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ICT/DM

KSA (Knowledge Skills and Abilities)
&
LMI (Labor Market Information)

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Regional Directory of Employer Engagement

- California Community Colleges:
 - ICT Regional Director in San Diego / Imperial Counties
 - Professor in San Diego Continuing Education
- Corporate:
 - Scripps Research : Research Programmer in Metabolomics and Mass Spectrometry
 - Senior Marketing Consultant to Qualcomm, Microsoft, Cisco, Karl Strauss, ViaSat, Welk Resorts
- Academic:
 - MBA – The Ohio State University
 - Master in Information Systems Management – Keller, (DeVry University)
 - BA in French, The Ohio State University
 - BA in International Studies, The Ohio State University



Duane Rinehart

Knowledge, Skills, Abilities for Success by Subsector

Business Software Applications	IT Networking/Cybersecurity	Computer Science / Software Development	Digital Media / Entertainment
Business Communications & Computer Literacy	A+ (or comparable hardware) (esp. retail)	CS-ADT	Graphic Design (Adobe - Photoshop, Illustrator, InDesign, Animate)
MS Office (Word, Powerpoint, Excel, Outlook)	Help desk / troubleshooting	C++, python, Java, Javascript + node.js	Video/Audio Production
Excel (pivot tables) or Google Docs	CISCO (or comparable) certification	Linux, Windows Server (certification valued but not without degree)	Photography
Quickbooks	Security+, CySA+, CISA, CISSP certifications	RDBMS (MySQL, MS SQL Server, Oracle) NoSQL (mongo, couchdb); graph db (e.g. Neo4j) for GIS	Writing / storytelling / journalism
Business math	Linux & Open source security tools (e.g. Kali)	Scripting (bash or Powershell)	[Web] Publishing
Salesforce (CRM)	Scripting (bash)	Debugging; Frameworks – AngularJS, React	Social media

KSA – Hybrid or New Subsectors

- New subsectors are evolving in data management / “cloud”, data science. In addition specialized applications of IT are forming in healthcare and advanced manufacturing

Data Management / Cloud	Analyzing Data (Data Science)	Healthcare	Advanced Manufacturing
Software Engineering	Data collection / web scraping	Security (HIPAA compliance)	Sensor-driven analytics
Scrum	Excel + Pivot Tables, Programming	Electronic Medical Records Systems	Universal integration (API, connecting subsystems)
Agile Development	SQL, JSON	ICD-10 coding (terminology)	Basic Statistics / Math
Unit Testing	Basic Statistics + R, SAS	Business management	CAD/CAM
DevOps	Machine Learning (applying algorithms)	Reporting	Robotics (programming)
Software Architecture	“Big Data” analytics	Credential – RHIT (Associate’s), RHIA (Bachelor’s)	Supply chain / ERP knowledge
Application Design	Predictive modeling		

ICT/DM Sector Includes...

Subsector	Jobs in Region ⁽¹⁾	Companies / Organizations (with Regional Presence)	Total Employees in Region
Business Software Applications (office productivity software)	26,820	89 ⁽²⁾	39,190 ⁽²⁾
IT Networking / Cybersecurity / Cloud	7,047 - 8,500 ⁽⁶⁾	3,805 ⁽³⁾	74,845 ⁽³⁾
Computer Science / Software Development (BS only)	5,074		
Digital Media / Entertainment	3,723	7,680 ⁽⁴⁾	296,042 ⁽⁴⁾

Note: “Core” Employment as percentage of total workers is 9.4% statewide ⁽⁵⁾; Region is 6.9-14% (Networking/Cybersecurity + Software Development), reflecting cybersecurity concentration (DoD and military), but also cross-sector opportunities

Sources: 1) Avg. annual job openings 2018-2023, WestEd (2020), Launchboard, US Census (BIW includes firms with <250 employees and only job education level greater than high school but less than bachelor); 2) ReferenceUSA (MAR-2019) – companies with HQ in region, 250+ employees; 3) ReferenceUSA (MAR-2019) NAICS codes: 334111, 334118, 334112, 334210, 334290, 334220, 334310, 334417, 334419, 334412, 334413, 334416, 334613, 334614, 511210, 517311, 517312, 517410, 517919, 518210, 519190, 541512; 4) ReferenceUSA (MAR-2019) NAICS codes: 334111, 334310, 334510, 335999, 336611, 339112, 339920, 511199, 511210, 515120, 517919, 519110, 541511, 541613, 541810, 541840, 541921, 561510, 611110, 621511, 622110, 711410, 841890; 5) CompTIA 2018 Cyberstates report – California (cyberstates.org); 6) San Diego Cyber Center of Excellence (2018) – upper limit of cybersecurity only

Major Employers by Subsector

Subsector	Employers ⁽¹⁾
Business Software Applications (office productivity software)	Illumina, ViaSat, General Atomics, Cubic, Qualcomm, Optum Health, Solar Turbines, Sempra Energy, Rady Children’s Hospital, Scripps Research, Callaway Golf, AMN Healthcare, Bridgepoint Education
IT Networking / Cybersecurity	NAVWAR (prev. SPAWAR) * (42-71% of all cyber jobs)
	Northrop Grumman, Raytheon, Solute, Serco, Engility (SAIC), Booz Allen Hamilton, Teradata, Qualcomm, General Atomics, Sony Electronics, BAE Systems, ViaSat, Accenture, Leidos, ServiceNow
Computer Science / Software Development (BS only)	Qualcomm, Intuit, Mitchell, Cymer, ViaSat, Illumina, General Atomics, General Dynamics, SAIC, Leidos
Digital Media / Entertainment	Sony, Qualcomm, Activision, HP, ServiceNow, Thermo Fisher Scientific, Via Technical, Illumina, Teradata, Accenture, Sayva Solutions

Sources: 1) CoE reports, San Diego EDC, and Primary Research

COVID-19 Role

- US Unemployment – 26.4m (16% of US Labor Force)⁽¹⁾
- California hardest hit: 3.4m (16.6% of CA Labor Force)⁽²⁾
 - Note: Excludes “gig” workers -> expected to rise more
- Many ICT jobs may be completed “off-site”, and are not at high risk of unemployment, exception being Digital Media/Entertainment (up to 51% unemployment – but only represents 3% of CA workforce -> max ~313K statewide)⁽⁴⁾
- Overall sector impact is still unclear however we have some data points:
 - Social distancing will likely continue through end of 2020⁽³⁾
 - CA Chancellor’s Office expects education budget will be financially impacted [negatively] – potential update in AUG-2020

Initiatives

- Tasks groups are forming to study impacted groups and labor market (WDC, CoE, EDC, Southwestern College, etc.)
- Regional Consortia is launching RFA (to be released early May 2020):
 - create inventory of all programs
 - assessment of enrollment/retention/success
 - Realignment of programs to industry needs
 - Stackability of credentials
 - Dual enrollment
 - Professional learning
 - Tracking of noncollege credential attainment

Appendix – KSA by Subsector Detail

Key Employment Drivers by Sub sector – Business Software Applications

- 17-26% increase in total job openings⁽¹⁾
- Baseline Knowledge (required for entry):
 - Business communications & literacy
 - MS Windows
 - Microsoft Office (esp. Excel)
 - Basic CRM (esp. Salesforce)
- Additional competencies (required for advancement)⁽²⁾ :
 - Excel pivot tables, depending on employer
 - Quickbooks, depending on employer
 - Intermediate Salesforce expertise (possible sub. w/ SAP or Oracle)



Key Employment Drivers by Sub sector – Business Software Applications (con't)

- Key driver is outsourcing CRM (analytics of customer data) to cloud (25% CAGR ⁽¹⁾ in US enterprises)
 - Major industries are: Financial Services, Manufacturing, Retail/Wholesale, Communications & Media; and Healthcare
 - Additional industry specific knowledge and language is vital
- Additional organization and communication skills are highly valued
 - Presentations, writing, research
 - Possible dual-major with business, English, etc.
 - Project management training / PMP ⁽²⁾

Key Employment Drivers by Sub sector – Cybersecurity / Networking

- 14-75% increase in total job openings⁽¹⁾
- Baseline Knowledge (required for entry):
 - General IT security knowledge
 - Data privacy
 - Information assurance
 - Data security
- Additional competencies (required for advancement)⁽²⁾ :
 - Network security
 - Authentication
 - Penetration testing
 - Intrusion detection
 - Vulnerability analysis
 - IoT (Internet of Things)
 - Artificial intelligence
 - Threat intelligence and analysis



Sources: 1) 14% from CoE Labor Market Analysis – “Information Security Analysts” (2018-2023), APR-2019; 28% from Cybrary, “2019 Job Outlook” (2016-2026); 75% from Burning Glass, “New Foundational Skills” (2012-2017); 2) Burning Glass and San Diego Cybersecurity Industry Economic Impact Study, MAR 2019;

Key Employment Drivers by Sub sector – Cybersecurity / Networking (con't)

- Knowledge of Linux, Network Administration, bash scripting, open source security tools (e.g. Kali), encryption, cloud security ⁽³⁾
- Many federal government contractors (primary-tertiary) require security clearance
- Regulatory Compliance: NIST800-171 ⁽²⁾
- Certifications are likely required in this area such as ⁽⁴⁾ :
 - (ISC)² – CISSP, CCSP, ISSMP, ISSAP
 - ISACA – CISA, CISM, CRISC, CGEIG
 - EC-Council – CEH, CHFI

Key Employment Drivers by Sub sector – Computer Science/Software Development

- 35-54% increase in total job openings⁽¹⁾
- Baseline Knowledge (required for entry):
 - Javascript (ECMA Script)
 - python
 - Debugging skills
- Additional competencies (required for advancement)⁽²⁾ :
 - Java
 - C/C++/C#
 - Frameworks (AngularJS/ReactJS for web or pandas for python)
- Connections to relational (RDBMS) and NoSQL databases are also critical.
 - SQL knowledge for RDBMS and ECMA Script (AJAX connection to data sources) play key roles in managing information flows⁽³⁾
 - Database storage of structured data is also precursor to data science/analytics and machine learning



Key Employment Drivers by Sub sector – Computer Science/Software Development (con't)

- HTML5/CSS skills are helpful for web development, scraping but are largely abstracted in MVC⁽⁴⁾ framework (relegating this skillset to digital media)
 - Specialization largely depends on employer size – firms with ≥ 250 emp can justify dedicated web developers (design, layout); smaller firms consolidate roles
- Additional languages are industry/project dependent:
 - Java, Kotlin (Android mobile devices)
 - Swift (Apple devices – e.g. iPhone)
 - javascript/ECMA Script (mainly web/mobile apps)
 - C (embedded, gaming, high performance apps)
 - C++, C#/Visual Basic (Window apps)

Key Employment Drivers by Sub sector – Digital Media

- 0-10% increase in total job openings⁽¹⁾
- Baseline Knowledge (required for entry):
 - Adobe Creative Suite (esp. InDesign, Photoshop, Illustrator, Animate)
 - MS Office (esp. Powerpoint, Excel)
 - Video editing (e.g. Final Cut Pro), depending on employer
 - Website design/development – web dev
 - Javascript (ECMA Script) – web dev
- Additional competencies (required for advancement)⁽²⁾ :
 - HTML5/CSS3 Responsive frameworks (e.g. Bootstrap) – web dev
 - Intermediate-level Adobe Animate (formerly Flash), Maya - multimedia



Sources: 1) 0% (Multimedia Artists & Animators), 5% (Film & Video Editors), 5% (Audio & Video Equipment Techs), 6% (Web Developers), 10% (Photographers) from CoE Labor Market Analysis (APR-2019); 2) San Diego-Imperial Regional KSA Analyzer and primary research

Key Employment Drivers by Sub sector – Digital Media (con't)

- **Web Development Skills (Design/layout):**
 - HTML5/CSS3 (Responsive web design & frameworks)
 - Javascript (ECMA Script) - React.js (Facebook) and Angular.js (Google) ⁽¹⁾ are leading but are employer dependent
 - Smaller firms consolidate design/layout with programming
- **Additional skills in content creation and communication are highly valued**
 - Creativity, presentations, writing, research
 - Familiarity with social media posting / editing
 - Possible dual-major with journalism, broadcasting, business, English, etc.

Key Employment Drivers by Sub sector – Data Management/Cloud

- 24-32% increase in total job openings⁽¹⁾
- Baseline Knowledge (required for entry):
 - Software engineering/architecture
 - Knowledge of Scrum/Agile
 - unit testing
 - DevOps
- Additional competencies (required for advancement)⁽²⁾ :
 - programming language frameworks (e.g. Java – Spring)
 - continuous deployment (e.g. Jenkins)
 - Salesforce development (e.g. Application Programming Interface, “API”)

“Career Ladder”



Sources: 1) 24% from Burning Glass, “New Foundational Skills” (2012-2017), Aggregated “DevOps Engineers”, “Data Engineers”, “Scrum Masters”, “Test Engineers” (32% from projected hires by 2022 from SD Regional EDC, “Advancing San Diego”, 2019; 2) Burning Glass, “New Foundational Skills” (2012-2017); 3) WhizLabs, “List of Best DevOps Certifications”, APR 2019 and New Horizons, “The 6 Most Valuable Cloud Certifications to Have on Your Résumé”, MAY 2019

Key Employment Drivers by Sub sector – Data Management/Cloud (con't)

- DevOps professionals also require advanced knowledge (and frequently certifications) ⁽³⁾ :
 - Cloud/virtualization technologies:
 - Docker, Kubernetes
 - AWS DevOps or Certified Solutions Architect
 - Google Cloud
 - Microsoft Azure DevOps
 - Configuration management ⁽⁴⁾:
 - Ansible (most used)
 - Chef, Puppet, Terraform, Salt
- Certifications provide additional value (hiring/advancement):
 - Scrum/Agile (project mgmt. or scrum master)
 - Continuous Delivery Architecture
 - Test Engineering

Sources: 1) 24% from Burning Glass, "New Foundational Skills" (2012-2017), Aggregated "DevOps Engineers", "Data Engineers", "Scrum Masters", "Test Engineers" (32%) from projected hires by 2022 from SD Regional EDC, "Advancing San Diego", 2019; 2) Burning Glass, "New Foundational Skills" (2012-2017); 3) WhizLabs, "List of Best DevOps Certifications", APR 2019 and New Horizons, "The 6 Most Valuable Cloud Certifications to Have on Your Résumé", MAY 2019; 4) RightScale 2019 State of the Cloud Report

Key Employment Drivers by Sub sector – Data Science / Data Analytics

- 29-68% increase in total job openings⁽¹⁾
- Baseline Knowledge (required for entry):
 - Data collection
 - Excel pivot tables
 - Basic statistics
- Additional competencies (required for advancement)⁽²⁾ :
 - Data science
 - Machine learning
 - R
 - SAS
 - Analytics
 - Data governance
 - Predictive modeling



Sources: 1) 29% from Indeed.com (2013-2019), 68% from Burning Glass, “New Foundational Skills” (2012-2017); 2) Burning Glass, “New Foundational Skills” (2012-2017)

Key Employment Drivers by Sub sector – Data Science / Data Analytics (con't)

Three core pillars (KSA detail follows):

- Data collection / aggregation / storage (web scraping, database aggregation, file imports & manipulation)
- Data Analysis (look at data; answer business questions)
- Data Visualization
- Critical thinking about the business implications (interpret the data), and telling the story with the data are highly valued ⁽¹⁾
- Key drivers are “big data” adoption (36% CAGR ⁽²⁾ in US enterprises), IoT, Defense Intelligence ⁽⁴⁾
 - Major industries are: Telecommunications, Insurance, Advertising, Financial Services, & Healthcare
 - Additional industry specific knowledge and language is vital

Key Employment Drivers by Sub sector – Data Science / Data Analytics (con't)

Data collection / aggregation / storage (web scraping, database aggregation, file imports & manipulation)

- File systems (especially for large data such as ReFS, ZFS, BtrFS) & knowledge of data governance
- Programming (python⁽²⁾, Java, C / C++ / C#, javascript, R⁽¹⁾)
- Ability to perform database queries, joins, etc. (SQL, JSON, MS Access)
- Cloud data storage/extraction (JSON, AWS, Google, Azure)
- Data cleaning (text manipulation)
- Apache Hadoop (hybrid filesystem / database)
- Familiarity with ETL (Extraction, Transformation & Loading) concepts

Representative Job titles: Data Engineer, Database Administrator, Cloud Technician, Data Warehouse Technician, Big Data Software Developer

Sources: 1) Ability to install libraries from CRAN is valued; 2) Use of pandas, numpy and related modules is required [for coding data]; 3) towardsdatascience.com/; 4) r4stats.com/; 5) Recently acquired by Salesforce – consolidation may spur additional skill requirements such as knowledge of Salesforce API

Key Employment Drivers by Sub sector – Data Science / Data Analytics (con't)

Data analysis (look at data; answer business questions)⁽⁴⁾

- Basic math, statistics [and ability to use software application] (R, SPSS, Statistica, Matlab, SAP)
- Programming (python⁽²⁾, Java, C / C++ / C#, javascript, R⁽¹⁾)
- Ability to perform database queries, joins, etc. (SQL, JSON)
- Excel (including pivot tables)
- Data portal usage (Qlik View, SAP Business Objects, SAS, Tableau)
- Critical thinking about the business implications (interpret the data), and telling the story with the data

Representative Job titles: Data Analyst, Database Administrator, Business Intelligence Analyst, Systems Analyst, Marketing Analyst, Operations Analyst

Sources: 1) Ability to install libraries from CRAN is valued; 2) Use of pandas, numpy and related modules is required [for coding data]; 3) towardsdatascience.com/; 4) r4stats.com/; 5) Recently acquired by Salesforce – consolidation may spur additional skill requirements such as knowledge of Salesforce API

Key Employment Drivers by Sub sector – Data Science / Data Analytics (con't)

Data Visualization (create presentations for decision making stakeholders)^(3, 4)

- End-user portal creation (Tableau⁽⁵⁾, GIS, Geo4w, d3.js, SAP Business Objects, PowerBI, Datatables)
- Ability to connect to databases or cloud storage [to setup visualization solution] (SQL, JSON, d3.js)
- Ability to format and customize interactive graphs, reports (HTML5/CSS, ECMA Script/javascript)

Representative Job titles: Data Visualization Specialist,

Other (more advanced)

- Amazon ML (machine learning)
- Hadoop, Apache Hive
- Apache Spark (clustered computing)
- Golang, Scala (programming)
- Understanding of machine learning / artificial intelligence concepts, (un)supervised models

Sources: 1) Ability to install libraries from CRAN is valued; 2) Use of pandas, numpy and related modules is required [for coding data]; 3) towardsdatascience.com/; 4) r4stats.com/; 5) Recently acquired by Salesforce – consolidation may spur additional skill requirements such as knowledge of Salesforce API

Key Employment Drivers by Sub sector – Crossovers: Healthcare & Advanced Manufacturing

- “Tech” Healthcare: 13-20% increase in total job openings ⁽¹⁾
 - Knowledge:
 - Security knowledge & procedures (HIPAA compliance)
 - Epic, Cerner, Meditech, AllScripts (EMR software)
 - ICD-10 coding (terminology)
 - Business management
 - Reporting tools
 - Telemedicine tools (networking, tech support)
 - Wearables (IoT, API) ⁽²⁾
 - Very regulated
 - Credentials are required – RHIT (Associate’s), RHIA (Bachelor’s) ⁽³⁾
- Advanced Manufacturing: 10% increase in total job openings ⁽⁴⁾
 - Knowledge:
 - Basic math
 - Robotics
 - Excel (including pivot tables)
 - API for subassemblies

Sources: 1) 13% for RHIT, 20% for RHIA, BLS (2016-2026); 2) Internet of Things (IoT) devices communicate with EMR systems via API; 3) Registered Health Information Technician/Administrator through AHIMA; 4) 10% from CoE Labor Market Analysis – “CNC Occupations – Machine Tools Programmers” (2018-2023)