	CH221		CH 100	CHEM 104**	CH 150
Elementary Chem Lab		1	CHE 104	CH 221	CH121	CH 104	CH 150	CH221		CH 100	CHEM 104**	CH 150
General Physics	Non-calculus based first term physics	4	PHY 201	PH 201	PH201	PH 201	PH201	PH201	PH201	PH201	PH 201	PH 201
General Physics	Non-calculus based second term physics	4	PHY 202**	PH202	PH202	PH 202	PH 202	PH 202	PHY 202	PHY 202	PH 202**	PH 202
Computer Language Elec		3	ENGR 286	Any C/C++ programming language course								
TOTAL CREDIT HOURS		97										

Connecting Students to the Pathway

- Student Needs
- Workforce Needs
- Filling the Pipeline



Project Lead the Way

- What is Project Lead the Way (PLTW)?
- National Curriculum in Pre-Engineering
- Available in 9 Oregon high schools; 7 more are expected to implement in 2007 - 2008

Project Lead the Way

- Core, Advanced & Capstone Classes
 - Intro To Engineering Design (Core)
 - Principles of Engineering (Core)
 - Digital Electronics (Core)
 - Computer Integrated Manufacturing (Adv)
 - Engineering Design and Development (Cap)

Project Lead the Way

- Why PLTW?
- PLTW Complements the Pathway
- Not Every Kid Will Be an Engineer
- Most Kids Benefit from Concrete Problem-solving Practice to Apply What They've Learned

Disciplines in Industry and Engineering

- Technology and Trades
- Engineering Technology
- Engineering
- Engineering Science

Strategy

- Project Lead the Way as an Entry Point
- Simultaneous College and HS Credit
- Emphasize Value
- Build Engineering Tech Core at CC's
- Articulation to 4-Year School—MfgET
- High-Demand Alternatives for Others

HS-CC-OIT Partnerships

- Example in Clackamas County
- Technology and Engineering Technology
- Transferable Credit

Bachelor of Science – Manufacturing Engineering Technology

- ABET-accredited four year degree
 - General education requirements per OUS
 - Math through integral calculus plus statistics
 - Engineering science requirements per ABET
 - Engineering mechanics
 - Electrical fundamentals
 - Material science
 - Curriculum emphasis on manufacturing process design and control systems

Master of Science – Manufacturing Engineering Technology

- 45 total credit hours graduate coursework
- 30 credit hours from the following four Curriculum Content Areas – at least one class in each, at least three classes in one
 - Engineering Science & Design Technology
 - Manufacturing Software & Computer Integration
 - Advanced Manufacturing Materials & Processes Technology
 - Business, Financial & Management Processes
- Thesis or approved Capstone Project

MfgET Degree Completion Programs

- Boeing Company in Seattle, Washington
 - All courses taught on-site at Boeing
 - AS, BS and MS Degrees available
- OIT Metro Campus in Portland, Oregon
 - Junior and Senior year courses only
 - Courses taught in Clackamas, Oregon or via distance education
 - BS and MS Degrees available

Accreditation Board for Engineering and Technology, Inc. – ABET

- Independent accrediting body for U.S. post-secondary degree programs in applied science, computing, engineering, and technology
 - Specifies minimum curricula, faculty, facilities and support activities for various engineering programs
 - Evaluation team performs campus visits to determine if standards are met

ABET Outcomes

- Engineering programs must demonstrate that their students attain:
 - (a) an ability to apply knowledge of mathematics, science, and engineering
 - (b) an ability to design and conduct experiments, as well as to analyze and interpret data
 - (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
 - (d) an ability to function on multi-disciplinary teams
 - (e) an ability to identify, formulate, and solve engineering problems
 - (f) an understanding of professional and ethical responsibility
 - (g) an ability to communicate effectively
 - (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
 - (i) a recognition of the need for, and an ability to engage in life-long learning
 - (j) a knowledge of contemporary issues
 - (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Professional Certifications in Manufacturing

- Provide an industry standard for professional recognition
- Third-party, independent validation of manufacturing-related knowledge and skills gained
- Can, in some cases, stand in for a formal degree
 - Some require prior completion of a 2-year or 4-year accredited degree program

Professional Certifications in Manufacturing

- Require suitable performance on a comprehensive “Body of Knowledge” examination
 - Some require successful completion of a pre-experience exam
 - Some have an Active Practice requirements prior to taking the exam
- Provide educators with excellent instruments for outcome-based assessment

Professional Certifications in Manufacturing

- State Boards of Registration: Licensure as Professional Engineer
 - National Council of Examiners for Engineering and Surveying (NCEES) administers Principles and Practices of Engineering exam (PE)
 - Oregon State Board of Examiners for Engineering and Land Surveying (OSBEELS) administers Engineering Intern (EI) and Professional Engineer (PE) licensure
 - Mechanical Engineer License – ME
 - Control Systems Engineer License – CSE

Professional Certifications in Manufacturing

- Society of Manufacturing Engineers
 - Certified Manufacturing Technologist – CMfgT
 - Certified Manufacturing Engineer – CMfgE
 - Certified Engineering Manager – CEM
 - Specialized programs for various fields
 - Six Sigma Certification
 - Lean Certification
 - Certificates in Metal Formability, Coil Slitting, Stamping Die, CMMS, etc.

Professional Certifications in Manufacturing

- Instrument Society of America
 - Certified Automation Professional – CAP
 - Certified Control Systems Technician – CCST
 - Certified Industrial Maintenance Mechanics – CIMM

Questions and Answers

*Presentation materials and additional resources available at
http://opas.ous.edu//Workgroups2007/Pathways/OACTE_Presentation_Apr07.html*