FOR IMMEDIATE RELEASE

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772-234-2787

Average market value for 593 non-certified tech skills rose in the second quarter of 2020, driven principally by increases in cash pay premiums for Applications Development Tools & Platforms, Data/Database, Operating Systems and Messaging and Communications noncertified skills.

508 tech certifications continued their three-year overall decline in market value, with pay premiums losses spread across all eight certification categories.

Which industries, tech domains and jobs are the winners and losers as the pandemic cuts through every aspect of our lives?

NOTE: This news release is a summary extract of content in the 3rd Quarter 2020 update of Foote Partners’ Tech Skills Demand and Pay Trends Report and IT Skills and Certification Volatility Index, two market intelligence trend reports updated every 3 months from data contributed by 3,602 U.S. and Canadian employers. It contains tech jobs and skills trends published in the firm’s IT Professional Salary Survey and IT Skills and Certifications Pay Index™ and deep-dive supply/demand benchmark and empirical research from Foote Partners field interviews.

Vero Beach, FL – August 5, 2020 - Extra pay awarded by employers to talented tech professionals for 593 non-certified tech skills ---also known as cash pay premiums---increased slightly in the second calendar quarter of 2020. Currently averaging the equivalent of 9.6 percent of base salary on average for a single non-certified skill, this is the highest average premium in 20 years. Conversely, average market values for 508 tech certifications decreased from April to June, down more than 2 percent overall, currently earning the equivalent of 6.9 percent of base salary on average for a single certification. That’s the lowest average pay premium for IT certifications in 7 years and the widest gap between certified and noncertified tech skills pay since mid-2000.
This according to the latest quarterly update of Foote Partners’ *IT Skills and Certifications Pay Index™* (ITSCPI) based on compensation data provided by 3,602 private and public-sector employers in 83 U.S. and Canadian cities who partner with the firm to report pay for their 326,656 technology professionals in the U.S. and Canada.

**Pay Performance, 3/12/24/24/36 months**

Certified vs. Non-certified Tech Skills

(80,162 IT professionals, data through 7/1/2020)

![Figure 1](image)

Source: Foote Partners, *IT Skills and Certifications Pay Index™* (2Q2017 – 2Q2020 datasets)
20-YEAR PAY PREMIUM TRENDS: Certified versus Noncertified Tech Skills

Average median cash pay premiums for a single certified or non-certified IT skill. Data through July 1, 2020 – 80,186 IT Professionals
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Certified IT Skills Pay Summary (through July 1, 2020)</strong></td>
<td></td>
</tr>
<tr>
<td>- Pay Performance Trends: 3 / 12 months</td>
<td>5</td>
</tr>
<tr>
<td>- 17-Year Pay Premiums by Category</td>
<td>6</td>
</tr>
<tr>
<td>- Market Value Gainers &amp; Highest Paying</td>
<td>7</td>
</tr>
<tr>
<td>- Market Value Losers</td>
<td>8</td>
</tr>
<tr>
<td><strong>IT Certifications Pay Summary (through July 1, 2020)</strong></td>
<td></td>
</tr>
<tr>
<td>- Pay Performance Trends: 3 / 12 months</td>
<td>9</td>
</tr>
<tr>
<td>- 17-Year Pay Premiums by Category</td>
<td>10</td>
</tr>
<tr>
<td>- Market Value Gainers &amp; Highest Paying</td>
<td>11</td>
</tr>
<tr>
<td>- Market Value Losers</td>
<td>12</td>
</tr>
<tr>
<td><strong>3Q 2020 Pandemic Tech Labor Trends Discussion &amp; Analysis</strong></td>
<td>14</td>
</tr>
<tr>
<td>- As the Pandemic Turns – Industry Winners</td>
<td>15</td>
</tr>
<tr>
<td>- Understanding the New Labor Landscape</td>
<td>18</td>
</tr>
<tr>
<td>- Repairing and Preparing the Tech Workforce</td>
<td>25</td>
</tr>
<tr>
<td><strong>IT Skills &amp; Certifications Pay Data Trend Charts &amp; Analysis</strong></td>
<td>30</td>
</tr>
<tr>
<td>- IT Certifications: Pandemic Winners</td>
<td>32</td>
</tr>
<tr>
<td>- Non-certified IT Skills: Pandemic Winners</td>
<td>46</td>
</tr>
<tr>
<td><strong>2020 IT Skills &amp; Certifications Volatility Index™</strong></td>
<td>59</td>
</tr>
<tr>
<td>- 15-Year Trending</td>
<td>61</td>
</tr>
<tr>
<td>- IT Certifications</td>
<td>62</td>
</tr>
<tr>
<td>- Non-certified IT Skills</td>
<td>63</td>
</tr>
<tr>
<td><strong>2020 IT Skills and Certifications Pay Index™</strong></td>
<td>64</td>
</tr>
<tr>
<td><strong>Foote Partners information</strong></td>
<td>66</td>
</tr>
</tbody>
</table>
IT NON-CERTIFIED SKILLS PAY SUMMARY – Through July 1, 2020

A. **NON-CERTIFIED TECH SKILLS** PAY PERFORMANCE: By Category

**NON-CERTIFIED TECH SKILLS.** 171 surveyed non-certified tech skills changed cash market value in the second quarter of 2020, with average cash pay premiums for 593 non-certified skills increasing by 0.6% overall. Pay performance in the second quarter was higher for six of eight non-certified tech skills categories reported. For the twelve-month period ending July 1, pay was also higher for the same six categories.

![Noncertified Tech Skills - % Growth/Decline 3 months & 12 months](Figure 2)

(593 skills, data through 7/1/2020)

Source: Foote Partners IT Skils & Certifications Pay Index™, 2nd Quarter 2020 data
17-YEAR NON-CERTIFIED TECH SKILLS PAY TRENDS BY CATEGORY

Average median cash pay premium for a single non-certified IT skill. Data through July 1, 2020 – 80,186 IT Professionals
# NON-CERTIFIED TECH SKILLS TREND HIGHLIGHTS: Market Value Gainers & Highest Paying – 2nd Quarter 2020

These noncertified tech skills *gained 10% or more in market value* in the three months ending July 1, 2020 vs. prior quarter (seen below grouped by segment). *Listed in descending order of amount of % gain and cash pay premium* (including ties). Highest paying skills listed on right in *alphabetical order*.

## TECH SKILLS (noncertified)

<table>
<thead>
<tr>
<th>Application Development skills</th>
<th>Systems/Networking skills</th>
<th>SAP &amp; Enterprise Business Applications skills</th>
<th>Highest Paying – Cash Premiums (A-Z)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apache Camel</td>
<td>Cisco UCCE</td>
<td>SAP FS (Insurance)</td>
<td>- Amazon Athena</td>
</tr>
<tr>
<td>Next.js</td>
<td>Active Directory</td>
<td>SAP BI (SAP BW)</td>
<td>- Amazon DynamoDB</td>
</tr>
<tr>
<td>Objective Caml (Ocaml)</td>
<td>Mobile device management</td>
<td>SAP Solution Manager</td>
<td>- Amazon RedShift</td>
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<tr>
<td>Oracle APEX</td>
<td>VoIP/IP telephony</td>
<td>SAP Lumira</td>
<td>- Apache Cassandra</td>
</tr>
<tr>
<td>Delphi</td>
<td>Microsoft Hyper-V</td>
<td>SAP FI - CA (Contract Accounting)</td>
<td>- Apache Cloudstack</td>
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<tr>
<td>BusinessObjects</td>
<td>Microsoft SCCM</td>
<td>SAP WEBI</td>
<td>- Artificial Intelligence</td>
</tr>
<tr>
<td>HP Unified Functional Testing</td>
<td>VPN/OpenVPN</td>
<td>Oracle HRMS</td>
<td>- Big Data analytics</td>
</tr>
<tr>
<td>Apache Lucene</td>
<td>Citrix Virtual Apps (XenApp)</td>
<td>Remedy</td>
<td>- Cloud Foundry PaaS</td>
</tr>
<tr>
<td>F#</td>
<td>Multiprotocol Label Switching (MPLS)</td>
<td>SAP MDM (Master Data Management)</td>
<td>- Cloudera Impala</td>
</tr>
<tr>
<td>Kotlin</td>
<td>SolarWinds</td>
<td>SAP ERP Operations (multi-skills)</td>
<td>- Cryptography (encryption, VPN, SSL/TLS, Hybrids)</td>
</tr>
<tr>
<td>Ethereum</td>
<td>vCloud</td>
<td>SAP Business One</td>
<td>- Cyber Threat Intelligence</td>
</tr>
<tr>
<td>Cloud Foundry PaaS</td>
<td>WIMAX/LTE</td>
<td>Oracle Eloqa</td>
<td>- Data Analytics</td>
</tr>
<tr>
<td>Apache Cloudstack</td>
<td>Wireless security</td>
<td></td>
<td>- Data Architecture</td>
</tr>
<tr>
<td>Apache Cordova</td>
<td>Cisco ISE (Identity Services Engine)</td>
<td></td>
<td>- Data Engineering</td>
</tr>
<tr>
<td>Tcl</td>
<td>VMware NSX</td>
<td></td>
<td>- Data Science</td>
</tr>
<tr>
<td>Microsoft SQL Server Management Studio (SSMS)</td>
<td>Intrusion prevention/detection systems</td>
<td></td>
<td>- DevSecOps</td>
</tr>
<tr>
<td></td>
<td>Apache Flume</td>
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<td>- Google TensorFlow</td>
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<td></td>
<td>Hbase</td>
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<td>- HBase</td>
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<td></td>
<td>Akka</td>
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<td>- Identity and access management</td>
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<td></td>
<td>Micrometer</td>
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<td>- Machine Learning</td>
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<tr>
<td></td>
<td>Apache Camel</td>
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<td>- Master data management</td>
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<td>Next.js</td>
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<td>- Microservices</td>
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<td></td>
<td>Objective Caml (Ocaml)</td>
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<td>- Natural language processing</td>
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<td>Oracle APEX</td>
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<td>- Neural Networks</td>
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<td></td>
<td>Delphi</td>
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<td>- Oracle Exadata</td>
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<td></td>
<td>BusinessObjects</td>
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<td>- Predictive Analytics and Modeling</td>
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<td>HP Unified Functional Testing</td>
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<td>- Prescriptive Analytics</td>
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<td>Apache Lucene</td>
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<td>- PyTorch</td>
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<td>- Risk analytics/assessment</td>
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<td>Kotlín</td>
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<td>- Rstudio</td>
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<td>Ethereum</td>
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<td>- Scala</td>
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<td>Cloud Foundry PaaS</td>
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<td>- Security architecture and models</td>
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<td>Apache Cloudstack</td>
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<td>- Smart Contract</td>
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<td>Microsoft SQL Server Management Studio (SSMS)</td>
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<tr>
<td>Database Skills</td>
<td>Messaging/Communications skills</td>
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<td>Risk</td>
<td>Java Messaging Service</td>
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<td>NewSQL</td>
<td>Message-oriented Middleware (Wave, XMPP/Jabber, etc.)</td>
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<tr>
<td>Cloudera Impala</td>
<td>SUSE</td>
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<td>Microsoft Exchange Server</td>
<td>Windows 10</td>
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<td>Amazon Athena</td>
<td>Linux</td>
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<td>Red Hat Enterprise Linux</td>
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<td>Operating Systems skills</td>
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## Management, Process & Methodology skills

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<tr>
<th>Bioinformatics</th>
<th>Marketo</th>
<th>Business performance management</th>
<th>Tableau</th>
<th>Quality Assurance/QA automation</th>
<th>Incident Management</th>
<th>SEO</th>
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Source: Foote Partners [IT Skills & Certifications Pay Index™](https://www.footepartners.com), 2nd Quarter 2020 data edition
NON-CERTIFIED IT SKILLS TREND HIGHLIGHTS: Market Value Losers – 2nd Quarter 2020

These noncertified IT skills **declined 10% or more in market value in the three months ending July 1, 2020** (grouped by segment). **Listed in descending order of amount of % decline**, including ties.

<table>
<thead>
<tr>
<th>TECH SKILLS (Noncertified)</th>
<th>TECH SKILLS (Noncertified)</th>
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</thead>
<tbody>
<tr>
<td><strong>Applications Development skills</strong></td>
<td></td>
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<tr>
<td>CA PPM (Clarity PPM)</td>
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<tr>
<td>SPSS</td>
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<tr>
<td>Oracle Applications Developer Framework</td>
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<td>Apache Ant</td>
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<td>JBehave</td>
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<td><strong>Web/E-commerce Development skills</strong></td>
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<td>Microsoft Commerce Server</td>
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<td>JBoss/WildFly</td>
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<td>Joomla</td>
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<td>TIBCO</td>
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<td>Apache web server</td>
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<td>KnockoutJS</td>
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<td>Scalable Vector Graphics (SVG)</td>
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<td>VBScript</td>
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<tr>
<td>WSDL (Web Services Description Language)</td>
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<td>Documentum</td>
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<tr>
<td>Apache Solr</td>
<td></td>
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<tr>
<td>Spring Boot</td>
<td></td>
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<tr>
<td>WebSphere</td>
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<tr>
<td>Spring Cloud</td>
<td></td>
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<tr>
<td><strong>SAP &amp; Enterprise Business Applications skills</strong></td>
<td></td>
</tr>
<tr>
<td>SAP BSP (Business Server Pages)</td>
<td></td>
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<tr>
<td>SAP IBP (Integrated Business Planning)</td>
<td></td>
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<tr>
<td>SAP Security</td>
<td></td>
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<tr>
<td>PeopleSoft (CRM/Financials/HCM)</td>
<td></td>
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<tr>
<td>SAP CAR (Customer Activity Repository)</td>
<td></td>
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<tr>
<td>Oracle CRM</td>
<td></td>
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<tr>
<td>SAP Forecasting and Replenishment (SAP F&amp;R)</td>
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<td>Web Dynapro</td>
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<td>SAP Fiori</td>
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<tr>
<td>SAP SD - GTS (Global Trade Systems)</td>
<td></td>
</tr>
<tr>
<td>SAP AFS (Apparel and Footwear Solutions)</td>
<td></td>
</tr>
<tr>
<td>SAP FI - FSCM (Financial Supply Chain Management)</td>
<td></td>
</tr>
<tr>
<td>SAP LES (Logistics Execution System)</td>
<td></td>
</tr>
<tr>
<td>SAP BusinessObjects Dashboards</td>
<td></td>
</tr>
<tr>
<td>SAP Business Worklow/Webflow</td>
<td></td>
</tr>
<tr>
<td>Enterprise Application Integration (EAI)</td>
<td></td>
</tr>
<tr>
<td>SAP HR-PA (Personnel Administration)</td>
<td></td>
</tr>
<tr>
<td>SAP NWDI (NetWeaver Development Infrastructure)</td>
<td></td>
</tr>
<tr>
<td>SAP PLM (Product Lifecycle Management)</td>
<td></td>
</tr>
<tr>
<td>SAP QM (Quality Management)</td>
<td></td>
</tr>
<tr>
<td>SAP BODI (Business Objects Data Integrator)</td>
<td></td>
</tr>
<tr>
<td>**SAP NWDS (NetWeaver Studio) **</td>
<td></td>
</tr>
<tr>
<td>**SAP Exchange Infrastructure (XI) **</td>
<td></td>
</tr>
<tr>
<td><strong>SAP Point-of-Sale Data Management POS DM</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Oracle NetSuite</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SAP BPC (BusinessObjects Planning and Consolidation)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>J.D. Edwards (Oracle)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Oracle Financials</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Oracle SCM (Supply Chain Management)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SAP Manufacturing</strong></td>
<td></td>
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<tr>
<td><strong>SAP Smart Forms</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SAP WM - EWM (Extended Warehouse Management)</strong></td>
<td></td>
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<tr>
<td><strong>Oracle E-Business suite</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Oracle Payroll/Receivables</strong></td>
<td></td>
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<tr>
<td><strong>Systems/Networking skills</strong></td>
<td></td>
</tr>
<tr>
<td>Storage virtualization/administration</td>
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<td>Cisco IPCC</td>
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<td>Rackspace Cloud</td>
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<td>CA Endevor</td>
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<td>Cisco ICM</td>
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<td>Kubernetes</td>
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<td>Prometheus</td>
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<td>Puppet</td>
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<td>Vagrant</td>
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<td>Ansible</td>
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<td>RedHat OpenShift</td>
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<td>Terraform</td>
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<tr>
<td>Chef/Opscode</td>
<td></td>
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<tr>
<td>Network security management</td>
<td></td>
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<tr>
<td><strong>Operating System skills</strong></td>
<td></td>
</tr>
<tr>
<td>OpenStack</td>
<td></td>
</tr>
<tr>
<td><strong>Messaging &amp; Communications skills</strong></td>
<td></td>
</tr>
<tr>
<td>Oracle Communications Messaging Server</td>
<td></td>
</tr>
<tr>
<td><strong>Management, Process &amp; Methodology</strong></td>
<td></td>
</tr>
<tr>
<td>Quantitative Analysis/Regression Analysis</td>
<td></td>
</tr>
<tr>
<td>TIBCO ActiveMatrix BusinessWorks</td>
<td></td>
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<tr>
<td>HL7</td>
<td></td>
</tr>
<tr>
<td>Metadata design and development</td>
<td></td>
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<tr>
<td>Big Data analytics</td>
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<tr>
<td><strong>Data/Database</strong></td>
<td></td>
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<tr>
<td>dBASE/xBASE</td>
<td></td>
</tr>
<tr>
<td>Blockchain</td>
<td></td>
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<tr>
<td>OpenEdge ABL</td>
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</table>

Source: Foote Partners [IT Skills & Certifications Pay Index™](https://www.footepartners.com), 2nd Quarter 2020 data edition
IT CERTIFICATIONS PAY SUMMARY

B. TECH CERTIFICATIONS PAY PERFORMANCE: By Category

TECH CERTIFICATIONS. Cash pay for tech certifications is currently at its five-year low. In the quarter ending July 1, 2020, 508 tech certifications lost even more value as a group, down an average of 2.2% in the quarter. 111 changed in value, with 87 of those losing value. Pay performance from April to June 2020 was lower for all certification segments and also for the twelve-month period ending July 1.

Tech Certifications - % Growth/Decline
3 months & 12 months
(508 certifications, data through 7/1/2020)

Figure 3

Source: Foote Partners IT Skills & Certifications Pay Index™, 2nd Quarter 2020 data
17-YEAR IT CERTIFICATIONS PAY TRENDS BY CATEGORY

Average median cash pay premium for a single IT certification. Data through July 1, 2020 – 80,186 IT Professionals

IT Certifications Premium Pay - by Category, Last 17 Years
(Values expressed as equivalent of % of base salary)
IT CERTIFICATIONS PAY TREND HIGHLIGHTS: Market Value Gainers & Highest Paying – 2nd Quarter 2020

These tech certifications *gained 10% or more in market value in the three months ending July 1, 2020* (seen below grouped by segment). *Listed in descending order of amount of % gain in cash pay premium* (including ties). Highest paying skills listed on right in alphabetical order.

<table>
<thead>
<tr>
<th>TECH CERTIFICATION Gainers</th>
<th>Applications Development/Programming Languages</th>
<th>Highest Paying – Cash Premiums (A – Z)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Info/Cyber Security certifications</strong></td>
<td><strong>Languages</strong></td>
<td>• Certified Cloud Security Professional</td>
</tr>
<tr>
<td>GIAC Exploit Researcher and Advanced Penetration Tester (GXPN)</td>
<td>IBM Certified Administrator - Cognos</td>
<td>• Certified Computer Examiner</td>
</tr>
<tr>
<td>Networking and Communications certifications</td>
<td>IBM Certified Designer - Cognos BI</td>
<td>• Certified Cyber Forensics Professional</td>
</tr>
<tr>
<td>Cisco Certified Design Expert (CCDE)</td>
<td>IBM Certified Developer - Cognos</td>
<td>• Certified Forensic Computer Examiner</td>
</tr>
<tr>
<td><strong>Systems Administration certifications</strong></td>
<td>IBM Certified Systems Administrator - WebSphere AS</td>
<td>• Certified ScrumMaster</td>
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<tr>
<td>Citrix Certified Expert - Networking</td>
<td>IBM Certified Solution Developer: WebSphere (all)</td>
<td>• Certified Secure Software Lifecycle Professional</td>
</tr>
<tr>
<td>CompTIA Server+</td>
<td>TIBCO Certified Professional</td>
<td>• Cisco Certified Architect</td>
</tr>
<tr>
<td>Pivotal Cloud Foundry Operator certification</td>
<td></td>
<td>• Cisco Certified Network Professional - Security</td>
</tr>
<tr>
<td>SUSE Enterprise Engineer (SCE)</td>
<td></td>
<td>• CompTIA Advanced Security Practitioner</td>
</tr>
<tr>
<td>Citrix Certified Associate - Networking (CCA)</td>
<td></td>
<td>• CyberSecurity Forensic Analyst</td>
</tr>
<tr>
<td>Citrix Certified Professional - Networking</td>
<td></td>
<td>• EC-Council Certified Encryption Specialist</td>
</tr>
<tr>
<td>Citrix Certified Professional-Virtualization (CCP-V)</td>
<td></td>
<td>• EC-Council Computer Hacking Forensic Investigator</td>
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<tr>
<td>HP Accredited Technical Professional (ATP - all)</td>
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<td>• EC-Council Licensed Penetration Tester</td>
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<tr>
<td>HP ATP - Cloud Administrator V1</td>
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<td>• GIAC Certified Penetration Tester</td>
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<tr>
<td>Citrix Certified Expert – Virtualization</td>
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<td>• GIAC Exploit Researcher and Adv. Penetration Tester</td>
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<tr>
<td><strong>Data/Database</strong></td>
<td><strong>Architecture, Project Management, and Process Certifications</strong></td>
<td>• GIAC Security Expert</td>
</tr>
<tr>
<td>Oracle Certified Expert - MySQL 5.1 Cluster Database Administrator</td>
<td>Certified Scrum Product Owner</td>
<td>• GIAC Security Leadership</td>
</tr>
<tr>
<td>SAS Certified Data Integration Developer for SAS 9</td>
<td>Six Sigma Yellow Belt</td>
<td>• InfoSys Security Architecture Professional (ISSAP/CISSP)</td>
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<tr>
<td></td>
<td>Salesforce.com Certified Technical Architect</td>
<td>• InfoSys Security Engineering Professional (ISSEP/CISSP)</td>
</tr>
<tr>
<td>Source: Foote Partners <em>IT Skills &amp; Certifications Pay Index™</em>, 2nd Quarter 2020 data edition</td>
<td></td>
<td>• PMI Program Management Professional</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• PMI Risk Management Professional</td>
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<tr>
<td></td>
<td></td>
<td>• Zachman Certified - Enterprise Architect</td>
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IT CERTIFICATIONS PAY TREND HIGHLIGHTS: Market Value Losers – 2nd Quarter 2020

These tech IT certifications declined 10% or more in market value in the three months ending July 1, 2020 vs. prior quarter (grouped by segment). Listed in descending order of amount of % decline, including ties.

<table>
<thead>
<tr>
<th>Application Development/Programming Languages</th>
<th>Systems Administration certifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS Certified Developer - Associate</td>
<td>VMware Certified Advanced Professional (all)</td>
</tr>
<tr>
<td>Red Hat Certified Architect: Application Platform</td>
<td>Novell Certified Linux Engineer (CLE)</td>
</tr>
<tr>
<td>Red Hat Certified Architect: DevOps</td>
<td>Novell Identity Manager Administrator</td>
</tr>
<tr>
<td>Microsoft Certified Solutions Developer (MCSD)</td>
<td>Linux Professional Institute certification (LPIC-Level 2)</td>
</tr>
<tr>
<td>Cloudera Certified Associate Spark and Hadoop Developer</td>
<td>Novell Certified Linux Professional</td>
</tr>
<tr>
<td>AWS Certified DevOps Engineer – Professional</td>
<td>VMware Certified Associate - Cloud</td>
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<tr>
<td></td>
<td>VMware Certified Associate - Data Center Virtualization</td>
</tr>
<tr>
<td></td>
<td>NetApp Certified Implementation Engineer (NCIE)</td>
</tr>
<tr>
<td></td>
<td>Google Associate Cloud Engineer</td>
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<tr>
<td></td>
<td>VMware Certified Advanced Professional 6.5 - Data Center Virtualization Design</td>
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<td></td>
<td>VMware Certified Advanced Professional 6/7 - Cloud Mgt and Automation Design</td>
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<td>VMware Certified Advanced Professional 6 - Data Center Virtualization Deployment</td>
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<tr>
<td></td>
<td>CompTIA Linux+</td>
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<tr>
<td></td>
<td>Linux Professional Institute certification (LPIC-Level 3)</td>
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<td></td>
<td>VMware Certified Design Expert (all)</td>
</tr>
<tr>
<td></td>
<td>EMC Data Center Architect (EMCDCA - all versions)</td>
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<tr>
<td></td>
<td>EMC System Administrator, Documentum Specialist (EMCSyA)</td>
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<tr>
<td></td>
<td>VMware Certified Advanced Professional 6/7 - Cloud Mgt and Automation Deployment</td>
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<tr>
<td></td>
<td>Microsoft Certified: Azure Administrator Associate</td>
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<tr>
<th>Data/Database</th>
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<tbody>
<tr>
<td>Oracle Certified Associate - DBA (OCA)</td>
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<tr>
<td>Cloudera Certified Associate Data Analyst</td>
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<tr>
<td>Cloudera Certified Professional: Data Engineer</td>
</tr>
<tr>
<td>Oracle Certified Professional - DBA (OCP)</td>
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<tr>
<td>Oracle Certified - MySQL 5</td>
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<tr>
<td>Oracle Certified Professional - Database Cloud Administrator</td>
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<tr>
<td>Oracle Certified Master - DBA (OCM)</td>
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<table>
<thead>
<tr>
<th>General/Foundation level and Training</th>
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<tr>
<td>Microsoft Certified Trainer (MCT)</td>
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<table>
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<tr>
<th>Web Development</th>
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<tbody>
<tr>
<td>CIW Web Development Professional</td>
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<tr>
<td>CIW Certified Database Design Specialist</td>
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</table>

Architecture, Project Management, and Process

<table>
<thead>
<tr>
<th>Certifications</th>
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<tbody>
<tr>
<td>Certified in the Governance of Enterprise IT (CGEIT)</td>
</tr>
<tr>
<td>EMC Cloud Architect Expert</td>
</tr>
<tr>
<td>Certified Business Analysis Professional (CBAP)</td>
</tr>
<tr>
<td>EMC Cloud Architect Specialist</td>
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<tr>
<td>PMI Agile Certified Practitionerl (PMI-ACP)</td>
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<tr>
<td>PMI Certified Associate in Project Management (CAPM)</td>
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<tr>
<td>Prince2 Practitioner</td>
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<tr>
<td>Prince2 Foundation</td>
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Info/Cyber Security certifications

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<thead>
<tr>
<th>Certifications</th>
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<tbody>
<tr>
<td>GIAC Information Security Fundamentals (GISF)</td>
</tr>
<tr>
<td>EC-Council Certified Security Analyst (ECSA)</td>
</tr>
<tr>
<td>Certified in Risk and Information Systems Control (CRISC)</td>
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<tr>
<td>EC-Council Certified Incident Handler V2 (ECIH)</td>
</tr>
<tr>
<td>GIAC Certified Forensics Analyst (GCFA)</td>
</tr>
<tr>
<td>GIAC Web Application Penetration Tester (GWAPT)</td>
</tr>
<tr>
<td>GIAC Certified Windows Security Administrator (GCWN)</td>
</tr>
<tr>
<td>Systems Security Certified Practitioner (SSCP)</td>
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</tbody>
</table>

Source: Foote Partners IT Skills & Certifications Pay Index™, 2nd Quarter 2020 data
## TECH CERTIFICATIONS Losers – cont’d

<table>
<thead>
<tr>
<th>Networking &amp; Communication certifications</th>
<th>Networking &amp; Communication- cont’d.</th>
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</thead>
<tbody>
<tr>
<td>SNIA Certified Storage Professional (SCSP)</td>
<td>Cisco Certified Network Associate (was Design Associate)</td>
</tr>
<tr>
<td>BICSI Technician and Registered Communications Distribution Designer</td>
<td>Certified Telecommunications Network Specialist (CTNS)</td>
</tr>
<tr>
<td>Cisco Certified Network Associate - Data Center</td>
<td>Cisco Certified Network Professional (was CC Design Professional)</td>
</tr>
<tr>
<td>CWNP/Certified Wireless Analysis Professional (CWAP)</td>
<td>VMware Certified Advanced Professional – Network Virtualization</td>
</tr>
<tr>
<td>CWNP/Certified Wireless Design Professional (CWDP)</td>
<td>AWS Certified Solutions Architect - Professional (Cloud)</td>
</tr>
<tr>
<td>Cisco Certified Network Associate (was CCNA Collaboration)</td>
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</tr>
<tr>
<td>Cisco Certified Network Associate (was CCNA Wireless)</td>
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</tr>
<tr>
<td>EMC Information Storage Associate (EMCISA)</td>
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</tr>
<tr>
<td>EMC Storage Administrator - Associate (EMCSA-A)</td>
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<tr>
<td>Juniper Networks Certified Internet Specialist (JNCIS)</td>
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<tr>
<td>SNIA Certified Storage Architect (SCSA)</td>
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<tr>
<td>SNIA Certified Storage Networking Expert (SCSN-E)</td>
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<tr>
<td>Juniper Networks Certified Internet Associate (JNCIA)</td>
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<tr>
<td>Cisco Certified Network Associate (was CCNA Cloud)</td>
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<tr>
<td>EMC Storage Administrator - Specialist (EMCSA-S)</td>
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<tr>
<td>VMware Certified Professional - Network Virtualization</td>
<td></td>
</tr>
<tr>
<td>EMC Storage Administrator - Expert (EMCSA-E)</td>
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</tbody>
</table>
3Q 2020 Pandemic Tech Labor Trends Discussion & Analysis

Data collected through April 1 to July 1, 2020
AS THE PANDEMIC TURNS

2020 began with a bang for IT professionals with 25,300 tech jobs added to U.S. payrolls in the first two months according to the U.S. Bureau of Labor Statistics (BLS). But by March this number dropped to only 6,000 new IT jobs and then the bottom dropped out in April with the BLS reporting a stunning net loss of 181,300 tech jobs in America. In May and June another net tech 22,800 jobs were lost, although the important category of Management/Technical Consulting Services added 16,400 new jobs signaling a recovery of the professional services industries.

Clearly, for those of us who analyze the tech workforce and forecast tech labor markets the elephant in the room is the COVID-19 pandemic and how the economy will react to it in the coming months. It’s too early to say with accuracy what lies ahead but one thing is already certain: before the pandemic employers were already struggling mightly with devising and building successful tech staffing models to meet their future and present needs and now these objectives have become even more elusive. In fact, it’s almost idyllic to think that prior to the pandemic the most common challenge shared by employers was balancing three things: the urgencies of digital transformation, combating ever deepening security threats, and at the same time keep increasingly complex systems and networks running smoothly and efficiently.

The pandemic and subsequent economic recession has created a new set of assumptions influencing the tech labor market and demand for skills going forward.

- Predatory hiring practices, principally by large employers
- Need for significant up-skilling and retraining
- Likely reduction in middle management jobs, similar to 2008 Great Recession
- Stay-at-home workforce continuing after pandemic winds down, creating significant changes for employers to navigate
- Acceleration of automation...including Artificial Intelligence
- Amped up digital transformation

But despite all of these new pressures on businesses and our private lives, one thing remains unchanged: technology evolution will continue to flourish, unaffected. The history of modern technology has been one of tech innovation often consistently exceeding our human ability to adopt the solutions they offer. There are a lot of reasons for this, chief among them our natural resistance to changing behaviors.
Industries beating the pandemic blues. With a total estimated U.S. workforce of 12.2 million tech jobs, there has barely been a dent in the national technology workforce as a result of the pandemic and economic recession. While the travel, hospitality and restaurant industries have been particularly hard it, many other industries are actively hiring and improving or expanding their tech skills depth. Here are some examples, and why:

- **Banking/Finance/Insurance**

  More people have been doing their banking online, unemployed workers are getting direct deposits from state agencies and businesses are receiving government loans and emergency disaster funds, all benefitting tech jobs in the banking industry. The financial services industry has benefitted from skyrocketing online purchases and increased digital transaction-driven credit card usage.

- **Information Technology**

  While management and technical consulting jobs are on the upswing as discussed above, BLS numbers also reveal three consecutive months of job losses in two tech job categories: Computer Systems Design/Related Services and Telecommunications. In our research partner employer base we’re finding strong hiring in many roles including cybersecurity, collaboration, communications, cloud computing, A.I./machine learning, data analytics, software-driven development, high-bandwidth networking, edge computing, and distributed data sourcing and storage. Many of the large tech companies including Facebook, Apple, Amazon, Microsoft, Netflix, and Google are aggressively recruiting according to Foote interviewees whose companies have lost their tech professionals to these employers and others. Other companies like IBM are investing in training and upskilling their workforces.

- **Consulting and Professional Services**

  US businesses have never really faced a crisis like this one before. In response, they are looking for help managing their risk, reducing expenses, and preparing a new strategy that will allow them the to survive -- and perhaps even thrive -- during and after the pandemic. Some companies are also looking to outsource some of their work as a way to deal with the current situation. Many of our research partners, on both the supply and demands sides of this trend, are reporting aggressive (even predatory) recruiting practices by these industry segments.

- **Law Enforcement**

  Despite recent pressures to "defund police" the fact remains that both local and state governments have been increasing their reliance on technology to improve the efficiency and effectiveness of their front-line personnel. As a result, law enforcement agencies and tech firms that serve the law enforcement sector have increased their hiring.

- **Shipping**

  Obviously, ubiquitous shelter-in-place quarantining and state restrictions on non-essential and essential businesses has increased the number of things being delivered. That’s meant an increase in business for shipping, trucking, logistics, and delivery companies such as FedEx, UPS. Also delivery startups such as DoorDash, Grubhub, and Postmates (recently announced Uber acquisition). They all need more IT workers to support their operations, including cloud, cybersecurity, and development specialists.
TECH LABOR TRENDS DISCUSSION & ANALYSIS – cont’d.

- **Online Retailers and Dot-coms in niche service areas**
  It’s not only the delivery services that need more IT personnel to support the increase in ecommerce, the online retailers also need more tech workers with Amazon being probably the best example in this category. They are reported to be focusing their recruiting in business intelligence, data science, database administration, hardware development, machine learning science, technical project management, software development, solutions architecture, operations, IT, and support engineering.

- **Education**
  This choice might appear counterintuitive given the stresses on school budgets from the pandemic except that education has almost entirely moved to an online model. This radical shift has meant that education institutions and suppliers have needed to dramatically (and quickly) increase their technical staff. School districts, colleges, and universities across the country need to hire more IT staff to support the new learning models.

- **Large Health care**
  Prior to the pandemic large healthcare systems and hospitals were robustly hiring to tech professionals to support initiatives in telemedicine, EMR systems, A.I., database and data management, data analytics, privacy and cybersecurity among others. The pandemic has had a mixed impact: while many healthcare organizations have been swamped with COVID-19 patients, others have laid off staff as patients have been forced to postpone elective and non-emergency care.

- **Biotech/Big Pharma**
  Some companies have been hiring IT staff as they ramp up their efforts to find vaccines and treatments for the novel coronavirus. Biotech firms have also benefitted from continued long-term demand for revolutionary drug advances.

- **Government (Defense)**
  The defense industry is also looking for technology professionals according to defense contractors and military suppliers we’ve interviewed, especially in cybersecurity for our national defense. And because today’s military is more digital than ever, this has also increased demand for technology workers. Job posting sites are still listing a preponderance of new tech job openings during the pandemic from top defense contractors and staffing augmentation firms.
TECH LABOR TRENDS DISCUSSION & ANALYSIS – cont’d.

UNDERSTANDING THE NEW LABOR LANDSCAPE

As companies create jobs that require the skills to implement emerging technologies such as artificial intelligence/machine learning (AI/ML), robotic process automation, and blockchain, IT and HR managers will have to understand the landscape of tech jobs and skills needed to identify the right pool of talent. Here are hot domain areas that the pandemic has made even hotter.

Acceleration of automation

For years, companies have been working toward automating repetitive jobs through algorithms that can complete administrative tasks, robots that can streamline manufacturing and drones that can deliver goods. Our recent findings are that the coronavirus and subsequent economic downturn has caused an acceleration in automation-related labor trends, in effect pulling the future forward. In warehouses, for example, some companies may be looking at more physical automation or robotics to do the work in order to protect people and avoid the situation that Amazon experienced with a number of ill warehouse workers. Other robotics have been under evaluation in retail settings to help check inventory—an important job during this pandemic when shelves have been periodically emptied of essential goods. But none of these physical robotic solutions are quick fixes. Organizations may also accelerate their use of robotic process automation (RPA), eliminating administrative-type jobs during a time when they are trying to cut costs.

There is debate about which jobs are most at risk and how soon. Rather than regarding this as a driver of mass unemployment, we believe this trend will not only persuade out-of-work workers to develop new skills in order to find new jobs but also drive massive tech workforce up-skilling and retraining efforts within organizations intent on capitalizing on the promises of automation. The automation space will create job opportunities as well. Climbing up the skills ladder is the best way to stay ahead of the automation wave.

Redoubling cybersecurity and DR protections

The pandemic has unfortunately given rise to an increase in the threat landscape with cyberattacks spiking during the first half of 2020. According to the FBI, attackers have found new ways to exploit the conditions brought on by widespread lockdowns: as of May 28, 2020, the FBI’s Internet Crime Complaint Center received nearly the same amount of complaints in 2020 as they had for the entirety of 2019. They also site evidence that criminals have launched new fraud efforts aimed at diverting Paycheck Protection Program funds, economic stimulus checks, and unemployment checks into their own pockets. Moreover, a survey conducted by security vendor CrowdStrike found a 100X increase in COVID-19-themed malicious files from February to April 2020.

Of course, global cybercrime costs have been growing for years, projected to be $6 trillion in 2021 with cumulative global spending of cybersecurity products and services combat cybercrime reaching $1 trillion for the five years ending 2021. Now we have a pandemic that will push those numbers even higher. What should employers do to fight back?

First you need to secure your endpoints. Anecdotally, one security vendor says that attacks on one customer’s APIs spiked up 297% in late April, sometimes exceeding 100,000 malicious requests per minute and that total attacks continued to increase 85% week over week in subsequent months. These attacks will continue to escalate, so developers need to look at how to limit the value for anyone gaining access. If they are unable to steal useful information (data or code), the API becomes less attractive as a target, so locking down APIs becomes an in-demand skill area. Also, in demand will be secure coding and
efforts to tighten up your code, paying particular attention to known vulnerabilities. Recent studies report that 70% of applications examined included open source code with security flaws. Relying on open source code can reduce development time for applications, but organizations need to make sure that they are maintaining that code and applying patches to open source libraries as they become available.

Clearly, demand for cybersecurity workers is not being met by supply and that gap has been highly publicized to be 6+ million shortfall. More employers will need to internally develop next-gen cyber experts who can develop and drive interconnected real-time systems. New professions and domain expertise will evolve, in particular the focus on hiring and supporting a team of machine learning experts to build custom cybersecurity solutions using existing hybrid tools and embedded AI tech in human-operated products. There will be greater reliance on AI smart tools to handle the bulk of event monitoring and incident response. The next generation of firewalls will have machine learning technology built into them, allowing the software to recognize patterns in web requests and automatically block those that could be a threat.

**A.I./cybersecurity staffing connection.** To cope with the shortfall in seasoned cybersecurity professionals, and those with AI/ML expertise in particular, we believe CSOs, CISOs and other security leadership have their work cut out for them in both governance and staffing areas.

To deliver long-term improvement transparently and ethically all employers must first install effective governance for A.I. in cybersecurity, addressing these objectives in their security architectures:

- Defining roles and responsibilities for cyber staff
- Monitoring AI algorithm output by cyber analysts before any action is taken
- Implementing a mechanism to monitor AI algorithms’ output logic and upgrades
- Creating control processes to monitor if an AI algorithm is behaving abnormally
- Identifying the risk tolerance for the output generated by AI algorithms
- Instituting a ‘plan B’ if AI algorithms fail or are tampered with
- Implementing key performance indicators to measure success

In defining roles and responsibilities for an A.I.-ready cyber staff, security management should strive to meet these critical capability requirements:

- Capable of improving the logic underpinning A.I. algorithms
- Capable of building algorithms that suggest and store complex passwords
- Process expertise
- Upskilling workers with organizational knowledge of ‘how things work’ at their company
- Create interfaces for cyber analysts to interact with A.I. tools and incident alerts
Companies spent an estimated $137 billion on cybersecurity risk management in 2019 according to Gartner. An increasing amount of this cybersecurity spending is focusing on AI/ML—and so should tech professionals in their career planning. Here are the most common AI supported use cases as a guide for how managers and workers might want to target recruitment and job searches, respectively.

- Augmentation of human security analysts and SOC workflows
- New attack recognition
- Behavioral analytics and risk scoring
- User-based threat detections
- On-device detection across the endpoint kill chain
- Proactive security in disconnected environments
- Big data query generation and analysis
- Threat proliferation and spread detection analysis
- Autonomous response
- Threat blocking automation
- Malware detection and classification
- Agent consolidation and deployment across other security tools
- Attack classification (unknown, insider, persistent)
- False positive reduction
- Product self-healing
- Machine data comprehension
- Encrypted traffic analysis
- Policy compliance analysis
- Cyber-risk insurance
- Cyber-risk due diligence augmentation (pre-mergers and acquisitions)

**Hot info/cybersecurity jobs in 2020-21.** Our research indicates the following info/cybersecurity jobs and domains for the next two years.

- A.I. / Machine Learning
- Access/identity management
- Advanced malware prevention
- Analytics and intelligence
- Application security development
- Audit and compliance
- Automation
- Cloud computing/virtualization
- Cloud security
- Cyber Threat Intelligence
- Cybersecurity
- Data Security
- DevSecOps
- Firewall/IDS/IPS
- Incident handling and response
- Intrusion prevention/detection systems
- Mobile security
- Network access control/identity mgt sys.
- Network security management
- PenTesting (Apps, System Security)
- Risk analytics/assessment
- Risk management
- Security Architecture & Privacy
- SIEM management
- Web services security
- Wireless security
TECH LABOR TRENDS DISCUSSION & ANALYSIS – cont’d.

In-demand Cybersecurity Certifications in 2020-21. Data and growth vectors recorded in our long-running IT Skills and Certifications Pay Index™ (published and updated every three months since 2000) point to the following security-related certifications as good job and career investments for the next two years.

- Certified Cyber Forensics Professional
- Certified Information Security Manager
- Certified Information Systems Auditor (CISA)
- Certified Scrum Product Owner
- Certified Secure Software Lifecycle Professional (CSSLP)
- Cisco Certified Network Professional – Security
- Citrix Certified Expert - Networking
- CompTIA Advanced Security Practitioner
- CompTIA Cybersecurity Analyst+
- Cybersecurity Forensic Analyst
- EC-Council Computer Hacking Forensic Investigator
- EC-Council Certified Encryption Specialist (ECES)
- GIAC Certified Forensics Examiner
- GIAC Certified Incident Handler
- GIAC Certified Penetration Tester
- GIAC Enterprise Defender
- GIAC Exploit Researcher and Advanced Penetration Tester
- Microsoft Certified Solutions Expert: Data Management and Analytics
- SAS Certified Data Integration Developer for SAS 9
- Six Sigma certifications

Diversify your security team. Our vast network of employer/research partners tell us that info/cyber teams benefit from workers with different backgrounds, approaches and personalities who approach cybersecurity situations from completely different angles. Degrees in psychology and law and those who have a criminal justice background have proven to be effective hires as are hires who can “think like a criminal”.

In addition to considering people with nontraditional backgrounds to combat diverse threats, we suggest targeting cyber potential within IT organizations. IT-skilled people working in networking, software development, systems engineering, financial and risk analysis are smart choices according to our findings. Feeder skills include system administration, firewalls, routers, Linux or iOS OS, VMware, and virtual machines open source software

Review your business continuity/disaster recovery plans. While the pandemic has not resulted in data center outages, the next crisis very well could, making a disaster recovery (DR) plan essential. Most enterprises have a DR plan, but many don’t test those plans as often as they should. If you don’t have a regular testing schedule or you test it only once a year or less, now is a good time to think about getting on a better schedule. Remember that you also need to maintain your DR plan. As your IT environment changes, you will likely need to update your DR plan in response. In addition, now would be a good time to incorporate some of the things you’ve learned from the pandemic into your DR plan.
Containerization expands

Another trend that was well underway before the pandemic was the increasing use of containers. Containerization software like Docker and Kubernetes can simplify IT management, reducing the burden on IT in a time of crisis. Containers also make it easier to move workloads from one environment to another, which can also be helpful in a disaster situation. While it’s impossible to be fully prepared for a crisis, with regard to IT, technologies like Kubernetes can help organizations lower their TCO by improving resource efficiency within their hybrid cloud infrastructure, which has proven critical in the face of distributed and remote work forces. A proactive approach to digitization and commitment to containerization is should be a consideration for tech professionals preparing their careers future crises.

Cloud adoption increases

Organizations with lower overhead costs are in a better position to weather the current financial turmoil. Better optimizing your public cloud usage or by auditing software licenses are strategies for eliminating unnecessary expenses. Most enterprises were well on their way transitioning toward the cloud before the pandemic began, but the crisis has made cloud seem even more attractive than before. Cloud-based apps make it easy for employees to do their work whether they are at home or in the office, and cloud computing can also reduce the management burden on IT and help control costs. Businesses that have already adopted cloud services because it makes access to their servers and data more ubiquitous and extensible can easily plug-in solutions that allow for faster and easier remote working at scale. Those that have resisted the move will now be facing questions around how to move servers and applications to the compute cloud and how to get the data integrated into their cloud architecture. For tech professionals our firm has been publishing salary data and detailed job descriptions with key skills, knowledge and experience for a wide range of cloud family jobs since 2007.

Networking technologies for expanding virtual business models and a remote workforce

During the pandemic crisis—and especially coming out of the pandemic—companies will increasingly be examining how they do networking and communications. Solutions and skills that support the virtual business operating model will be excel, including higher bandwidth connections such as 5G, software-driven technologies, and distributed data sourcing and storage. This will be driven an organizations insistence on accelerating their ability to provide a more flexible, agile, protective, proactive, virtual, and fast-moving technology infrastructure. Skills related to network and cloud security, as well as business continuity and data recovery, will be in demand as well. The rise of the remote worker has also led to greater demand for people with the skills to resolve network access issues and optimize network connections. For those moving to the cloud, a need has arisen for good QoS [quality of service] and bandwidth control.

Middle management erosion?

In the months and years ahead, we could continue to see a hollowing out of middle management similar to the aftermath of the global financial crisis in 2008. Promotions into management were fewer which had a negative effect of wage growth as workers were not promoted to middle-management roles as frequently. There is some cause for optimism however: the demand for top-tier managers could rebound once the pandemic subsides because organizations will want to emphasize productivity. The fear here is that with fewer managers required to oversee a higher volume of direct reports, this creates room for error and lack of oversight.
**Big Data and IoT explodes**

There will be 31 billion connected things by the end of 2020 and as many as 75 billion by 2025 according to some estimates made prior to the COVID pandemic. Moreover, global spending on the Internet of Things (IoT) is estimated to reach 1.29 trillion this year and the global IoT device market reaching $1.1 trillion by 2026. The effect of this explosion in sensors and devices on big data analytics and cyberthreat levels should be obvious. Not as obvious to some are these drivers and the skills in demand for each:

- The shift from ad hoc analytics use cases to operationalizing production quality Big Data pipelines
- Rise of real-time streaming analytics
  - Skill areas: NewSQL databases, in-memory data grids, and dedicated streaming analytic platforms converging to enable ultra-fast processing of streaming analytics. Enabled by SQL capabilities in open source streaming frameworks like Kafka, Spark, and Flink
- Merging of BI/Analytics, data science, and data engineering teams and skill sets
- Rise in cloud-based and containerized identity and access management (IAM, IDaaS) services (13% CAGR next six years, to $24 billion)
- Rising demand for workers experienced with supervised algorithms and unsupervised learning, effective in identifying anomalous behavior and triggering reduced or restricted access.
- Nation-sponsored organizations will continue to develop cyber-attack technologies for defense and offense, as attackers have access to “strategic weapons” that don’t require the infrastructure or the cost of conventional weapons.
- Countries and states will have a bigger role in protecting large scale environments (power grids, water supply, traffic control, etc.) and maybe even to provide some of their intelligence to the public

There are many hot jobs to be found in the Big Data/IoT space…here are a few, and why.

- **Big Data Development Engineer.** There are many applications for big data across lots of industries and the demand for skilled, big data development engineers is growing. Due to the massive amounts of data, it has become more and more difficult to manipulate and analyze data ultimately extract value information from it. No matter the level of technical depth or development, demand for this position will continue to increase in the future. There are several hard skills required: SQL, programming, exploratory analysis skills, Hadoop/parallel processing, machine learning and data mining. As for the soft skills, the ability to model, optimize and simulate. have gained much popularity recently. Big data development engineers should be willing to constantly upgrade skills and accumulate practical experience.

- **Database Administrator.** Many projects need database support and this position is engaged in the management, maintenance, and security of database systems. Among other duties, they install, back up, update and patch databases, as well as ensure database access, completeness, and coherence. It is a critical role because the loss of sensitive information could be catastrophic for companies and organizations. Key skills needed for the job include fluency in SQL, UNIX, and databases such as Oracle, MySQL, PostgreSQL, and, Oracle Database.
TECH LABOR TRENDS DISCUSSION & ANALYSIS – cont’d.

- **Data analyst**. The responsibilities of this position include developing frameworks for data, analytics, and strategy development; implementing data-analysis tools; providing user training; collecting and analyzing data sets from diverse sources to inform business decisions and make accurate predictions; tracking and monitoring internal and external data. Key skills needed for the job include an ability to analyze large data sets and filter relevant data sets; attention to detail; an analytical mind, problem-solving ability; experience in data modeling and reporting software; and the ability to write actionable reports in clear language.

- **Data engineer**. Incumbents in this position build systems to handle big data; design, develop, build, test, and maintain architectures, including databases and large-scale data-processing systems; find ways to acquire and filter data; develop high-performance algorithms for data use, such as predictive modeling and proof of concepts; and create and implement disaster-recovery plans. Key skills needed for the job include: Knowledge of Hadoop-based technologies, SQL-based technologies, NoSQL technologies, data-modeling tools, and various coding languages including Python, C/C++ or Java, Perl; statistical analysis and modeling; predictive modeling; neuro-linguistic programming, machine learning, and text analysis experience.

**Don’t Forget About the Marketability of Soft Skills**

A time of crisis results in greater stress for everyone, but teams with strong interpersonal relationships are better able to cope with emergencies as they arise. Right now, a majority of enterprise IT professionals are working from home, which can make it much more difficult for groups to communicate; managers know that it is harder to build relationships with co-workers and among workers when working remotely. To compensate, team members are encouraged to make frequent and expert use of collaboration tools and video communication tech to stay in close communication with their co-workers. Clearly, team relationships will be a lot closer if they’re able to move back into the workplace and retire some of the messaging habits gained during quarantine times, although some who we interviewed believe that a generally more agile way of working and communicating with colleagues will continue. More meetings will become emails, and more emails will become instant messages.

For managers, if there is budget for training, strong consideration should be given to investing in their teams’ "soft" skills as well as their technical skills. For tech professionals, they should be alert to the value of their soft skills in their overall branding when contemplating job opportunities.
TECH LABOR TRENDS DISCUSSION & ANALYSIS – cont’d.

REPAIRING AND PREPARING YOUR TECH WORKFORCE

A snapshot of today: a reported 80% of the global workforce is in lockdown, 33% of the population is unemployed, the global supply chain is massively disrupted, medical practitioners are ordered to shut down, physical distancing is mandated, and in the U.S. a food supply panic sweeps the nation. Yet thanks to technology, many businesses have continued operating with some degree of normalcy. Technology systems have safe-guarded supply chains; remote communications have been leveraged in education, medical services, customer services, logistics, and entertainment; and essential businesses like commerce, insurance, and finance have continued providing services online. In short, technology has played a vital role in enabling our economy to survive.

The tech staffing challenge has now moved well beyond quick fixes. More than ever, hiring managers need to think about their tech staffing needs strategically over the next few years, define specific tech skills that will be required and at what bench strength and not rely on consultants and contingent workers to solve their skills gap problems. They need to configure a roadmap for how to get there so that they’re not scrambling for talent last minute when the time comes.

We conducted interviews from early-to-mid-2020 with 350+ senior tech execs and decision makers across 40 industries to inquire about their tech workforce plans. Many execs were conspicuously stressed out about this subject. They sensed harder tech labor challenges in 2020 than any year in recent history and this was before the pandemic took hold. They were open about ‘people problems’ getting exponentially worse unless their companies begin laying the groundwork right now for a new strategy for staffing.

What has concerned them most prior to the arrival of COVID-19 were game-changing emerging technologies that have been altering the landscape of not just businesses but the private lives of billions of people. Layered into all of these is also a requirement to build deeper cybersecurity capabilities for the escalating threat levels that these disruptors have created:

- Next-gen Internet of Everything
- AI-driven development
- Blockchain
- Mobility
- Big Data/Information Integration/ BI analytics
- Cybersecurity
- Hyperautomation/Robotic Process Automation
- Autonomous things
- Multiexperience Platforms
- Edge computing
- Distributed Cloud computing
- Healthcare tech/IoMT/Telemedicine
- Carbon-reducing technology/exponential energy

Some execs believe that the coronavirus pandemic will undoubtedly create an acceleration in labor trends such as automation and ‘going digital’ at their companies as they are forced to find ways to operate with fewer employees physically present. But at the same time there will need to be a significant up-skilling and retraining, especially for laid off workers looking to re-enter the labor market.
We also heard many opinions about the newly amplified stay-at-home workforce remaining in place after the pandemic winds down. With tech professionals balancing the demands of work life and home life all in the same place, employers have relaxed rules about the number of hours their workforces are working which makes sense: it’s just a lot harder for employers to deny flexibility around work hours and work settings. The execs and decision makers we interviewed are increasingly calibrating expectations for when they need everyone in the office or online for staff meetings and other team activities.

Altogether this amounts to a massive transformation of the technology and tech-business hybrid workforce as the focus becomes how to deliver on a wide variety of new operational solutions and revenue-generating opportunities. And all of these prospects depend on solving a puzzle: how to get the mix of critical technology and business skills and experience just right when shortages of skills and talent have never been more constraining to business transformation, and to do it during pandemic uncertainties.

**Tech-neutral versus tech-driven matters.** We believe the pandemic will not have a negative impact on technology evolution, a fact that has proven time and again with past market interruptions. Evolving technology always seems to barrel down the train tracks at breakneck speed no matter what, often out-distancing the ability of humans to adopt it or quickly turn it into drivers of competitive advantage, market share, or profitability.

But what this COVID chaos will change is how various employers and industries choose to invest in technology now as their normal revenue channels are disrupted. For example, industries most directly negatively affected by the pandemic—transportation and tourism, hospitality, restaurants, fitness/gyms, arts and entertainment, and local government—are all buyers of technology but relatively 'tech neutral' in their overall business strategy. Their relationship with their technology vendors and service providers will change for sure. Winners in the pandemic have been telecommunication, grocery, e-commerce, fintech, digital media, sporting goods, and logistics/warehouse management who are more tech driven in their business models.

So too will this pandemic tip the scales in favor of large employers with vast cash reserves and unwavering customer bases such as Amazon, Alphabet/Google, Facebook, Netflix and Apple who can finance ferocious predatory behaviors in local tech talent markets stunted by recent developments. Our interviews and recent data from companies in our 3,602 research partner network has revealed many stories of 'surgical' labor losses by aggressive recruiters targeting specific individuals and also clusters of highly valued talent in specialized skill areas and product domains. Many employers caught in the haze of pandemic confusion never saw these critical talent losses coming and had only withering defenses to combat their talent defections.

The upshot of all Foote Partners statistical data and empirical research is that 2020 and 2021 will continue to be domi- nated by responses to the novel coronavirus and the trend of employers taking stock in how poorly prepared they are from a talent perspective for consuming these revolutionary new technologies. If these new blockbuster technologies existed independent of one another it would not be nearly as frightening from a labor demand perspective. But they don’t: they’re all part of one gigantic dynamic mesh. This mesh will demand an unprecedented level of talent that will place a stunning labor strain on employers regardless of whether they are developing, supporting, or consuming these pervasive groundbreaking technologies.

On top of all this, when (or whether) they will continue to invest in them based on the global recession. We’ll know more as the months pass but we don’t expect any return to ‘normalcy’ until well in to 2022.

And here’s the rub: employers cannot aspire to capitalize on these transformation technologies without first climbing out of the deep hole they’ve been digging for years. That means perfecting HR practices that lack the power, agility and flexibility necessary to do competitive combat in a labor environment substantially different than what has existed heretofore.
There is a window of opportunity right now while these new technologies are maturing. More employers are commencing the serious work of repairing broken or underperforming people management systems and practices.

**LABOR FORECAST: Architecture to the rescue—but this time for managing tech professionals**

Foote Partners has worked with countless employers over more than 25 years in rethinking how they define the work of their tech professionals and shape an enterprise tech workforce to deliver on tech-driven business goals. But even more important, how they need to think about and build capabilities for the future, executing on business strategies that are not yet fully formed but which we, as experienced forecasters and analysts, have helped them understand capabilities they will need to be operational in their future.

Our conclusion is that the only approach to this particular work that has ever achieved consistent success — much less any proven success at all — has been one based on a strong architectural foundation. Not business architecture or technical architecture but rather people architecture.

By this we mean applying, to human capital management, traditional architecture principles and practices. Adopting a framework for tech people and pay that properly defines, classifies, and aligns job roles, levels, skills and competencies across the enterprise and allows for accurate matching of people and jobs to a constantly evolving marketplace. And perhaps most importantly, one that that is flexible in principle and agile enough in practice to enable job and pay scalability, meet forecasted labor needs, and accommodate growth and change with minimal pressure while also not creating new problems as a by-product.

*Tech People Architecture (TPA)* is similar in principle to traditional IT architecture initiatives but applied instead to workforce management and tech human capital. There are strategy and capability roadmaps, phase gate blueprints, benchmarks, performance metrics, and stakeholder management is critical. Governance issues need careful attention and business strategy drives it all. *Agile Compensation* is the answer to the chaos created by the proliferation of technology related job titles and lack of consistency in job definition and pay programs across the enterprise for the same work performed.

(For a detailed explanation of Tech People Architecture see: [WorldatWork Journal - November/December 2019 issue](https://www.worldatwork.org/journals/world-at-work/2019/11-12))

But with Agile Compensation and Tech People Architecture it’s about how key human capital management (HCM) elements such as job definition and design, skills demand and acquisition, compensation, incentives and recognition, professional development, and work/life balance plug into an overall optimized operational model. The model is tuned to new technologies, business strategy, organizational goals, and culture and performance philosophies and—because most of these are in constant flux—-it promotes flexibility and scalability, like any disciplined architecture approach.
**Popularity of Tech People Architecture and Agile Compensation practices.** Clearly the widespread acceptance of technology’s singular role as an engine of innovation and competitiveness is unquestioned. But so is the energized role thrust upon technology professionals and organizations to monetize technology.

With this, senior business management has held both tech leadership and business line leaders increasingly more accountable for managing the technology talent deployed to architect, build, and secure new products and services that are largely technology driven. Their performance for delivering higher levels of information and tech management has been more closely scrutinized. Examples include advanced analytics (for making more informed decisions), greater security (against dreaded cyber-attacks), and capitalizing on fast moving trends such as artificial intelligence/machine learning and digital innovation. Meanwhile, for the CIO, the imperative to streamline operations, reduce costs in every possible manner, and ensure compliance with countless regulations must still be met.

Taken together, this has placed tremendous pressure on tech leadership to execute flawlessly and predictably in unfamiliar areas. For many employers this can only be achieved with a dramatic transformation of the tech workforce to a more appropriately skilled group of professionals who are capable of a level of agility, flexibility and aptitude not commonly associated with their predecessors. Companies must be able to architect their human capital to meet business needs now and especially in the future.

The cost of not being able to meet these high-performance bars is more difficult finding, developing and retaining tech talent that can perform at a high caliber on increasingly more difficult tasks. TPA approaches enable employers to cope with the complexity of defining, determining pay, and laying out career paths for complex jobs at a time when recruiters are picking off your best people in the pandemic ‘haze’.

Technology People Architecture and Agile Compensation focus on how key human capital management (HCM) elements such as job definition and design, skills demand and acquisition, compensation, incentives and recognition, professional development, and work/life balance plug into an overall optimized operational model. The model is tuned to new technologies, shifting business strategy and organizational imperatives, culture, and performance philosophies.

Together they propel flexibility and scalability, like any disciplined architecture approach. *This is exactly what has been missing for decades in the HR functions at many employers, resulting in constant labor gaps, skills deficits, and failure to execute consistently.*

For employers, Agile Compensation and Tech People Architecture has solved these problems:

- Reducing by 50% to 70% the number of tech-related job titles used to plan and administer pay — without changing the actual job titles bestowed on tech workers.

- Reducing tech staff churn in key roles, especially the most experienced tech workers

- Streamlining and simplifying compensation administration, giving employers the capacity to classify and market price any job, no matter how unique it is.
TECH LABOR TRENDS DISCUSSION & ANALYSIS – cont’d.

- Reducing uncertainty about how much to pay tech professionals, especially new jobs and the “Swiss Army knife” hybrid positions.
- Reducing job definition/design chaos around tech jobs that don’t fit in with established tech roles.
- Increasing consistent availability and quality of skills and workers and achieving higher utilization rates.

Why has Tech People Architecture become the most successful alternative for most employers? Because architecture practices are familiar to technology executives. Technical architecture practices have been successful for decades because, when done well, companies have achieved an understanding of what they have systems-wise and could then connect it to where they were going and how they were going to get there, all within a process inclusive of all the various stakeholders who shared the risk in the outcome. TPA achieves the same results, except for shaping the tech workforce for both current and future requirements.
IT Skills & Certifications Pay Data Trend Charts & Analysis

IT Skills and Certifications Pay Index™ – 2nd Quarter 2020 data edition

(Data collected through July 1, 2020)

- IT Certifications (Page 32)
- Noncertified IT Skills (Page 46)
- IT Skills & Certifications Volatility Index™ (Page 59)
How to interpret gains and losses in IT skills and certifications pay premiums

Quarterly gains and losses in premium pay reflect a widening or narrowing, respectively, in the gap between supply and demand for skills and certifications. This may occur for any number of reasons. For example, a quarterly decline in pay for a skill may signal that the market supply of talent for that skill is catching up to demand—not necessarily that demand is starting to wane. IT professionals are often attracted to a skill or certification if they perceive that it has rising value in the marketplace and therefore can help them to achieve higher pay, greater job security, a promotion, or more flexibility in their career choices. As they pursue greater competency in that skill or as more workers attain certification, supply increases and market pricing (which is elastic to the laws of supply and demand) will be driven downward unless demand is rising at the same proportional rate. Conversely, if demand rises and supply is not increasing to match that level of demand, pay premiums for specific skills and certifications will increase.

Therefore, when interpreting gains and losses in market pay it is important to consider all factors that could be driving supply and demand and market perception. Those factors range from:

- aggressive marketing of certifications by vendors;
- changes in certification programs (e.g. certification extensions or retirement);
- new technology and evolution/maturation of current technologies;
- technology adoption rate;
- product integration strategies,
- economic conditions;
- employment opportunities;
- mergers/acquisitions;
- budget cycles and the timing of skills and talent acquisition by employers;
- changes in labor sourcing plans pursuant to company strategies.
IT Certifications: Pandemic winners

(Data collected through July 1, 2020)
Cash pay premiums are reported for these IT certifications (508)

Avaya Certified Design Specialist
Avaya Certified Implementation Specialist
Avaya Certified Integration Specialist
Avaya Certified Solution Specialist
Avaya Professional Design Specialist
AWS Certified Developer - Associate
AWS Certified DevOps Engineer - Professional
AWS Certified Solutions Architect - Associate (Cloud)
AWS Certified Solutions Architect - Professional (Cloud)
AWS Certified SysOps Administrator-Associate (Cloud)
BICSI Technical
BICSI Technician and Registered Communications Distribution Designer
Broadcom Certified Network Engineer
Broadcom Certified Network Professional
Broadcom Certified Fabric Designer
Broadcom Certified Fabric Professional (BCFP)
Certificate of Cloud Security Knowledge
Certification Authorization Professional (CAP)
Certification of Capability in Business Analysis (CCBA)
Certified Analytics Professional (CAP)
Certified Business Analysis Professional (CBAP)
Certified Business Continuity Professional (CBCP)
Certified Cloud Architect
Certified Cloud Security Professional (CCSP)
Certified Cloud Technology Professional
Certified Computer Examiner (CCE)
Certified Computing Professional (CCP-ISC2)
Certified Cyber Forensics Professional
Certified Data Centre Management Professional (CDCMP)
Certified Data Management Professional (CDMP)
Certified Disaster Recovery Engineer (CDRE)
Certified Forensic Computer Examiner (CFCE)
Certified Fraud Examiner
Certified Healthcare Information Security and Privacy Practitioner (HCISPP)
Certified in Convergent Network Technologies (CNT)
Certified in Governance, Risk and Compliance
Certified in Risk and Information Systems Control (CRISC)
Certified in the Governance of Enterprise IT (CGEIT)
Certified Information Privacy Manager- all countries
Certified Information Privacy Professional - all countries
Certified Information Privacy Technician- all countries
Certified Information Security Manager (CISM)
Certified Information Systems Auditor (CISA)
Certified Information Systems Security Professional (CISSP)
Certified Information Systems Security Professional (CISSP)
Certified Information Systems Security Professional (CISSP)
Certified IT Architect (IASA CITAS)
Certified IT Compliance Professional
Certified Manager of Software Quality (CMSQ)
Certified Penetration Testing Engineer (CPTE)
Certified Project Management Practitioner
Certified Protection Professional
Certified ScrumMaster
Certified Scrum Coach
Certified Scrum Developer
Certified Scrum Product Owner
Certified Scrum Professional
Certified Scrum Trainer
Certified Secure Software Lifecycle Professional (CSSLP)
Certified Software Quality Analyst (CSQA)
Certified Telecommunications Network Specialist (CTNS)
Check Point Certified Security Administrator (CCSA)
Check Point Certified Security Expert (CCSE)
Check Point Certified Security Master (CCSM)
Cisco Certified Architect
Cisco Certified CyberOps Associate
Cisco Certified Design Expert (CCDE)
Cisco Certified DevNet Associate
Cisco Certified DevNet Professional
Cisco Certified Entry Network Technician (CCENT)
Cisco Certified Internetwork Expert (CCIE, all variations)
Cisco Certified Network Associate - Data Center
Cisco Certified Network Associate (CCNA Routing and Switching)
Cisco Certified Network Associate (was CCNA Cloud)
Cisco Certified Network Associate (was CCNA Collaboration)
Cisco Certified Network Associate (was CCNA Wireless)
Cisco Certified Network Associate (was Design Associate)
Cisco Certified Network Professional - Collaboration
Cisco Certified Network Professional - Data Center
Cisco Certified Network Professional - Data Center (CCNP Cloud)
Cisco Certified Network Professional - Enterprise (was CCNP Routing and Switching)
Cisco Certified Network Professional - Enterprise (was CCNP Wireless)
Cisco Certified Network Professional - Security
Cisco Certified Network Professional (CCNP)
Cisco Certified Network Professional (was CC Design Professional)
Cisco Certified Systems Instructor (CCSI)
Cisco Data Center Unified Computing Design Specialist
Cisco Data Center Unified Fabric Support Specialist
Citrix Certified Associate - Networking (CCA)
Citrix Certified Associate – Virtualization
Citrix Certified Expert - Networking
Citrix Certified Expert - Virtualization
Citrix Certified Instructor (CCI - Virtualization, Networking, or Mobility)
Citrix Certified Professional - Networking
Citrix Certified Professional-Virtualization (CCP-V)
Citrix XenServer Certified (CC-XenServer)
CIW Certified Database Design Specialist
CIW Web Design Professional
CIW Web Development Professional
CIW Web Foundations Associate
CIW Web Security Professional
Cloud U (Rackspace)
CloudHopper Certified Associate Administrator
CloudHopper Certified Associate Data Analyst
CloudHopper Certified Associate Spark and Hadoop Developer
CloudHopper Certified Professional: Data Engineer
CompTIA A+
CompTIA Advanced Security Practitioner
CompTIA Certified Technical Trainer
CompTIA Cloud Essentials
CompTIA Cloud+
CompTIA Cybersecurity Analyst+
CompTIA Linux+
CompTIA Mobile App Security+
CompTIA Mobility+
CompTIA Network (Network+)
CompTIA Penetration Tester
CompTIA Project+
CompTIA Security+
CompTIA Server+
CompTIA Storage+
Convergence Technologies Professional (CTP)
CSX CyberSecurity Practitioner (CSXP)
CWP/CNP Certified Wireless Security Professional (CWSP)
CWP/CNP Certified Wireless Analysis Professional (CWAP)
CWP/CNP Certified Wireless Design Professional (CWDP)
CWP/CNP Certified Wireless Network Administrator (CWNW)
CWP/CNP Certified Wireless Network Trainer (CWTN)
CWP/CNP Certified Wireless Technology Specialist (CWT6)
CWP/CNP/Certified Wireless Network Expert (CWN6)
CWP Security Forensic Analyst
EC-Council Certified Application Security Professional (CASE)
EC-Council Certified Encryption Specialist (ECES)
EC-Council Certified Ethical Hacker (CEH)
EC-Council Certified Incident Handler V2 (ECIH)
EC-Council Certified Network Defender
EC-Council Certified Network Defense Architect (CNDNA)
EC-Council Certified Security Analyst (ECSA)
EC-Council Computer Hacking Forensic Investigator (CHFI)
EC-Council Disaster Recovery Professional (EDRP)
EC-Council Licensed Penetration Tester (LPT)
EMC Cloud Architect Expert
EMC Cloud Architect Specialist
EMC Cloud Engineer (EMCCE)
EMC Data Center Architect (EMCDDA - all versions)
EMC Data Science Associate
EMC Data Science Specialist, Advanced Analytics
EMC Implementation Engineer - Expert (EMCIE)
EMC Implementation Engineer - Specialist (EMCIE)
EMC Information Storage Associate (EMCSA)
EMC Platform Engineer - Specialist (EMCPE)
EMC Storage Administrator - Specialist (EMCSA-A)
EMC Storage Administrator - Expert (EMCSA-E)
EMC Storage Administrator - Specialist (EMCSA-S)
EMC System Administrator – Documentum Specialist (EMCSya)
EMC Technology Architect - Expert (EMCTA)
EMC Technology Architect - Specialist (EMCTA)
GIAC Assessing Wireless Networks
GIAC Certified Defending Advanced Threats (GDAT)
GIAC Certified Detection Analyst (GCDA)
GIAC Certified Enterprise Defender (GCED)
GIAC Certified Forensics Examiner (GCFE)
GIAC Certified Forensics Examiner
GIAC Certified Incident Handler (GCIH)
GIAC Certified Intrusion Analyst (GCA)
GIAC Certified Penetration Tester (GPTN)
GIAC Certified Perimeter Protection Analyst (GPPA)
GIAC Certified Project Manager (GCPM)
GIAC Certified Unix Security Administrator (GCUX)
GIAC Certified Web Application Defender
GIAC Certified Windows Security Administrator (GCWN)
GIAC Critical Controls Certifications (GCCC)
GIAC Cyber Threat Intelligence (GCTI)
PMI Project Management Professional (PMP)
PMI Risk Management Professional (PMI-RMP)
Prince2 Foundation
Prince2 Practitioner
Professional Certified Investigator
Professional in Project Management (GAQM)
Qualified Information Security Professional (QISP)
Rackspace Certified Technician
Red Hat Certified Architect (RHCA)
Red Hat Certified Architect: Application Development
Red Hat Certified Architect: Application Platform
Red Hat Certified Architect: Cloud
Red Hat Certified Architect: DevOps
Red Hat Certified Datacenter Specialist (RHCD)
Red Hat Certified Engineer in Red Hat OpenStack
Red Hat Certified Engineer (RHCE)
Red Hat Certified System Administrator in Red Hat OpenStack
Red Hat Certified Systems Administrator (RHCSA)
RedHat Certified Specialist in Virtualization
RSA Certified Administrator (RSA/CA)
RSA Certified Instructor (RSA/Ci)
Salesforce Certified Administrator
Salesforce Certified Advanced Administrator
Salesforce Certified Application Architect
Salesforce Certified Data Architecture and Management Designer
Salesforce Certified Mobile Solutions Architecture Designer
Salesforce Certified Platform Developer
Salesforce Certified Systems Architect
Salesforce Certified Technical Architect
Salesforce Commerce Cloud Digital Developer
Salesforce Platform App Builder
SAS Certified Advanced Programmer for SAS 9
SAS Certified Base Programmer for SAS 9
SAS Certified Big Data Professional Using SAS 9
SAS Certified Data Integration Developer for SAS 9
SAS Certified Data Scientist Using SAS 9
SAS Certified Predictive Modeler - SAS Enterprise Miner 14
SAS Certified Statistical Business Analyst - SAS 9
SAS® Certified Advanced Analytics Professional Using SAS®9
SAS® Certified BI Content Developer for SAS®9
SAS® Certified Data Quality Steward for SAS®
Siebel 8 Consultant Certified Expert
Six Sigma Black Belt
Six Sigma Green Belt
Six Sigma Master Black Belt
Six Sigma Yellow Belt

SNIA Certified Storage Architect
SNIA Certified Storage Networking Expert (SCSN-E)
SNIA Certified Storage Professional
SNIA Certified Systems Engineer Sniffer Certified Expert
SolarWinds Certified Professional (SCP)
SUSE Certified Administrator
SUSE Enterprise Engineer (SCE)
SUSE Enterprise Architect or (SEA)
Systems Security Certified Practitioner (SSCP)
Teradata 14 Certified Associate
Teradata 14 Certified Database Administrator
Teradata 14 Certified Enterprise Architect
Teradata 14 Certified Master
Teradata 14 Certified Professional
Teradata 14 Certified Solutions Developer
Teradata 14 Certified Technical Specialist
TIBCO Certified Professional
TIBCO Certified SOA Architect
TOGAF 9 Certified
VMware Certified Advanced Professional 6.5 - Data Center Virtualization Design
VMware Certified Advanced Professional – Network Virtualization
VMware Certified Advanced Professional (all)
VMware Certified Advanced Professional 6 - Data Center Virtualization Deployment
VMware Certified Advanced Professional 6/7 - Cloud Mgmt and Automation Deployment
VMware Certified Advanced Professional 6/7 - Cloud Mgmt and Automation Design
VMware Certified Associate - Cloud
VMware Certified Associate - Data Center Virtualization
VMware Certified Design Expert – Network Virtualization
VMware Certified Design Expert - Cloud Mgmt and Automation
VMware Certified Design Expert (all)
VMware Certified Design Expert – Network Virtualization
VMware Certified Design Expert - Cloud Mgmt and Automation
VMware Certified Design Expert (all)
VMware Certified Design Expert 6 - Data Center Virtualization
VMware Certified Professional - Digital Workspace
A. TECH CERTIFICATIONS CURRENTLY EARNING WELL ABOVE-AVERAGE PAY AND STILL GAINING IN CASH MARKET VALUE

The average market value for 508 tech certifications decreased 2.2 percent overall in the second quarter of 2020, the eighth consecutive calendar quarter of losses that total 10 percent over the same period. Pay premiums for single certifications are averaging the equivalent of 6.9% of base salary in July 2020.

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**Why have more certifications been losing value than gaining value?**

Certifications decline in market value for a number of obvious and not so obvious reasons. Pay premiums may diminish as a certification expires, is retired, or is replaced with more appropriate certifications as technology evolves. Also, there remains a lingering bias that taking a proctored exam does not confer expertise in a subject on the test taker, especially when the pass rate is 70 percent correct answers. The certification industry has fought back against this bias by adding laboratory requirements and even peer review panels that decide if the candidate has qualified to receive designation.

But just as often it’s their popularity that drives down pay premiums for a certification: as interest in a certification escalates and more people attain the certification the gap between supply and demand for the certification narrows, driving down its market value as the laws of scarcity would dictate. This has been documented in the case of dozens of certifications over the 20 years Foote Partners has been tracking and reporting their cash pay premiums in the *IT Skills and Certifications Pay Index*.

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**Which certifications are bucking the trend---highest paying and still growing in value?** The following tech certifications are distinctive for two reasons: they recorded notable gains in cash market value in the six months ending July 1, 2020 and are also earning cash pay premiums significantly higher than the average of all 508 certifications being reported.
CERTIFICATION ANALYSIS - cont'd.

1. **CompTIA Advanced Security Practitioner (CASP+)**
   - Average Pay Premium: 14 percent of base salary equivalent
   - Market Value Increase: 27.3 percent (in the six months through July 1, 2020)

   The **Advanced Security Practitioner** from CompTIA is the only hands-on, performance-based certification for practitioners — not managers — at the advanced skill level of cybersecurity. While cybersecurity managers help identify what cybersecurity policies and frameworks could be implemented, CASP+ certified professionals figure out how to implement solutions within those policies and frameworks. This certification validates advanced-level competency in risk management, enterprise security operations and architecture, research and collaboration, and integration of enterprise security. It measures knowledge in the following:

   - Enterprise security domain expanded to include operations and architecture concepts, techniques and requirements
   - More emphasis on analyzing risk through interpreting trend data and anticipating cyberdefense needs to meet business goals
   - Expanding security control topics to include mobile and small-form factor devices, as well as software vulnerability
   - Broader coverage of integrating cloud and virtualization technologies into a secure enterprise architecture
   - Inclusion of implementing cryptographic techniques, such as blockchain, cryptocurrency and mobile device encryption

2. **GIAC Exploit Researcher and Advanced Penetration Tester (GXPN)**
   - Average Pay Premium: 13 percent of base salary equivalent
   - Market Value Increase: 30 percent (in the six months through July 1, 2020)

   A white hat hacker, or ethical hacker, uses penetration testing techniques to test an organization's IT security and to identify vulnerabilities. IT security staff then uses the results of such penetration tests to remediate vulnerabilities, strengthen security and lower an organization's risk factors. Penetration testing is never a casual undertaking; it involves lots of planning, which includes getting explicit permission from management to perform tests, and then running tests as safely as possible. These tests often involve the very same techniques that attackers use to breach a network for real.

   White hat hacking involves a great deal of problem solving, as well as communication skills. A white hat hacker also requires a balance of intelligence and common sense, strong technical and organizational skills, impeccable judgement and the ability to remain cool under pressure.

   At the same time, a white hat needs to think like a black hat hacker, with all their nefarious goals and devious skills and behavior. Some top-rate white hat hackers are former black hat hackers who got caught, and for various reasons decided to leave a life of crime behind and put their skills to work in a positive (and legal) way. There are no standard education criteria for a white hat hacker — every organization can impose its own requirements on that position — but a bachelor's or master's degree in information security, computer science or even mathematics provides a strong foundation. For those who aren't college bound, a military background, especially in intelligence, can help your resume get noticed by hiring managers. Military service is also a plus for employers who require or prefer those with security clearances.

   The **GIAC Exploit Researcher and Advanced Penetration Tester** certification targets security personnel whose job duties involve assessing target networks, systems and applications to find vulnerabilities. The GXPN certifies that candidates have the knowledge, skills, and ability to conduct advanced penetration tests, model the behavior of attackers to improve system security, and the knowledge to demonstrate the business risk associated with these behaviors.
3. **Certified Secure Software Lifecycle Professional (CSSLP)**
   
   Average Pay Premium: 13 percent of base salary equivalent  
   Market Value Increase: 18.2 percent (in the six months through July 1, 2020)

Like other (ISC)² certifications, the **Certified Secure Software Lifecycle Professional (CSSLP)** is a vendor-neutral credential relevant to many kinds of programming and development projects. Aimed at software developers, engineers, architects, QA and penetration testers, security specialists and the like, the CSSLP recognizes competency in securing applications throughout the software development lifecycle. Prerequisites include at least four years’ full-time work-related experience in the software development lifecycle (SDLC) in at least one of eight CSSLP domains, or three years’ experience plus a bachelor's degree or equivalent in an IT-related field such as computer science or information technology. The required exam covers all phases of this lifecycle, including secure software concepts, requirements, design, implementation and coding, and testing. Candidates should also be up to speed on the eight CSSLP Common Body of Knowledge (CBK) domains which include software concepts, requirements, design, implementation/programming, testing, lifecycle management, deployment, and operations.

4. **[Tie] GIAC Certified Penetration Tester (GPEN)**  
   EC-Council Computer Hacking Forensic Investigator (CHFI)
   
   Average Pay Premium: 12 percent of base salary equivalent  
   Market Value Increase: 20 percent (in the six months through July 1, 2020)

The **GIAC Certified Penetration Tester (GPEN) certification** validates a practitioner's ability to properly conduct a penetration test, using best practice techniques and methodologies. GPEN certification holders have the knowledge and skills to conduct exploits and engage in detailed reconnaissance, as well as utilize a process-oriented approach to penetration testing projects.

**Computer forensics** is the application of computer investigation and analysis techniques in the interests of determining potential legal evidence. Evidence might be sought in a wide range of computer crime or misuse, including but not limited to theft of trade secrets, theft of or destruction of intellectual property, and fraud. **Computer hacking forensic investigation** is the process of detecting hacking attacks and properly extracting evidence to report the crime and conduct audits to prevent future attacks.

Likewise, achieving the **Computer Hacking Forensic Investigator (CHFI) certification** validates that you have the knowledge and skills to detect hacking attacks, to properly obtain evidence needed to report the crime and prosecute the cybercriminal, and to conduct an analysis that enables you to prevent future attacks. CHFI presents a methodological approach to computer forensics including searching and seizing, chain-of-custody, acquisition, preservation, analysis and reporting of digital evidence. With a focus on computer forensics from a vendor-neutral perspective, CHFI certification provides the ideal level of network security expertise for law enforcement personnel, system administrators, security officers, defense and military personal, legal professionals, bankers, security professionals and anyone who is concerned about the integrity of the network infrastructure.

CHFI investigators can draw on an array of methods for discovering data that resides in a computer system, or recovering deleted, encrypted, or damaged file information known as computer data recovery. The purpose of the CHFI credential is to validate the candidate’s skills to identify an intruder’s footprints and to properly gather the necessary evidence to prosecute in the court of law.
Areas of expertise covered in GPEN include:
• Comprehensive Pen Test Planning, Scoping, and Recon
• In-Depth Scanning and Exploitation, Post-Exploitation, and Pivoting
• In-Depth Password Attacks and Web App Pen Testing

These are the roles most common roles for GPEN certificants:
• Security personnel responsible for assessing networks and systems to find and remediate vulnerabilities
• Penetration testers
• Ethical hackers
• Red Team members
• Blue Team members
• Defenders, auditors, and forensic specialists who want to better understand offensive tactics

6. [Tie] GIAC Security Leadership (GSLC)
EC-Council Certified Encryption Specialist (ECES)

*Average Pay Premium: 12 percent of base salary equivalent
*Market Value Increase: 9.1 percent (in the six months through July 1, 2020)

The **EC-Council Certified Encryption Specialist (ECES)** certification introduces professionals and students to the field of cryptography. Certificants have a solid foundation in modern symmetric and key cryptography including the details of algorithms such as Feistel Networks, DES, and AES, plus:

• Overview of other algorithms such as Blowfish, Twofish, and Skipjack
• Hashing algorithms including MD5, MD6, SHA, Gost, RIPEMD 256 and others.
• Asymmetric cryptography including thorough descriptions of RSA, Elgamal, Elliptic Curve, and DSA.
• Significant concepts such as diffusion, confusion, and Kerkchoff’s principle.

Certificants have practical applications of the following:

• How to set up a VPN
• Correct and incorrect deployment of encryption technologies. Encrypt a drive.
• Hands-on experience with steganography
• Hands on experience in cryptographic algorithms ranging from classic ciphers like Caesar cipher to modern day algorithms such as AES and RSA.
• Best practices when implementing encryption technologies
• Common mistakes made in implementing encryption technologies
• How to select the best standard for your organization
The **GIAC Security Leadership (GSLC)** certification validates a practitioner's understanding of governance and technical controls focused on protecting, detecting, and responding to security issues. GSLC certification holders have demonstrated knowledge of data, network, host, application, and user controls along with key management topics that address the overall security lifecycle. Areas covered include:

- Cryptography concepts & applications for managers, networking concepts & monitoring for managers
- Managing a security operations center, application security, negotiations and vendors, and program structure
- Managing security architecture, security awareness, security policy, and system security
- Risk management and security frameworks, vulnerability management, incident response and business continuity

8. [Tie]  **Certification of Capability in Business Analysis (CCBA)**

- **GIAC Certified Enterprise Defender (GCED)**
- **Certified Scrum Product Owner**

  - Average Pay Premium: 11 percent of base salary equivalent
  - Market Value Increase: 22.2 percent (in the six months through July 1, 2020)

The **Certification of Capability in Business Analysis (CCBA)** designation is a professional certification from International Institute of Business Analysis (IIBA) for business analysis practitioners who want to be recognized for their expertise and skills.

The CCBA highlights a certificant's capability to work effectively with stakeholders, to model business processes, and identify and evaluate opportunities for better business outcomes. The certification represents skills and knowledge applied to real-life scenarios.

The CCBA exam is based on *A Guide to the Business Analysis Body of Knowledge* (BABOK Guide). To earn the CCBA designation, a business analyst needs to be knowledgeable in all six knowledge areas in the BABOK Guide with proficiency in at least two. To apply for the Capability in Business Analysis (CCBA) exam, applicants must meet the following criteria:

- Minimum 3750 hours of business analysis work experience aligned with BABOK Guide in the last seven years
- Minimum 900 hours in each of 2 of the 6 knowledge areas OR 500 hours in each of 4 of the 6 knowledge areas
- Minimum 21 hours of Professional Development in the past four years
- Minimum high school education or equivalent
- Two references from a career manager, client or Certified Business Analysis Professional recipient

The **GIAC Certified Enterprise Defender (GCED)** certification builds on the security skills measured by the GIAC Security Essentials certification. It assesses more advanced, technical skills that are needed to defend the enterprise environment and protect an organization as a whole. GCED certification holders have validated knowledge and abilities in the areas of defensive network infrastructure, packet analysis, penetration testing, incident handling and malware removal. Areas covered by this certification include:

- Incident handling and computer crime investigation
- Computer and network hacker exploits
- Hacker tools (Nmap, Nessus, Metasploit and Netcat)
CERTIFICATION ANALYSIS - cont'd.

From a business standpoint, one of the most vital roles on any Scrum team is the Product Owner (PO). It is a challenging role, one that requires the PO to take accountability for making business decisions about the product—decisions such as which features to include and the priority of those features. However, these decisions cannot be made in a vacuum. Because the PO must get input from other business stakeholders, they need skills such as facilitation, conflict management, creative thinking, and the ability to influence the team and other stakeholders.

While the Certified ScrumMaster® (CSM®) helps the Scrum Team work together to learn and implement Scrum, as a Certified Scrum Product Owner® (CSPO®), you create the product vision; write or participate in the writing of product requirements; develop and prioritize the list of these features called a product backlog; review, test and accept the product; .and make sure the best possible job is done to satisfy the customer. To achieve this certification, the candidate attends a live online or in-person course taught by a Certified Scrum Trainer® (CST®), or receives private coaching from a Certified Agile Coach (CAC). After successfully completing the course, you will be asked to accept the CSPO License Agreement.

Benefits of a Certified Scrum Product Owner certification:

- Expand career opportunities across all industry sectors adopting Agile practices
- Demonstrate your attainment of core Scrum knowledge
- Learn the foundation of Scrum and the scope of the Product Owner role
- Engage with Agile practitioners committed to continuous improvement

11. Six Sigma Black Belt

Average Pay Premium: 11 percent of base salary equivalent
Market Value Increase: 10 percent (in the six months through July 1, 2020)

Six Sigma levels simplified. Six Sigma is defined as a method for reducing variation in manufacturing, service or other business processes. At the project level, there are master black belts, black belts, green belts, yellow belts, and white belts. These people conduct projects and implement improvements.

- **Master Black Belt**: Trains and coaches Black Belts and Green Belts. Functions more at the Six Sigma program level by developing key metrics and the strategic direction. Acts as an organization’s Six Sigma technologist and internal consultant.
- **Black Belt**: Leads problem-solving projects. Trains and coaches project teams.
- **Green Belt**: Assists with data collection and analysis for Black Belt projects. Leads Green Belt projects or teams.
- **Yellow Belt**: Participates as a project team member. Reviews process improvements that support the project.
- **White Belt**: Can work on local problem-solving teams that support overall projects, but may not be part of a Six Sigma project team. Understands basic Six Sigma concepts from an awareness perspective.
- **Brown Belt**: Brown Belt is not traditionally used in Six Sigma and is not recognized by most organizations or accrediting agencies. However, some organizations may classify a Brown Belt as a person who has their Green Belt and has passed the Black Belt certification exam, but hasn't completed a second Six Sigma project.
The **Certified Six Sigma Black Belt** is a professional who can explain Six Sigma philosophies and principles, including supporting systems and tools. A Black Belt should demonstrate team leadership, understand team dynamics and assign team member roles and responsibilities. Black Belts have a thorough understanding of all aspects of the define, measure, analyze, improve and control (DMAIC) model in accordance with Six Sigma principles. They have basic knowledge of lean enterprise concepts, are able to identify non-value-added elements and activities and are able to use specific tools.

Earning a **Six Sigma Black Belt** requires two completed projects with signed affidavits or one completed project with signed affidavit and three years of work experience in one or more areas of the Six Sigma Body of Knowledge. The Six Sigma Black Belt project is one that uses appropriate tools within a Six Sigma approach to produce breakthrough performance and real financial benefit to an operating business or company. The tools are generic: It is the structure of the project and the associated process (improvement model) that distinguish a Black Belt project from other similar quality improvement projects. Financial impact as an outcome is also a requirement within a Black Belt project when compared to other projects.

Examples of projects that qualify:

- Manufacturing product defect reduction.
- Human resources recruitment cycle time reduction.
- Reduced accounts payable invoice processing costs.
- Reduced Manufacturing machine setup time.

Projects that do not qualify:

- Prepackaged or classroom exercise that are mock, or simulated projects that were previously completed and/or that do not include actual “hands on” work.
- No real organization or business unit; no current problem or cost benefit.
- Basic product improvement projects not associated with process improvements.
- Software maintenance or remediation without detailed process measurements.
- Any project without measured before-and-after cost benefits.

**12. [Tie] GIAC Certified Forensics Examiner (GCFE)**

*Six Sigma Green Belt*  
*Salesforce.com Certified Technical Architect*

**Average Pay Premium:** 10 percent of base salary equivalent  
**Market Value Increase:** 25 percent (in the six months through July 1, 2020)

The **GIAC Certified Forensic Examiner (GCFE)** certification validates a practitioner’s knowledge of computer forensic analysis, with an emphasis on core skills required to collect and analyze data from Windows computer systems. GCFE certification holders have the knowledge, skills, and ability to conduct typical incident investigations including e-Discovery, forensic analysis and reporting, evidence acquisition, browser forensics and tracing user and application activities on Windows systems. Areas covered by this certification include:

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CERTIFICATION ANALYSIS - cont'd.

- Windows Forensics and Data Triage
- Windows Registry Forensics, USB Devices, Shell Items, Key Word Searching, Email and Event Logs
- Web Browser Forensics (Firefox, IE and Chrome) and Tools (Nirsoft, WOanware, SQLite, ESEDatabaseView and Hindsight)

The Six Sigma Green Belt operates in support of or under the supervision of a Six Sigma Black Belt, analyzing and solving quality problems and involved in quality improvement projects. They help with statistical analysis and may lead projects in a part-time capacity. A Green Belt has at least three years of work experience who wants to demonstrate his or her knowledge of Six Sigma tools and processes. They are employees who spend some of their time on process improvement teams.

The Six Sigma Green Belt certification requires three years of work experience in one or more areas of the Six Sigma Green Belt Body of Knowledge. Candidates must have worked in a full-time, paid role. Paid intern, co-op or any other course work cannot be applied toward the work experience requirement.

Minimum expectations of a Certified Six Sigma Green Belt are:
- Operates in support of or under the supervision of a Six Sigma Black Belt.
- Analyzes and solves quality problems.
- Involved in quality improvement projects.
- Participated in a project, but has not led a project.
- Has at least three years of work experience.
- Has ability to demonstrate their knowledge of Six Sigma tools and processes.

The Salesforce.com Certified Technical Architect is the highest certification and the ultimate test of all Salesforce credentials. The CTA is an architect and strategist — someone who can bridge the gap between a business' vision and the technology. They know how to make use of technology to achieve real business results. CTAs are regarded as the absolute elite amongst Salesforce professionals, who have not only mastered the knowledge but possess excellent consulting and communication skills. Technical Architects possess broad knowledge across multiple development platforms and draw on their skills and experience to assess customer requirements and architecture to design secure, high-performance technical solutions.

15. GIAC Certified Incident Handler (GCIH)

Average Pay Premium: 10 percent of base salary equivalent
Market Value Increase: 11.1 percent (in the six months through July 1, 2020)

Incident handler is a term used to describe the activities of an organization to identify, analyze, and correct hazards to prevent a future reoccurrence. These incidents within a structured organization are normally dealt with by either an Incident Response Team (IRT), or an Incident Management Team (IMT). The teams are often either designated beforehand, or during the event and are placed in control of the organization while the incident is dealt with, in order to retain business processes.
The GIAC Incident Handler (GCIH) certification is an IT/IS security credential aimed at demonstrating an individual’s proficiency and understanding in detecting, responding to and resolving computer security incidents in a corporate environment. The GCIH validates a practitioner’s ability to detect, respond, and resolve computer security incidents using a wide range of essential security skills. GCIH certification holders have the knowledge needed to manage security incidents by understanding common attack techniques, vectors and tools, as well as defend against and respond to such attacks when they occur.

GCIH is for Incident handlers; Incident handling team leads; System administrators; security practitioners; security architects; any security personnel that are first responders. Areas of expertise covered by the GCIH include:

- Incident Handling and Computer Crime Investigation
- Computer and Network Hacker Exploits
- Hacker Tools (Nmap, Nessus, Metasploit and Netcat)
- Backdoor and trojan horses
- DNS attacks
- Exploiting Systems
- IP address spoofing
- Network sniffing
- Password attaches
- Rootkits
- Scanning
- Worms, bots and botnets
B. TECH CERTIFICATIONS LOSING THE MOST IN CASH MARKET VALUE

In the table below are tech certifications currently recording the largest market value losses in the six months ending July 1, 2020. In some cases, these declines can be attributed to a narrowing of the gap between supply and demand as more candidates achieve certification. However as stated earlier in this report, not all employers recognize certification to be an adequate measure of talent in a technology discipline, preferring alternative forms of accreditation to fit their needs.

<table>
<thead>
<tr>
<th>CERTIFICATION</th>
<th>Average Pay Premium (% of base salary equivalent)</th>
<th>6-mo. Market Value Change (Jan 2020 to June 2020)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified in the Governance of Enterprise IT (CGEIT)</td>
<td>8 %</td>
<td>-32.9 %</td>
</tr>
<tr>
<td>Cisco Certified Network Associate - Data Center</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWNP/Certified Wireless Analysis Professional (CWAP)</td>
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<td></td>
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<tr>
<td>CWNP/Certified Wireless Design Professional (CWDP)</td>
<td></td>
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</tr>
<tr>
<td>Microsoft Certified Solutions Associate: Web Applications</td>
<td>4 %</td>
<td>-33.3 %</td>
</tr>
<tr>
<td>Novell Certified Linux Engineer (CLE)</td>
<td></td>
<td></td>
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<tr>
<td>Novell Identity Manager Administrator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIW Web Development Professional</td>
<td>2 %</td>
<td>-33.3 %</td>
</tr>
<tr>
<td>EMC Cloud Architect Specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIAC Web Application Penetration Tester (GWAPT)</td>
<td>7 %</td>
<td>-30.3 %</td>
</tr>
<tr>
<td>VMware Certified Design Expert - Cloud Mgt and Automation</td>
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<tr>
<td>Certified in Convergent Network Technologies (CCNT)</td>
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<tr>
<td>Juniper Networks Certified Internet Professional (JNCIP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NetApp Certified Implementation Engineer (NCIE)</td>
<td>5 %</td>
<td>-28.6 %</td>
</tr>
<tr>
<td>Oracle Certified Associate - DBA (OCA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMware Certified Advanced Professional (all)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIAC Secure Software Programmer-.NET</td>
<td>8 %</td>
<td>-27.3 %</td>
</tr>
<tr>
<td>GIAC Network Forensic Analyst (GNFA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certified IT Architect (IASA-CITA)</td>
<td>9 %</td>
<td>-25.0 %</td>
</tr>
<tr>
<td>EMC Cloud Architect Expert</td>
<td></td>
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<tr>
<td>Help Desk Analyst: Tier 1 Support Specialist/Ed2Go</td>
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<tr>
<td>Oracle Certified Professional - DBA (OCP)</td>
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<tr>
<td>Qualified/ Information Security Professional Q/ISP</td>
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<tr>
<td>Salesforce Certified Platform Developer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMware Certified Advanced Professional 6.5 - Data Center Virtualization Design</td>
<td>6 %</td>
<td>-25.0 %</td>
</tr>
<tr>
<td>VMware Certified Advanced Professional 6/7 - Cloud Mgt and Automation Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microsoft Certified Trainer (MCT)</td>
<td>3 %</td>
<td>-25.0 %</td>
</tr>
<tr>
<td>SNIA Certified Storage Professional (SCSP)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4
Tech Skills (Non-certified): Pandemic winners

(Data collected through July 1, 2020)
## Apps Dev. Tools/Platforms
- Agile software development
- Amazon Kinesis
- Amazon Web Services
- Apache Airflow
- Apache Ant
- Apache Camel
- Apache Cloudstack
- Apache Cordova
- Apache Flex
- Apache Hadoop
- Apache Lucene
- Apache Maven
- Apache Pig
- Apache Spark
- Apache Struts/Struts2
- Apache Tomcat
- Apache Zookeeper
- Automated Testing
- AWS CloudFormation
- AWS Lambda
- Behavior-Driven Development
- Bitbucket
- Boost C++
- Business Objects
- C
- C#
- C++
- C/C++/CLI
- CA PPM/Clarity PPM
- Cerena Millennium
- Clojure
- Cloudera software
- Cloud Foundry PaaS
- Cobol
- Cognos
- Confluence
- Cucumber
- Delphi
- Drupal
- Eclipse
- Elixir
- Epic Systems applications
- Erlang
- Ethereum
- F#
- Git/GitHub
- GitLab
- Go language (Golang)
- Gmli/Guidewire
- Gradle
- Groovy/Grails
- Grunt
- Hibernate/HHibernate
- HP ALM (App. Lifecycle Mgt)
- HP Unified Functional Testing
- Integration Testing
- iRise
- Jasmine
- Java SE/Java EE
- JBehave
- Jenkins
- JIRA
- JUnit
- Kotlin
- MapReduce
- MATLAB
- Microsoft Azure
- Microsoft SQL Server Mgt Studio
- Microsoft Team Foundation Server
- NetWeaver
- Next.js
- Nim
- NU NI
- Objective-C
- Objective Carri (OCarri)
- OpenShift
- Oracle APEX
- Oracle Apps Developer Framework
- PL/SQL
- Powerbuilder
- Progress 4GL/Development tools
- R language
- Red Hat Fuse
- Rstudio
- Ruby
- Ruby on Rails
- Saas
- SAS
- Scala
- Scrum
- Selenium
- ServiceNow ITSM
- SPSS
- SQL
- Swift
- Tcl
- TestNG
- TransacT-SQL/ISQLT
- UML (unified modeling language)
- Visual Basic 6.0
- Visual C++
- VMware Cloud Foundry PaaS
- WebSphereMQ
- Xcode

### SAP & Enterprise Bus. Apps.
- ABAP (all modules)
- Baan
- Enterprise Application Integration (EAI)
- IBM Sterling
- J.D. Edwards /Oracle
- Lawson
- Microsoft Dynamics/Dynamics 365
- NetWeaver
- NetWeaver Portal (SAP EP)
- Oracle BPM
- Oracle CRM
- Oracle E-Business suite
- Oracle Eloqua
- Oracle ERP
- Oracle Financials
- Oracle HFM (Hyperion Fin. Mgt)
- Oracle HRMS
- Oracle NetSuite
- Oracle Payables
- Oracle Payroll
- Oracle Retail
- Oracle SCM
- Oracle SOA Suite
- Pega
- PeopleSoft (CRM/Financials/HCM)
- Remedy
- Salesforce
- Accelerated SAP (SLM)
- SAP AFS
- SAP ALLE
- SAP APO
- SAP Auto-ID infrastructure
- SAP Basis Components
- SAP BI Accelerator
- SAP BODI
- SAP Data Services (SAP BODS)
- SAP BOXI (aka Crystal Reports)
- SAP BPC
- SAP BSP
- SAP Business One
- SAP Business Workflow/Webflow
- SAP CA
- SAP CAF
- SAP CAR
- SAP CCM
- SAP CE
- SAP CFM
- SAP CO
- SAP CO-PA
- SAP CRM
- SAP Crystal Reports
- SAP CS
- SAP Digital Banking
- SAP EB P
- SAP EDI
- SAP EHS
- SAP EPM
- SAP ERP
- SAP ESA
- SAP Exchange Infrastructure (XI)
- SAP FI (Financial Accounting)
- SAP FI - CA
- SAP FI – FSCM
- SAP FI - Travel Management
- SAP Fiori
- SAP F&R
- SAP FS (Insurance)
- SAP GRC
- SAP GTS
- SAP HANA
- SAP HCM (SAP HR)
- SAP HCM ESS/MSS
- SAP HR-PA
- SAP Hybris
- SAP IBP (Integrated Business Planning)
- SAP IS-U (Utilities)
- SAP ITS
- SAP Leonardo
- SAP LES
- SAP LO
- SAP Lumira
- SAP Manufacturing
- SAP MDG (Master Data Governance)
- SAP MDM
- SAP MX
- SAP MII
- SAP MM
- SAP MRO
- SAP MRS
- SAP Netweaver Applications Server
- SAP Netweaver BW (BIW)
- SAP Netweaver Visual Composer
- SAP NWDI
- SAP NWDS
- SAP Oil & Gas
- SAP PI (NetWeaver Process Integ.)
- SAP PLM
- SAP PM
- SAP POSDM
- SAP PP
- SAP PS
- SAP PSCD
- SAP Public Sector Management
- SAP PY (Payroll)
- SAP QM
- SAP for Retail
- SAP Service & Asset Mgt
- SAP S/4HANA
- SAP SCM
- SAP SD
- SAP SD - GTS
- SAP Security
- SAP SEM
- SAP SM
- SAP Smart Forms
- SAP Solution Manager
- SAP SRM
- SAP TM
- SAP UI5 (UI development toolkit for HTML5)
- SAP Web Application Server
- SAP WEBI
- SAP WM
- SAP WM – EWM
- SAP Xceller
- Siebel/Siebel Analytics
- Software AG webMethods
- SuccessFactors
- Web Dynapro
- Workday HCM
585 Non-Certified IT Skills Reported

Web/e-Commerce Development
Active Server Pages
ActiveX
Adobe Experience Manager
Ajax
Amazon Cloudwatch
AngularJS
Apache Solr
Apache web server
Apache Velocity
Apache Wicket
Apex Code
Backbone.js
CGI
Cold Fusion MX
Content management systems
CSS/LESS
Django
Docker /Docker Swarm
Documentum
Elasticsearch
Ember.js
Front End Development
GatsbyJS
Google Analytics
Google App Engine
Google Cloud Platform
HTMML
JavaBeans/EJB 3.0
JavaFX
JavaScript
Java Server Pages
JBoss/Wildfly
Jetty
Joomla!
jQuery
JSON
Julia
KnockoutJS
Laravel PHP
Magento
Magnolia
Microsoft .NET
Microsoft BizTalk Server
Microsoft Commerce Server
Microsoft Identity Integration Server
Microsoft Internet Information Services
Microsoft Internet Security and Acceleration Server (ISA)
Microsoft SharePoint/SharePoint Server
Microsoft Silverlight
Microsoft Visual Studio
Mobile applications development
Mule/Mule ESB
Node.js
Oracle Fusion
Oracle WebLogic/
Oracle Workflow
Pandora
Perl
PHP (all)
Python
React
Redux
REST
RESTful
SailPoint
Scalable Vector Graphics (SVG)
Secure software development
Silecure CMS
SOAP
Social Media/Networks
Spring Framework
Spring Boot
Spring Cloud
Spring MVC
TIBCO
UDDI
Umbraco
VBScript
Video/graphics editing
Visual Interdev
VoiceXML
Web collaboration appliances
Web Content Development
Web Design
WebSphere
WebSphere Datapower
Wixis
WSDL
XML/XACML
XHTML MP
XML (all variants)

Management, Methodology
and Process
Artificial Intelligence
Azure Machine Learning
Big Data Analytics
Bioinformatics
Business Analysis
Business Analytics
Business intelligence
Business performance management
Business process management/
modeling/Improvement
Caffe
Capacity Planning/Management
Change management
COBIT
Collaboration software
Complex Event Processing/Event
Correlation
Configuration Management
Continuous Improvement
Continuous Integration
CRM
Cryptography (encryption, VPN)
Cybersecurity
Cyber Threat Intelligence
Data Acquisition and Control Systems
Data Analytics
Data Architecture
Data Cleansing
Data Engineering
Data Governance
Data Integration
Data Management
Data Mining
Data Modelling
Data Privacy
Data Quality
Data Science
Data Security
Data Visualization
DevOps
DevSecOps
Digital Analytics
Digital Forensics
eDiscovery
E-Procurement
ERP
Flink
Functional Programming
Game Development
General Data Protection Regulation
(GDPR)
Google TensorFlow
HL7
Identity and access management
Incident Management
Information management
IT Audit
IT Governance
ITIL V3
Kanban
Keras
Machine Learning
Marketo
Metadata design and development
Microservices
Microsoft SQL Server Analysis Services
Microsoft Visio
Natural language processing
Network Architecture
Neural Networks
NIST
Penetration testing
Power BI
Predictive Analytics and Modeling
Prescriptive Analytics
Program Management
Project management/governance
PyTorch
QlikView
Quality Assurance/QA Automation
Quality management/TQM
Quantitative Analysis/Regression Analysis
Razor
Requirements Engineering/Analysis
Risk analytics/assessment
Risk management
Robotic Process Automation
Security architecture and models
Security auditing
Security management
Security testing
SEO
Service Management
Six Sigma/Lean Six Sigma
Social media analysis/analytics
Software development lifecycle
management
Splunk

Tableau
Test automation
Test Driven Development/Scripting
TIBCO ActiveMatrix BusinessWorks
TOGAF (Enterprise Architecture)
Usability Research/Human Factors
Research
User Acceptance Testing
User Experience/Interface Design
Vulnerability Scanning/Assessment/
Management
Waterfall
Web Analytics
Webtrends analytics
Zachman Framework

Messaging & Communications
ActiveMQ
Apache Camel
Apache Kafka
IBM Domino
Java Messaging Service
Message-oriented Middleware (Wave,
XMPP/ Jabber, etc.)
Microsoft Exchange
Novell Groupwise
Oracle Comm Messaging Server
RabbitMQ
TIBCO Enterprise Message Service
TIBCO Rendezvous
Unified Communications/Messaging

Operating Systems
AIX
Apache Cloudstack
CoreOS
HP-UX
Linux
Mac OS X
Mobile operating systems (iOS, Android)
OpenStack
Red Hat Enterprise Linux
Solaris
SUSE
Unix (all)
VMware vSphere
Windows 8/10
Windows NT
Windows Server 2008/2012

### Systems/Networks
- Active Directory
- Amazon Elastic Kubernetes Service
- Ansible
- Apache Flume
- Arista
- ATM
- Azure Active Directory
- Business continuity and disaster recovery planning
- CA Endevor
- Chef/Opscode
- Cisco ASA
- Cisco CUCM
- Cisco ICM
- Cisco IPCC
- Cisco ISE/Identity Services Engine
- Cisco Nexus
- Cisco Prime
- Cisco UCCE
- Cisco UCX
- Citrix Hypervisor (XenServer)
- Citrix Virtual Apps (XenApp)
- Cloud architecture
- Cloud security
- DHCP
- EIGRP
- Ethernet
- Fast Ethernet
- Gigabit Ethernet
- HP ConvergedSystem
- HP Quality Center
- HTTPS
- IaaS (Infrastructure as a Service)
- Infrastructure architecture
- Intrusion prevention/detection systems
- IPX/SPX
- Juniper
- Kubernetes
- LAN
- Microsoft Application Virtualization
- Microsoft Hyper-V
- Microsoft SCCM
- Microsoft SCVMM
- Microsoft Virtual Server
- Mobile device management
- Mobile security
- Multiprotocol Label Switching
- NAS/Network Attached Storage
- Network access control/identity mgmt systems
- Network security management
- Novell Netware
- PaaS
- Performance Analysis/Tuning
- Performance Testing
- Prometheus
- Puppet
- Rackspace Cloud
- RedHat OpenShift
- Routing (e.g. OSPF)
- Salt
- SAN/Storage Area Networks
- Security skills (project-based)
- Security Information and Event Management (SIEM)
- SMTP
- SolarWinds
- Storage virtualization/administration
- TCP/IP
- Terraform
- Tivoli
- Vagrant
- vCloud
- Virtualization (various)
- Virtual security
- VMware ESXi Server
- VMware NSX
- VoIP/IP telephony
- VPN/OpenVPN
- WAN/3G/4G services
- Web Infrastructure
- Web services security
- Wireless Network Mgmt
- Wireless security
- Wireless sensors/RFID
- Wireline Networking/Telecomm.
- WML

### Data/Database
- Amazon Athena
- Amazon DynamoDB
- Amazon RedShift
- Apache Cassandra
- Apache CouchDB
- Apache Hive
- Azure Cosmos DB
- Azure Data Factory
- Azure SQL Database
- Azure Synapse Analytics
- Base SAS
- Blockchain
- Cloudera Impala
- Couchbase Server
- Data mining
- Data security
- Database management
- DB2
- dBASE/DBASE
- ETL (Extract, transform, load)
- GIS
- Hbase
- Informatica
- Java Database Connectivity
- Master data management
- Microsoft Access
- Microsoft Exchange Server
- Microsoft SQL Server Integration Services
- MongoDB
- MySQL
- NewSQL
- NoSQL
- OpenEdge ABL
- Oracle Application Server
- Oracle Business Intelligence
- Oracle Coherence
- Oracle DB 9i/10g/11i/12c
- Oracle Enterprise Manager
- Oracle Exadata
- Oracle Forms
- Oracle Reports
- PostgreSQL
- Redis
- Visual SQL
A. NON-CERTIFIED TECH SKILLS EARNING HIGH PAY—AND STILL GROWING IN VALUE

The following non-certified tech skills meet two prerequisites: they are earned workers cash pay premiums well above the average of all 593 skills reported in our IT Skills and Certifications Pay Index™, and they recorded gains in cash market value in the six months ending July 1, 2020.

No skill below is earning less than the equivalent of 16 percent of base salary—significant considering the average for all skills reported is 9.6 percent of base—and are listed in descending ranked order of cash premium and market value increases (including ties). Not surprising, the list contains a number of security, coding, database, analytics and artificial intelligence related skills.

1. DevSecOps
   
   Average Pay Premium: 19 percent of base salary equivalent
   
   Market Value Increase: 5.6 percent (in the six months through July 1, 2020)

DevSecOps is the philosophy of integrating security practices within the DevOps process and involves creating a ‘Security as Code’ culture with ongoing, flexible collaboration between release engineers and security teams. It’s a natural and necessary response to the bottleneck effect of older security models on the modern continuous delivery pipeline. The goal is to bridge traditional gaps between IT and security while ensuring fast, safe delivery of code. Silo thinking is replaced by increased communication and shared responsibility of security tasks during all phases of the delivery process.

In DevSecOps, two seemingly opposing goals — “speed of delivery” and “secure code” — are merged into one streamlined process. In alignment with lean practices in agile, security testing is done in iterations without slowing down delivery cycles. Critical security issues are dealt with as they become apparent, not after a threat or compromise has occurred.

There are six important components to a DevSecOps approach:

• Code analysis – deliver code in small chunks so vulnerabilities can be identified quickly.
• Change management – increase speed and efficiency by allowing anyone to submit changes, then determine whether the change is good or bad.
• Compliance monitoring – be ready for an audit at any time (which means being in a constant state of compliance, including gathering evidence of GDPR and PCI compliance, etc.).
• Threat investigation – identify potential emerging threats with each code update and be able to respond quickly.
• Vulnerability assessment – identify new vulnerabilities with code analysis, then analyze how quickly they are being responded to and patched.
• Security training – train software and IT engineers with guidelines for set routines
2. **Security architecture and models**

   *Average Pay Premium:* 18 percent of base salary equivalent  
   *Market Value Increase:* 5.6 percent (in the six months through July 1, 2020)

Two fundamental concepts in computer and information security are the **security model**, which outlines how security is to be implemented—in other words, providing a “blueprint”—and the **security architecture** of a computer system, which fulfills this blueprint. Security architecture is a view of the overall system architecture from a security point and how the system is put together to satisfy the security requirements. It describes the components of the logical hardware, operating system, and software security components, and how to implement those components to architect, build and evaluate the security of computer systems. With cybersecurity related skills gaining prominence and the threat landscape continuing to be a core business issue, we expect security models and architecting skills to continue to be strong going forward.

3. **RStudio**

   *Average Pay Premium:* 17 percent of base salary equivalent  
   *Market Value Increase:* 21.4 percent (in the six months through July 1, 2020)

**RStudio** is an integrated development environment for R, a programming language for statistical computing and graphics, and for Python. It is available in two formats, RStudio Desktop and web browser-accessible RStudio Server running on a remote server. RStudio is partly written in the C++ programming language and uses the Qt framework for its graphical user interface, however a bigger percentage of the code is written in Java and JavaScript. The keys for RStudio’s popularity for analyzing data in R include:

- **R is open source.** It's free which is an advantage against paying for MATLAB or SAS licenses. This is also important if you're working with global teams in areas where software is expensive or in inaccessible. It also means that R is actively developed by a community and there are regular updates
- **R is widely used.** R is used in many subject areas (not just bioinformatics) making it more likely for finding help online when it’s needed.
- **R is powerful.** R runs on multiple platforms (Windows/MacOS/Linux). It can work with much larger datasets than popular spreadsheet programs like Microsoft Excel, and because of its scripting capabilities it is more reproducible. There are thousands of available software packages for science, including genomics and other areas of life science.

4. **[Tie] Cryptography**

   - **Natural language processing**
   - **Neural Networks**
   - **Master data management**

   *Average Pay Premium:* 17 percent of base salary equivalent  
   *Market Value Increase:* 6.3 percent (in the six months through July 1, 2020)

**Cryptography** (or cryptology) is the practice and study of techniques for secure communication in the presence of third parties called adversaries. More generally, cryptography is about constructing and analyzing protocols that prevent third parties or the public from reading private messages. Modern cryptography exists at the intersection of the disciplines of mathematics, computer science, electrical engineering, communication science, and physics and includes various aspects
of information security such as data confidentiality, data integrity, authentication, and non-repudiation. Applications of cryptography include electronic commerce, chip-based payment cards, digital currencies, computer passwords, and military communications.

Human language doesn't speak in zeros and ones, but there's a lot of benefit and productivity that can be gained when machines are taught to read, decipher, understand, and make sense of the human language in a manner that is valuable. That's the goal of natural language processing, usually shortened as NLP. Early efforts at this include pieces of digital assistants like Alexa, Microsoft Cortana, Google Assistant, and Siri. It's the driving force behind such common applications as Google Translate, the grammatical checking in Microsoft Word, and Interactive Voice Response (IVR) applications used in call centers. NLP is also essential when it comes to working with many types of unstructured data such as the data in electronic health records, emails, text messages, transcripts, social media posts -- anything with a language component. It's through NLP that we can get to more advanced technologies such as sentiment analysis.

NLP involves applying algorithms to identify and extract the natural language rules such that the unstructured language data is converted into a form that computers can understand. When the text has been provided, computers utilize algorithms to extract meaning associated with every sentence and collect the essential data from them. Many different classes of machine-learning algorithms have been applied to natural-language-processing tasks. These algorithms take as input a large set of "features" that are generated from the input data. Thus, NLP has evolved into research focused on statistical models which make soft, probabilistic decisions based on attaching real-valued weights to each input feature. These models have the advantage that they can express the relative certainty of many different possible answers rather than only one, producing more reliable results when such a model is included as a component of a larger system.

Systems based on machine-learning algorithms have many advantages and they all are driving NLP forward as a hot skill area to invest in. Consider the following.

- Learning procedures used during machine learning automatically focus on the most common cases, whereas when writing rules by hand it is often not at all obvious where the effort should be directed.
- Automatic learning procedures can make use of statistical inference algorithms to produce models that are robust to unfamiliar input (e.g. containing words or structures that have not been seen before) and to erroneous input (e.g. with misspelled words or words accidentally omitted). NLP’s advantage is that creating systems of handwritten rules that make soft decisions is extremely difficult, error-prone and time-consuming.
- Systems based on automatically learning the rules can be made more accurate simply by supplying more input data. There is a limit to the complexity of systems based on handcrafted rules, beyond which the systems become more and more unmanageable. But creating more data to input to machine-learning systems simply requires a corresponding increase in the number of man-hours worked, generally without significant increases in the complexity of the annotation process.
Neural networks are a set of algorithms, modeled loosely after the human brain, that are designed to recognize patterns. They interpret sensory data through a kind of machine perception, labeling or clustering raw input. The patterns they recognize are numerical, contained in vectors, into which all real-world data, be it images, sound, text or time series, must be translated and they help cluster and classify. You can think of them as a clustering and classification layer on top of the data you store and manage. They help to group unlabeled data according to similarities among the example inputs, and they classify data when they have a labeled dataset to train on. Neural networks can also extract features that are fed to other algorithms for clustering and classification; you can think of deep neural networks as components of larger machine-learning applications involving algorithms for reinforcement learning, classification and regression.}

Because of their ability to reproduce and model nonlinear processes, neural networks have found applications in many disciplines—with many more to follow as employers continue to build on these capabilities and acquire or develop tech skills internally to execute everything. Here are examples of applications already in play:

- System identification and control (e.g. vehicle control, trajectory prediction, process control)
- Quantum chemistry
- Pattern recognition (e.g. radar systems, face identification, signal classification, 3D reconstruction, object recognition)
- Sequence recognition (gesture, speech, handwritten and printed text)
- Medical diagnosis (e.g. various cancers)
- Natural disaster infrastructure reliability analysis
- Finance (e.g. automated trading systems)
- Data mining and visualization
- Machine translation
- Social network filtering
- Building black-box models (e.g. geoscience: hydrology, ocean modelling and coastal engineering, and geomorphology. ANNs have been e
- Cybersecurity (e.g. discriminating between legitimate and malicious activities, penetration testing, botnet detecting, credit cards frauds and network intrusions.
- General game playing

Master data management (MDM) arose out of the necessity for businesses to improve the consistency and quality of their key data assets, such as product data, asset data, customer data, location data, etc. Many businesses today, especially global enterprises, have hundreds of separate applications and systems where data that crosses organizational departments or divisions can easily become fragmented, duplicated and most commonly out of date. When this occurs, accurately answering even the most basic but critical questions about any type of performance metric or KPI for a business becomes hard. The basic need for accurate, timely information is acute and as sources of data increase, managing it consistently and keeping data definitions up to date so all parts of a business use the same information is a never-ending challenge. That’s what has and will continue to drive a premium on MDM skills.
5. **[Tie] Cloud Foundry**  
- **Cloudera Impala**
  - Average Pay Premium: 16 percent of base salary equivalent
  - Market Value Increase: 14.3 percent (in the six months through July 1, 2020)

**Cloud Foundry** is an open source, multi-cloud application platform as a service (PaaS). Unlike most other cloud computing platform services — which are tied to particular cloud providers — Cloud Foundry is a container-based architecture running apps in any programming language over a variety of cloud service providers. If desired, you can deploy it on AWS, but you can also host it yourself on your own OpenStack server, or through HP Helion or VMware vSphere. Cloud Foundry is promoted for continuous delivery as it supports the full application development lifecycle, from initial development through all testing stages to deployment. Its architecture runs apps in any programming language over a variety of cloud service providers, allowing developers to use the cloud platform that suits specific application workloads and move those workloads as necessary within minutes with no changes to the application.

Cloud Foundry is optimized to deliver fast application development and deployment; highly scalable and available architecture; DevOps-friendly workflows; a reduced chance of human error; Multi-tenant compute efficiencies. Key benefits of Cloud Foundry that power its popularity include:

- Application portability.
- Application auto-scaling.
- Centralized platform administration.
- Centralized logging.
- Dynamic routing.
- Application health management.
- Integration with external logging components like Elasticsearch and Logstash.
- Role-based access for deployed applications.
- Provision for vertical and horizontal scaling.
- Infrastructure security.
- Support for various IaaS providers

**Cloudera Impala** is an open source Massively Parallel Processing (MPP) query engine that provides high-performance, low-latency SQL queries on data stored in popular Apache Hadoop file formats. The fast response for queries enables interactive exploration and fine-tuning of analytic queries rather than long batch jobs traditionally associated with SQL-on-Hadoop technologies, meaning that data can be stored, shared, and accessed using various solutions that avoids data silos and minimizes expensive data movement. Impala returns results typically within seconds or a few minutes, rather than the many minutes or hours that are often required for Hive queries to complete. We cannot underestimate the value of this to advanced data analytics platforms and the work of data scientists and analysts engaged in Big Data initiatives and the impact this has on skills acquisition demand going forward.
6. [Tie] Apache Cassandra
   Artificial Intelligence
   Cyber Threat Intelligence
   Data Analytics
   Google TensorFlow
   Predictive Analytics and Modeling
   Average Pay Premium: 16 percent of base salary equivalent
   Market Value Increase: 6.7 percent (in the six months through July 1, 2020)

**Apache Cassandra** is a highly scalable, high-performance distributed NoSQL database management system designed to handle large amounts of data across many commodity servers, providing high availability with no single point of failure. Cassandra offers robust support for clusters spanning multiple datacenters, with asynchronous masterless replication across cloud service providers, allowing low latency operations for all clients. It can handle petabytes of information and thousands of concurrent operations per second across hybrid cloud environments. Cassandra offers the distribution design of Amazon Dynamo with the data model of Google's Bigtable.

Aside from being a backbone for Facebook and Netflix, Cassandra is a very scalable and resilient database that is easy to master and simple to configure, providing neat solutions for quite complex problems. Event logging, metrics collection and evaluation, monitoring the historical data — all of these tasks are quite hard to accomplish correctly, given the variety of OS’s, platforms, browsers and devices both startup products and enterprise systems face in their daily operations.

Important advantages driving the popularity of Cassandra:

- Helps solve complicated tasks with ease (e.g. event logging, metrics collection, performing queries against the historical data)
- Has a short learning curve
- Lowers admin overhead and costs for a DevOps engineer
- Rapid writing and lightning-fast reading
- Extreme resilience and fault tolerance

**Artificial Intelligence** (aka A.I.) is a term that means different things to different people, from robots coming to take your jobs to the digital assistants in your mobile phone and home. But it is actually a term that encompasses a collection of technologies that include machine learning, deep learning, natural language processing, computer vision, and more. Artificial intelligence can also be divided into ‘narrow A.I.’ and ‘general A.I.’. Narrow A.I. is the kind we most often see today – A.I. suited for a narrow task. This could include recommendation engines, navigation apps, or chatbots. These are A.I.s designed for specific tasks. Artificial general intelligence is about a machine performing any task that a human can perform, and this technology rapidly expanding though still relatively aspirational for many organizations.

Machine learning is typically the first step for organizations that are adding A.I.-related technologies to their IT portfolio and one of the reasons why A.I. skills pay is growing. This is about automating the process of creating algorithms by using data to "train" them rather than human software developers writing code. Basically, what you are doing is showing the algorithm examples, in the form of data. By "looking" at all these examples, the machine learns to recognize patterns and differences.
Deep learning takes machine learning a few steps further by creating layers of machine learning beyond the first decision point. These hidden layers are called a neural network—as described earlier—and are meant to simulate the way human brains operate. Deep learning works by taking the outcome of the first machine learning decision and making it the input for the next machine learning decision. Each of these is a layer. Python is also the language of deep learning and neural networks.

**Cyber Threat Intelligence** is what cyber threat information becomes once it has been collected, evaluated in the context of its source and reliability, and analyzed through rigorous and structured tradecraft techniques by those with substantive expertise and access to all-source information. Like all intelligence, cyber threat intelligence provides a value-add to cyber threat information, which reduces uncertainty for the consumer, while aiding the consumer in identifying threats and opportunities. It requires that analysts identify similarities and differences in vast quantities of information and detect deceptions to produce accurate, timely, and relevant intelligence.

Rather than being developed in an end-to-end process, the development of intelligence is a circular process, referred to as the intelligence cycle. In this cycle requirements are stated; data collection is planned, implemented, and evaluated; the results are analyzed to produce intelligence; and the resulting intelligence is disseminated and re-evaluated in the context of new information and consumer feedback. The analysis portion of the cycle is what differentiates intelligence from information gathering and dissemination. Intelligence analysis relies on a rigorous way of thinking that uses structured analytical techniques to ensure biases, mindsets, and uncertainties are identified and managed. Instead of just reaching conclusions about difficult questions, intelligence analysts think about how they reach the conclusions. This extra step ensures that, to the extent feasible, the analysts’ mindsets and biases are accounted for and minimized or incorporated as necessary. The process is a cycle because it identifies intelligence gaps, unanswered questions, which prompt new collection requirements, thus restarting the intelligence cycle. Intelligence analysts identify intelligence gaps during the analysis phase. Intelligence analysts and consumers determine intelligence gaps during the dissemination and re-evaluation phase.

In cyber threat intelligence, analysis often hinges on the triad of actors, intent, and capability, with consideration given to their tactics, techniques, and procedures (TTPs), motivations, and access to the intended targets. By studying this triad it is often possible to make informed, forward-leaning strategic, operational, and tactical assessments.

- **Strategic intelligence** assesses disparate bits of information to form integrated views. It informs decision and policy makers on broad or long-term issues and/or provides a timely warning of threats. Strategic cyber threat intelligence forms an overall picture of the intent and capabilities of malicious cyber threats, including the actors, tools, and TTPs, through the identification of trends, patterns, and emerging threats and risks, in order to inform decision and policy makers or to provide timely warnings.

- **Operational intelligence** assesses specific, potential incidents related to events, investigations, and/or activities, and provides insights that can guide and support response operations. Operational or technical cyber threat intelligence provides highly specialized, technically-focused, intelligence to guide and support the response to specific incidents; such intelligence is often related to campaigns, malware, and/or tools, and may come in the form of forensic reports.

- **Tactical intelligence** assesses real-time events, investigations, and/or activities, and provides day-to-day operational support. Tactical cyber threat intelligence provides support for day-to-day operations and events, such as the development of signatures and indicators of compromise (IOC). It often involves limited application of traditional intelligence analysis techniques.
**Data analytics** is the process of examining data sets in order to draw conclusions about the information they contain, increasingly with the aid of specialized systems and software. Data analytics technologies and techniques are widely used in commercial industries to enable organizations to make more-informed business decisions and by scientists and researchers to verify or disprove scientific models, theories and hypotheses.

Data analytics initiatives can help businesses increase revenues, improve operational efficiency, optimize marketing campaigns and customer service efforts, respond more quickly to emerging market trends and gain a competitive edge over rivals -- all with the ultimate goal of boosting business performance. Depending on the particular application, the data that's analyzed can consist of either historical records or new information that has been processed for real-time analytics uses. In addition, it can come from a mix of internal systems and external data sources.

**TensorFlow** is a popular open-source deep learning library developed at Google, which uses machine learning in all of its products to take advantage of their massive datasets and improving the search engine, translation, image captioning and recommendations. TensorFlow is also used for machine learning applications such as neural networks. Its flexible architecture allows for the easy deployment of computation across a variety of platforms (CPUs, GPUs, TPUs), and from desktops to clusters of servers to mobile and edge devices. TensorFlow provides stable Python and C APIs without API backwards compatibility guarantees for C++, Go, Java, JavaScript and Swift. Third-party packages are available for C#, Haskell, Julia, R, Scala, Rust, OCaml and Crystal.

Python has always been the choice for TensorFlow due to the language being extremely easy to use and having a rich ecosystem for data science including tools such as Numpy, Scikit-learn, and Pandas.

**Predictive Analytics and Modeling** is a process that uses data and statistics to predict outcomes with data models. These models can be used to predict anything from sports outcomes and TV ratings to technological advances and corporate earnings. Predictive modeling is also often referred to as:

- Predictive analytics
- Predictive analysis
- Machine learning

These synonyms are often used interchangeably. However, predictive analytics most often refers to commercial applications of predictive modeling, while predictive modeling is used more generally or academically. Of the terms, predictive modeling is used more frequently. Machine learning is also distinct from predictive modeling and is defined as the use of statistical techniques to allow a computer to construct predictive models. In practice, machine learning and predictive modeling are often used interchangeably. However, machine learning is a branch of artificial intelligence, which refers to intelligence displayed by machines.

Predictive modeling is useful because it gives accurate insight into any question and allows users to create forecasts. To maintain a competitive advantage, it is critical to have insight into future events and outcomes that challenge key assumptions.
Analytics professionals often use data from the following sources to feed predictive models:

- Transaction data
- CRM data
- Customer service data
- Survey or polling data
- Digital marketing and advertising data
- Economic data
- Demographic data
- Machine-generated data (for example, telemetric data or data from sensors)
- Geographical data
- Web traffic data
Q3 2020 Data Trend Charts

2020 IT Skills & Certifications Volatility Index™
(Data collected through July 1, 2020)

Demand dynamics in benchmarked certified and non-certified IT skills pay
TRENDS HIGHLIGHTS

2020 IT Skills & Certifications Volatility Index™

Volatility in market value for individual IT skills and certifications—defined as incidence of gains or declines over a period of time in premium pay earned by IT professionals for specific technical and business skills—increased from April 1, 2020 to July 1, 2020 according to the latest update of Foote Partners’ long-running IT Skills and Certifications Pay Index™ of market values for tech skills. Market value is measured by tracking additional cash compensation paid to workers by their employers for specific certified and non-certified skills they possess.

Current Quarterly Recap (data collected through July 1, 2020)

TOTAL: All Skills and Certifications
- 28% of skills and certifications (307 of 1,090) changed in market value in 2nd Quarter 2020 compared to 29% in the 1st Quarter, 21% in the last quarter of 2019 and 17.4% in the third quarter of 2019.
- 122 gained value and 185 declined in value

CERTIFIED SKILLS
- 22% of reported certifications (111 of 505) changed market value in 2nd Quarter 2020, six points lower than the 28.2% volatility in the 1st Quarter, and well above 15.5% in the last quarter of 2019 and 7.1% in the 3rd quarter of 2019.
- 24 certifications gained market value; 87 declined in value

NON-CERTIFIED SKILLS
33.5% of reported skills (171 of 578) changed value in 2nd Quarter 2020, four points higher than 29.6% in the 1st Quarter, and well above 26% in the third and fourth quarters of 2019.
- 98 gained in market value; 98 declined in value

Tracking skills volatility is useful in many ways: analyzing and forecasting demand for skills; monitoring IT workforce transition; and understanding IT management decision making. In fact, we believe statistical volatility in IT skills pay offers a more complete story of true labor market conditions than salary movements and hiring behavior, among other common indicators. Important in this distinction is that skills can be segmented and benchmarked more meaningfully than jobs allowing to microanalyses.

Similar to jobs, IT skills have broad skills categories that can be tracked (e.g., security, networking, systems, database, applications development). But unlike jobs, skills pay can be pinpointed to hundreds of niches and specialization. Also, unlike most job trends analyses, within skills categories and niches are vendor-specific and vendor independent skill specializations for more granular tracking, analysis, and forecasting.

Skills and certifications volatility prior to 2008 averaged in the 14% - 19% range. Quarterly volatility in the last two years has been in the 20% to 31% range. This is an important shift that we believe signals a move that employers are taking a more long-term view to building their tech workforces for emerging technologies such as Blockchain, AI/Machine learning, and a variety of digital solutions. Tech leaders right now are demanding more agility, faster reaction times, and more predictable execution; this is keeping volatility high as skills markets constantly adjust to meet surges in demand for specific certified and non-certified skills.

They will be able to achieve those capabilities through applying architecture principles and practices to people management. We discuss this in greater detail earlier in this report.
Recent IT skills and certifications volatility trends

QUARTERLY SUMMARY

2nd quarter 2020 volatility in skills and certifications values measured 28%, well above the one-year average of 24% for all 1,101 certified and noncertified skills reported by Foote Partners.

NON-CERTIFIED SKILLS VOLATILITY in 2Q 2020 was 4 points higher than the prior quarter and the average volatility over the past 2 years (28.4)

IT CERTIFICATIONS VOLATILITY in 1Q 2020 exploded, at 28% nearly double the 15.5% volatility in the prior quarter. In 2Q 2020 it settled back somewhat, at 22%.

(Pay data supporting these charts available in the IT Skills and Certifications Pay Index™ – 2007 to 2020 quarterly data edition)
**VOLATILITY HIGHLIGHTS**

**IT Certifications – 2nd Quarter 2020 data**

**VOLATILITY INDEX: How Many of 508 IT Certifications Changed Market Value in 2nd Quarter 2020?**

<table>
<thead>
<tr>
<th>Category</th>
<th>% of Certifications</th>
<th>Total that changed</th>
<th>Went Down in Value</th>
<th>Went Up in Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture/Project Management/Project Process</td>
<td>2.0%</td>
<td>4.8%</td>
<td>16.0%</td>
<td>23.8%</td>
</tr>
<tr>
<td>Info/Cyber Security</td>
<td>4.3%</td>
<td>16.3%</td>
<td>12.0%</td>
<td>14.0%</td>
</tr>
<tr>
<td>System Admin &amp; Engineering</td>
<td>8.8%</td>
<td>25.9%</td>
<td>17.2%</td>
<td>24.5%</td>
</tr>
<tr>
<td>Networking &amp; Communications</td>
<td>10.2%</td>
<td>25.5%</td>
<td>17.2%</td>
<td>23.5%</td>
</tr>
<tr>
<td>Web Development</td>
<td>1.0%</td>
<td>16.7%</td>
<td>20.5%</td>
<td>22.0%</td>
</tr>
<tr>
<td>Data/Database</td>
<td>11.9%</td>
<td>19.1%</td>
<td>16.5%</td>
<td>22.0%</td>
</tr>
<tr>
<td>Apps Development/Prog. Languages</td>
<td>4.3%</td>
<td>16.3%</td>
<td>12.0%</td>
<td>14.0%</td>
</tr>
<tr>
<td>Beginner and Training</td>
<td>0.0%</td>
<td>10.2%</td>
<td>12.5%</td>
<td>22.0%</td>
</tr>
<tr>
<td>ALL CERTIFICATIONS SURVEYED</td>
<td>4.8%</td>
<td>17.2%</td>
<td>20.0%</td>
<td>22.0%</td>
</tr>
</tbody>
</table>

(0.0% to 30.0%)

(Source: Foote Partners LLC, 2020 IT Skills & Certifications Pay Index™)

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**IT Skills and Certifications Volatility Index™
2Q 2020 data edition findings: Tech Certifications**

**IT Certifications Volatility Highlights**

Among 505 certifications surveyed, highest volatility (>20%) occurred in these segments (ranked highest to lowest):

- Systems Administration & Engineering
- Networking & Communications
- Architecture/Project Mgt/Process
- Applications Development/Programming Languages

Within segments, notable upward volatility (value gains) occurred most in these (ranked):

- Applications Development/Programming Languages

Within segments, notable downward volatility (value declines) occurred most in these (ranked):

- Networking & Communications
- Architecture/Project Mgt/Process
- Systems Administration & Engineering
- Web Development
- Data/Database
- Info/Cybersecurity

(Pay data supporting these charts available in the IT Skills and Certifications Pay Index™ – 2007 to 2020 quarterly data edition)
VOLATILITY HIGHLIGHTS Non-certified IT Skills – 2nd Quarter 2020 data

IT Skills and Certifications Volatility Index™
2Q 2020 data edition findings: Non-certified IT Skills

Noncertified IT Skill Pay Volatility Highlights

Among 585 noncertified IT skills surveyed, high volatility (>20%) occurred in these segments (ranked highest to lowest):

- Operating Systems
- Data/Database
- Applications Development Tools & Platforms
- [Tie]SAP & Enterprise Business Apps; Systems/Networking
- Management/Methodology/Process
- Messaging and Communications
- Web/E-commerce Development

Within segments, notable upward volatility (value gains) occurred most in these (ranked):

- Operating Systems
- Applications Development Tools & Platforms
- Data/Database
- Systems/Networking

Within segments, notable downward volatility (value declines) occurred most in these (ranked):

- SAP & Enterprise Business Apps
- Web/E-commerce Development
- Systems/Networking
- Data/Database
- Management/Methodology/Process

(Pay data supporting these charts available in the IT Skills and Certifications Pay Index™ – 2007 to 2020 quarterly data edition)

(Source: Foote Partners LLC, 2020 IT Skills & Certifications Pay Index™)
2020 IT Skills and Certifications Pay Index™

- Pay premiums for **1,101 certified and noncertified IT skills**
  - Three data points for each position: 10th, 50th, 90th percentile

- Verified and validated IT skills pay data from **80,186 IT professionals at 3,602 employers** in US and Canada

- Current data collected through July 1, 2020 (updated quarterly)

- **Excel format data tables. Master agreements for data loading in place with MarketPay, CompAnalyst, WillisTowersWatson.**

- Certifications Guide containing basic information about surveyed IT certifications (pre-requisites; costs; test content; lab requirements, etc.)

**Pricing:** $5,800 single edition. $19,800 annual subscription

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**Definition of IT skills premium pay**

- Pay that IT workers receive for possessing high-value IT and business skills used on the job

- Given in the form of a bonus, or embedded in base salary to adjust for the presence of a dominant vendor or technology central to job performance (examples: Cisco Network Engineer, Python Software Engineer, Redhat Linux Systems Administrator, or SAP Developer.)

- Often used to adjust either base pay or total pay in situations where job title does not match actual on-the-job duties and responsibilities, and changing the job title is not an attractive option

- May be used as a reward, recruiting inducement, retention tool, or as a guide for creating consulting rate cards
ABOUT THIS RESEARCH

Foote Partners’ primary research survey for tracking IT skills and certifications pay and supply/demand volatility is the industry-leading IT Skills and Certifications Pay Index™ (ITSCPI), launched in 1999 and updated every three months since that time. Data covering 326,656 tech professionals at 3,602 employers in 83 U.S. and Canada cities are reported for IT salaries and skills pay earned for 242 positions and 1,101 certified and noncertified technical and business skills. Verified and validated pay data for 80,186 tech workers has been included in the 2nd Quarter 2020 data edition of the ITSCPI, compiled from data collected through July 1, 2020.

Demographics of the participating organizations for our latest update are as follows, measured most appropriately for the type of business, by revenues, assets, total premiums and operating budgets:

- 18% of participating organizations have $5 billion+ in sales/$15+ billion in total assets
- 28% of participating organizations earn more than $1 billion in annual revenues or more than $5 billion in total assets
- 46% of participating organizations have $500+ million in sales/$1+ billion in total assets/$500+ million in premiums/$500+ million operating budget (government, educational, not-for-profit)
- 54% of participating organizations fall in the SMB (small-to-medium sized business) segment, generally defined as organization under $500 million in sales.
- [Public sector] 5% have operating budgets of $500 million or more, [nonprofit/educational sectors] 4% with operating budgets $100 million to less than $500 million

TO OBTAIN A COPY OF THE LATEST IT SKILLS AND CERTIFICATIONS PAY INDEX™

Please visit the Foote Partners web site: IT Skills and Certifications Pay Index
Foote Partners 3Q 2020 Tech Compensation Survey Product Map

Survey Demographics
- 65 US/18 Canadian cities (326,656 IT workers, 3,602 employers)
- 174 Europe/UK cities (189,988 IT workers, 2,065 employers)
- 45+ industries
- Updated continuously.

IT Professional Salary Survey
- 242 Jobs, 37 IT job families

IT Skills & Certification Pay Index™
- 1,101 skills/cert

IT Skills Demand and Pay Trends Report

IT Skills HOT List Forecast

IT Skills Volatility Index

IT Salary+Skills Pay Survey Reports

Custom Salary Reports
- Skip survey reports and buy only the job titles, job families, and cities needed

Custom Salary Reports
- Choose on the job titles or job families needed
- Choose cities needed

Long-term Job Descriptions
- Updated continuously
- Comprehensive, includes internal/external relationships key to job success, skills and certification; detailed experience factors.

Short-term Job Profiles (JD excerpts)
- Available

SALARY+SKILLS REPORTS AVAILABLE
- Applications Development
- Big Data
- Business Analysts/Business Technology
- Database
- Data Warehousing/Business Intelligence
- E-Commerce
- IT Architecture
- Microsoft Windows
- Networking Operations & Engineering
- Project Management
- SAP
- IT Security
- Systems Engineering and Administration
- Web/int
ABOUT FOOTE PARTNERS

Foote Partners, LLC is a technology analyst firm and independent benchmark research organization focusing on the people (versus vendor) side of managing technology and technology value creation. A thought leader and trusted advisor to thousands of employers on five continents who purchase our products and services, our company provides pragmatic benchmark research and forward-thinking advice and market intelligence targeting the tech workforce in the modern highly integrated business/IT hybrid environment in which all private and public organizations now operate.

Our products are deeply grounded in specialized proprietary data-driven statistical and empirical research, benchmark surveys, and business intelligence collected from thousands of North American employers with whom we have deep longstanding research partnerships. These partnerships have been created and supported specifically to enable unique market intelligence views and difficult-to-find decision support research on the multiple facets of IT human capital management. As a group, these U.S., Canadian, and European partners were selected to meet strict criteria for what we believe is the most meaningful demographic representation for tech professionals in each local labor markets.

Founded in 1997 and comprised of former Gartner industry analysts, McKinsey & Company, Mercer and WillisTowersWatson senior consultants, and former corporate HR, IT, and business executives, the firm’s research division publishes 70+ quarterly-updated benchmarking, analytical research and forecasting products that help employers benchmark their IT compensation, solve difficult information technology management and workforce problems, and strengthen their ability to execute complex business solutions.

Foote Partners tech compensation survey findings and labor market trend analyses are featured regularly in countless business, HR, and IT media sources and periodicals around the globe, including Bloomberg BusinessWeek, Forbes, Fortune, Wall Street Journal, New York Times, CIO Magazine, ComputerWorld, and WorldatWork’s Journal and Workspan Magazine; and in appearances on network and cable television, National Public Radio, and countless podcasts and webcasts.

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