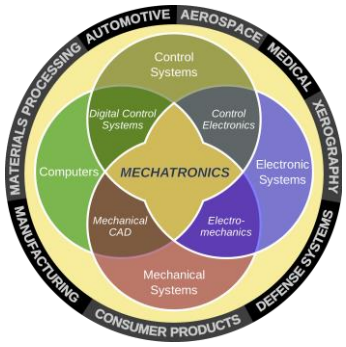
MECHATRONICS CAREERS in the CENTRAL VALLEY/MOTHER LODE REGION & SOUTH CENTRAL VALLEY SUB-REGION

A labor market profile of Mechatronics in Community College Programs

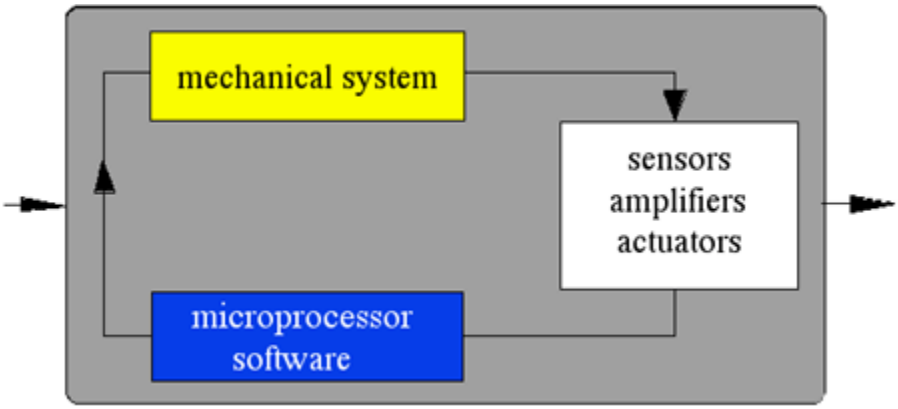


What is Mechatronics?

Mechatronics is an interdisciplinary area of engineering that combines mechanical and electrical engineering and computer science. A typical mechatronic system picks up signals from the environment, processes them to generate output signals, and then transforms them into forces, motions and actions (Exhibit 1).

Examples of mechatronic systems are robots, digitally controlled combustion engines, machine tools with self-adaptive tools, contact-free magnetic bearings and automated guided vehicles. The design of these products and devices typically requires extensive knowledge of systems and software. With advances in technology, software has become integral to the function and operation of products and devices. Consequently, software has become an actual "machine element."

Exhibit 1 – Relationship among mechatronics disciplines



The following labor market information provides context for the purpose of supporting mechatronics program conversations at Clovis College. It is recommended that the college work with department advisory boards and local industry partners to reach consensus.

Occupational Overview

Mechatronics professionals are the technicians and engineers who research, design, develop or test automation systems, smart devices or industrial systems control. They also maintain automated equipment. Technicians and engineers conduct their work in laboratories, offices or on-site manufacturing plants. These professionals work toward the same goal of producing and/or maintaining safe and efficient automated equipment. While technicians usually maintain machinery, engineers are more concerned with the design and development of components and products.

There are a few mechatronics postsecondary programs in California and a couple within the California community college system; however, the latter are housed under more generalized TOP codes and titles. The TOP code and title options in Exhibit 2 are based on the occupational titles provided for this profile.

Exhibit 2 – Mechatronics-related TOP codes

TOP Code	Program	SOC Code	Occupation
070600	Computer Science (transfer)	15-1131	Computer Programmers
070700	Computer Software Development	15-1131	Computer Programmers
070710	Computer Programming	15-1131	Computer Programmers
092400	Engineering Technology, General	17-3023	Electrical and Electronics Engineering Technicians
		17-3026	Industrial Engineering Technicians
		17-3027	Mechanical Engineering Technicians
		51-2022	Electrical and Electronic Equipment Assemblers
093400	Electronics and Electric Technology	17-3023	Electrical and Electronics Engineering Technicians
		51-2022	Electrical and Electronic Equipment Assemblers
		49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment
		49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment
		49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay
093410	Computer Electronics	17-3023	Electrical and Electronics Engineering Technicians
		49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment
093420	Industrial Electronics	17-3026	Industrial Engineering Technicians
		49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment
		51-2022	Electrical and Electronic Equipment Assemblers
093430	Telecommunications Technology	17-3023	Electrical and Electronics Engineering Technicians
093440	Electrical Systems and Power Transmission	17-3023	Electrical and Electronics Engineering Technicians
		49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay
093500	Electro-Mechanical Technology	17-3024	Electro-Mechanical Technicians
094300	Instrumentation Technology	17-3025	Electro-Mechanical Technicians
094500	Industrial Systems Technology and Maintenance	17-3027	Mechanical Engineering Technicians
094830	Motorcycle, Outboard and Small Engine Repair	49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment
095220	Electrical	17-3023	Electrical and Electronics Engineering Technicians
095600	Manufacturing and Industrial Technology	17-3026	Industrial Engineering Technicians
	No TOP Code Match	49-9041	Industrial Machinery Mechanics
		51-2023	Electro-Mechanical Equipment Assemblers
		17-2199.05	Mechatronics Engineers

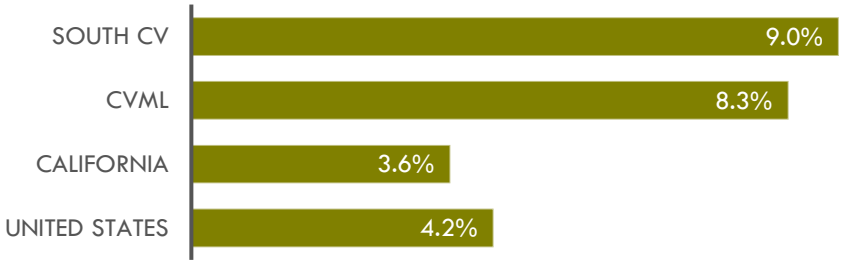
Projected Employment Growth

O*NET online projects a 2-4% national employment increase in mechatronics jobs between 2014 and 2024 with 33,000 projected openings. The top two industries with the most mechatronics positions are government and manufacturing.

Overall, mechatronics occupations identified by the study are projected to add jobs over the next five years with the greatest gains at the subregional level (South Central Valley), followed by the entire region (Central Valley/Mother Lode).

The South Central Valley is projected to grow at a speed more than double state and national rates (Exhibit 3). The Central Valley/Mother Lode region also far out-paces both the state and nation in terms of job growth, but not quite at the level of the South Central Valley.

Exhibit 3 – Projected mechatronics job growth



The study also analyzed projected growth by occupation for the Central Valley/Mother Lode region and South Central Valley subregion. Twelve occupations were identified, employing a total of 10,802 workers in the region.

Industrial Machinery Mechanics is the largest occupation at both the regional and subregional level, with 4,514 and 2,833 jobs respectively. Within the mechatronics cluster, this occupation also has the greatest projected growth at 13% and 15%, adding more than 5,000 jobs in the region over the next five years.

The largest occupation requiring an associate degree is Electrical and Electronics Engineering Technicians. This occupation has a more modest projected growth rate of 4% (regional) and 5% (subregional).

The smallest occupation is Electro-Mechanical Technicians which is projected to only add two jobs annually over the next five years.

Exhibit 4 shows the employment outlook for each mechatronics occupation in the Central Valley/Mother lode region. The data are sorted in descending order by current number of jobs and projected annual openings.

Exhibit 4 – Projected occupational growth for the Central Valley/Mother Lode region

SOC Code	Occupation	2016 Jobs	2021 Jobs	% Growth*	Annual Openings**
49-9041	Industrial Machinery Mechanics	4,514	5,111	13%	263
49-9051	Electrical Power-Line Installers and Repairers	1,177	1,228	4%	61
17-3023	Electrical and Electronics Engineering Technicians	1,175	1,223	4%	35
15-1131	Computer Programmers	1,104	1,152	4%	41
17-2199	Engineers, All Other	937	975	4%	26
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	618	646	5%	19
51-2022	Electrical and Electronic Equipment Assemblers	546	583	7%	15
51-2023	Electromechanical Equipment Assemblers	221	227	3%	5
17-3027	Mechanical Engineering Technicians	207	229	11%	9
17-3026	Industrial Engineering Technicians	143	157	10%	6
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment	118	124	5%	4
17-3024	Electro-Mechanical Technicians	42	47	12%	2

*Growth refers to net change over the period, i.e. new job creation or job decline, and does not factor in replacement jobs.
**Annual openings represents the annual average number of new jobs plus replacement jobs projected for the five-year period.

Hourly Wages

The living wage for one adult in the Central Valley/Mother lode region ranges from $9.99/hour in Merced County to $12.62/hour in Mono County. The region's overall average is $10.53/hour. In the South Central Valley subregion, the living wage ranges from $10.21/hour in Kings County to $10.70/hour in Fresno County, with an overall average of $10.43/hour.

Wages were analyzed by occupation and compared with regional and subregional living wages.

Entry-level hourly wages range from $10.02 regional/$9.83 subregional for Electromechanical Equipment Assemblers to $24.96 regional/$25.43 subregional for Electrical Power-Line Installers and Repairers. Only the Electromechanical Equipment Assemblers occupation falls below the average living wage for a single adult.

The average hourly entry-level wage within the mechatronics occupational cluster is $18.05 for the region and $18.07 for the South Central Valley subregion. These averages are far above the average hourly living wage for one adult at the regional ($10.53) and subregional ($10.43) levels.

Exhibit 5 – Entry-level and median hourly wages

SOC Code	Occupation	Entry-level Hourly Wage*	Median Hourly Wage
49-9041	Industrial Machinery Mechanics	$14.86	$24.14
49-9051	Electrical Power-Line Installers and Repairers	$24.96	$44.43
17-3023	Electrical and Electronics Engineering Technicians	$23.60	$34.51
15-1131	Computer Programmers	$21.63	$34.66
17-2199	Engineers, All Other	$18.31	$47.65
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment	$18.41	$25.35
51-2022	Electrical and Electronic Equipment Assemblers	$10.63	$14.93
51-2023	Electromechanical Equipment Assemblers	$10.02	$13.78
17-3027	Mechanical Engineering Technicians	$17.38	$25.82
17-3026	Industrial Engineering Technicians	$19.78	$27.35
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment	$20.21	$27.62
17-3024	Electro-Mechanical Technicians	$19.54	$27.81

*Entry-level hourly wage is represented by the 10th percentile wage – 10% of workers in the occupation make less, while 90% of the workers in the job make more than this amount.

Typical Education Level

Education and training requirements for entry-level work will vary by occupation and employer preference. Exhibit 6 shows the typical required entry-level education as identified by the Bureau of Labor Statistics as well as employer educational preferences collected by O*NET.

Based on Bureau of Labor Statistics, two mechatronics occupations require at least a bachelor's degree: computer programmers and engineers, all other/mechatronics engineers.

In addition, there are four occupations that require at least an associate degree and two that require at least a postsecondary non-degree award. Technicians comprise the occupations requiring an associate degree, while installers and repairers are occupations that require a postsecondary non-degree award.

Exhibit 6 – Mechatronics educational requirements

Occupation	Typical Entry-level Education	O*NET Job Zone: Education
Computer Programmers	Bachelor's degree	Most require a bachelor's degree, but some do not.
Engineers, All Other/Mechatronics Engineers	Bachelor's degree	Most require a bachelor's degree, but some do not.
Electrical and Electronics Engineering Technicians	Associate degree	Most require vocational training or an associate degree.
Electro-Mechanical Technicians	Associate degree	Most require vocational training or an associate degree.
Industrial Engineering Technicians	Associate degree	Most require vocational training or an associate degree.
Mechanical Engineering Technicians	Associate degree	Most require vocational training or an associate degree.
Electrical and Electronics Installers and Repairers, Transportation Equipment	Postsecondary non-degree award	Most require vocational training or an associate degree.
Electrical and Electronics Repairers, Commercial and Industrial Equipment	Postsecondary non-degree award	Most require vocational training or an associate degree.
Industrial Machinery Mechanics	High school diploma/equivalent	Most require vocational training or an associate degree.
Electrical Power-Line Installers and Repairers	High school diploma/equivalent	Most require vocational training or an associate degree.
Electrical and Electronic Equipment Assemblers	High school diploma/equivalent	Most require a high school diploma.
Electromechanical Equipment Assemblers	High school diploma/equivalent	Most require a high school diploma.

Occupational Trends

Mechatronics is vital to modern engineering systems and requires multidisciplinary expertise across a range of disciplines, such as mechanical engineering, electronics, information technology and control systems science.

- Safety-enabled productivity is one trend as manufacturers look to broaden their horizons beyond protecting operators and equipment to encompass protecting performance.

- Some organizations are using safe speed and speed to make a variety of operations more productive and continuous by reducing frequent delays.

Trends that manufacturers should be taking a close look at in 2016 include big data, predictive maintenance, the Industrial Internet of Things (IIoT), and smart energy monitoring for transparent factory operations.

- The combination of sensors, the broad connectivity of the Internet of Things (IoT) and big data functionality will increasingly enable organizations to mine their data for actionable insights. This level of transparency into operations will allow an entire organization, from machine operators to upper management, to make decisions that streamline performance and enhance profitability.

- Depending on the implementation, information can be available in minutes or even in real time. Management can review information such as operational equipment effectiveness, throughput and changeover time. Maintenance and system integrators alike can have parameters like current draw and load curve delivered to their mobile phones.

Regional Programs

Nine of the 14 community colleges in the region have one or more programs within the 15 mechatronics-related TOP codes. When program award data for the Central Valley/Mother Lode region was reviewed, it was determined that a total of 302 awards were earned in the 2013-2014 academic year, and 393 were awarded in 2014-2015. Awards represented a combination of certificates and associate degrees.

Exhibit 7 – Mechatronics-related postsecondary awards

College	Awards 2013-2014	Awards 2014-2015
Bakersfield	71	71
Cerro Coso	4	
Fresno City	58	133
Merced	56	53
Modesto	31	50
Porterville		25
Reedley	4	7
San Joaquin Delta	29	14
Sequoias	49	40

A review of educational institutions in the region revealed that that three California State Universities, one private university and two private technical schools offer mechatronics-related programs. In 2013-2014, these institutions reported conferring 113 awards or degrees.

Conclusion & Recommendations

Based on this study's occupational and program findings, it is suggested that colleges in the region and subregion consider taking the following steps:

- Review the TOP codes and occupational titles included in this assessment to ensure that only those occupations with the most direct employment relevance to the curricula have been included.
- As curriculum is review and updated or as new curriculum is developed, consider incorporating some of the industry trends identified by the study such as safety-enabled productivity, predictive maintenance, and smart energy monitoring.
- Based on the review of employer educational preferences and employment projections, mechatronics associate degree programs should focus on the following occupations: Electro-Mechanical Technicians, Industrial Engineering Technicians and Mechanical Engineering Technicians.
- Only two occupations in the mechatronics cluster require a postsecondary non-award degree. However, these occupations are projected to experience little growth (only 4-5%) in coming years. Colleges may want to take this into consideration when updating existing programs or developing new programs.
- Encourage employers on the advisory board to participate in the Center of Excellence Central Valley/Mother Lode regional study of manufacturing production line occupations scheduled to begin in June 2016. The study will be used to identify or validate in-demand coursework as well as certificates and degrees preferred by employers for new hires.

For more information on this report, please contact:

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Sources: Economic Modeling Specialists Intl. (EMSI), Bureau of Labor Statistics (BLS), and Mechatronics Consulting (http://www.mcgs.ch/index.html)