FOR IMMEDIATE RELEASE

Contact: David Foote (dfoote@footepartners.com) - Bill Reynolds (bill@footepartners.com) - Ted Lane (tlane@footepartners.com)
772-234-2787

NOTE: This news release is a summary extract of content from the 4th Quarter 2021 update edition of both the Foote Partners’ 2022 IT Skills Demand and Pay Trends Report and 2022 IT Skills and Certification Volatility Index, two market intelligence trend reports updated every 3 months from data contributed by HR departments at 3,934 U.S. and Canadian employers. It contains IT jobs, skills and certifications data trends published in the firm’s IT Skills and Certifications Pay Index™ and deep-dive supply/demand benchmark analysis from Foote Partners field interviews.

Average market value for 642 non-certified tech skills declined slightly in final quarter of 2021 for the second consecutive quarter, as 83 skills gained in value while 119 declined in period.

For just the second time in three years, average market value in the final three months of 2021 for 567 tech certifications increased, buoyed by growth in Data/Database, Applications Development, and Info/Cybersecurity certifications.

We continue to stand by our early-2021 pandemic prediction that employers won’t be feeling any sense of normalcy or find comfort in predicting their future until the end of this year.

February 4, 2022 – Vero Beach, FL. Extra pay awarded by employers to talented tech professionals for 642 non-certified tech skills --- also known as cash pay premiums---decreased slightly in the fourth quarter of 2021, contributing to a 1.5 percent overall decline in the last twelve months. The current average pay premium bonus for a single skill is the equivalent of 9.4 percent of base salary.

Conversely, average market values for 567 tech certifications increased for the second consecutive quarter and only the second time since mid-2018, up 0.2 percent, for the equivalent of 6.6 percent of base salary cash bonus premium on average for a single certification. Still, certifications have lost more than 7 percent of market value on average over the past two years. (Figure 1)

This according to the latest quarterly update of Foote Partners’ IT Skills and Certifications Pay Index™ (ITSCPI) based on compensation data provided by 3,934 private and public-sector employers in 83 U.S. and Canadian cities who partner with the firm to report pay for their 360,794 technology professionals in the U.S. and Canada.
Since its launch in 1999, the IT Skills and Certifications Pay Index™ has continuously tracked cash pay premiums paid to tech professionals by their employers for an ever-increasing number of popular tech skills and certifications. Rigorously validated data and detailed market analyses are updated and published by Foote Partners every 90 days. Currently, premiums are reported for 1,209 certifications and non-certified skills.

Pay Performance, 3/12/24/24/36 months
Certified vs. Noncertified Tech Skills

(87,223 IT professionals, data through 1/1/2022)

Figure 1

Source: Foote Partners, IT Skills and Certifications Pay Index™ (4Q2018 – 4Q2021 datasets)
MULTI-YEAR PAY PREMIUM TRENDS: **Certified** versus **Noncertified** IT Skills

Average median cash pay premiums for a single certified or noncertified IT skill. N = 87,223 IT Professionals
IT Skills & Certifications Pay Data Trend Charts & Analysis

IT Skills and Certifications Pay Index™ – 4th Quarter 2021 data edition

(Data collected through January 1, 2022)

- Noncertified IT Skills (Page 6)
- IT Skills & Certifications Volatility Index™ (Page 29)
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.
Noncertified IT Skills Data Trend Charts & Analysis

(Data collected through January 1, 2022)
642 Non-Certified Tech Skills Reported

Apps Dev. Tools/Platforms
Agile software development
Amazon Kinesis
Amazon Web Services
Apache Airflow
Apache Art
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
Appium
Automated Testing
AWS CloudFormation
AWS CloudFront/CloudFront Functions
AWS Lambda
Bamboo
Behavior-Driven Development
Bitbucket
Boost C++
Business Objects
C
C#
C++ /CLI
CA PPM (Clarity PPM)
Cerner Millennium
CircleCI
Clojure
Cloudera software
Cloud Foundry PaaS
Cobol
Cognos
Confluence
Cucumber
Delphi
Drupal
Eclipse
Elixir
Epic Systems applications
Erlang
Ethereum
F#
Full Stack Development
Git/GitHub
GILab
Gosu/Guidewire
Gradle
Groovy/Grails
Grunt
Hibernate/NIHibernate
HP ALM (App. Lifecycle Mgt)
HP Unified Functional Testing
Integration Testing
JRe
Jasmine
Java SE/Java EE
JBehave
Jenkins
JIRA
JUnit
Kotlin
MapReduce
MATLAB
Microsoft Azure
Microsoft Azure Stack
Microsoft Logic Apps
Microsoft Power Platform
Microsoft SQL Server Mgt Studio
Microsoft Team Foundation Server
NetWeaver
NextJS
NIL
NUNIT
Objective-C
Objective Caml (OCaml)
OpenShift
Oracle APEX
Oracle Apps Developer Framework
PL/SQL
Powerbuilder
Progress 4GL/Development tools
R language
RapidMiner
Red Hat Fuse
Retool
Ruby
Ruby on Rails
Rust
Saas
SAS
SAS Enterprise Guide
Scala
Scrum
Selenium
ServiceNow ITSM
SPSS
SQL
Swift
Tcl
TestNG
Transact-SQL/SQLt
UML (unified modeling language)
Visual Basic 6.0
Visual C++
VMware Cloud Foundry PaaS
WebSphereMQ
Xcode

SAP & Enterprise Bus. Apps.
ABAP (all modules)
Baah (Infor LN ERP)
Enterprise Application Integration
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
PeopleSoft (CRM/Financials/HCM)
Remedy ITSM
Salesforce
Salesforce Fall Cloud
Salesforce Service Cloud
Selenium
SAP (SAPL)
SAP AFS
SAP ALE
SAP APO
SAP Ariba
SAP Auto-ID Infrastructure (SAP RF)
SAP Basis Components
SAP BI / SAP BW
SAP BO Data Services
SAP BODI
SAP BOXI
SAP BO Dashboard Design
SAP BPC
SAP BSP
SAP Business One
SAP Business Workflow/Workflow
SAP CA
SAP CAP
SAP CAR
SAP CCM
SAP CE
SAP CFP
SAP CO
SAP CO-PA
SAP CRM
SAP Crystal Reports
SAP CS
SAP Digital Banking
SAP EBP
SAP EDI
SAP EHS
SAP EPM
SAP ERP
SAP ESA
SAP Exchange Infrastructure (XI)
SAP FI (Financial Accounting)
SAP FI – CA
SAP FI - CO
SAP FI – FSCM
SAP FI - Travel Management
SAP First
SAP F&R (Forecasting/Replenish)
SAP FS (Insurance)
SAP GRC
SAP GTS
SAP HANA
SAP HCM (SAP HR)
SAP HCM ESS/MESS
SAP HR-PA
SAP HR-PY (Payroll)
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
SAP MDM
SAP MDX
SAP MI
SAP MM
SAP MRO
SAP NRS
SAP Netweaver Applications Server
SAP Netweaver BW (BW)
SAP NetWeaver Visual Composer
SAP NWDI
SAP NWDS
SAP Oil & Gas SAP PI (NetWeaver Process Integration)
SAP PLM
SAP PM
SAP POSDM
SAP PP
SAP PS
SAP PSCD
SAP Public Sector Management
SAP QM
SAP for Retail
SAP SAM (Service & Asset Mgt)
SAP S/HANA
SAP SCM
SAP SD
SAP SD - GTS
SAP Security
SAP SEM
SAP SM
SAP Smart Forms
SAP Solution Manager
SAP SRM
SAP TM
SAP UIS (UI development toolkit for HTML5)
SAP Web Application Server
SAP WEBI
SAP WM
SAP WM – EWM
Siebel/Siebel Analytics
Software AG webMethods
SuccessFactors
Web Dynpro
Workday HCM

Footers
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February 4, 2022
### Web/Commerce Development
- Active Server Pages
- ActiveX
- Adobe Experience Manager
- Ajax
- Amazon Cloudwatch
- AngularJS
- Apache Solr
- Apache Velocity
- Apache web server
- Apache Wicket
- Apex Code
- Backbone.js
- CGI
- Cold Fusion MX
- Content management systems
- CSS/CSS3
- Django
- Docker/Docker Swarm
- Documentum
- Elasticsearch/Elastic Stack
- Ember.js
- Front End Development
- GatsbyJS
- Google Analytics
- Google App Engine
- Google Cloud Platform
- HTML5
- JavaBeans/EJB 3.0
- JavaFX
- JavaScript
- Java Server Pages
- JBoss/Wildfly
- Jekyll
- Joomla!
- jQuery
- JSON
- Julia
- KnockoutJS
- Laravel PHP
- Magento
- Magnolia
- Microsoft .NET
- Microsoft BizTalk Server
- Microsoft Blazor
- Microsoft Commerce Server
- Microsoft Identity Integration Server
- Microsoft Internet Information Services
- Microsoft Forefront Threat Management Gateway (ISA)
- Microsoft Sharepoint/Sharepoint Server
- Microsoft Silverlight
- Microsoft Visual Studio
- Mobile applications development
- Node.js
- Oracle Fusion
- Oracle WebLogic/
  Oracle Workflow
- Pandas
- Perl
- PHP (all)
- PySpark
- Python
- React
- Redux
- REST
- RESTful
- SailPoint
- Scalable Vector Graphics (SVG)
- Secure coding/SW development
- Sitecore CMS
- SOAP
- Social Media/Networks
- Spring Framework
- Spring Boot
- Spring Cloud
- Spring Integration
- Spring MVC
- Spring Security
- TIBCO
- UDDI
- Umbraco
- VBScript
- Video/graphics editing
- Visual Interdev
- Voice/XML
- Web collaboration appliances
- Web Content Development
- Web Design
- WebSphere
- WebSphere Datapower
- Wikis
- WSDL
- XAML/XACML
- XHTML MP
- XML (all variants)

### Management, Methodology and Process
- Artificial Intelligence
- Artificial Intelligence for IT Operations (AIOps)
- Azure Machine Learning
- Big Data Analytics
- Bioinformatics
- Business Analysis
- Business Analytics
- Business Intelligence
- Business performance mgmt
- Business process management/
  modeling/improvement SW
- 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 Migration
- Data Mining
- Data Modelling
- Data Privacy
- Data Protection
- Data Quality
- Data Science
- Data Security
- Data Strategy
- Data Transformation
- Data Visualization
- DataOps
- DataRobot Enterprise AI Platform
- Deep Learning
- Deployment Automation
- DevOps
- DevSecOps
- Digital Analytics
- Digital Forensics
- Digital Marketing
- E-Discovery
- E-Procurement
- ERP
- Flink
- Functional Programming
- Functional Testing
- 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 Power BI
- Microsoft SQL Server Analysis Services
- Microsoft Visio
- MLOps
- Natural language processing
- Network Architecture
- Neural Networks
- NIST
- Penetration testing
- Predictive Analytics and Modeling
- Prescriptive Analytics
- Program Management
- Project management/governance
- PyTorch
- QlikView
- Quality Assurance/QA Automation
- Quality management/TQM
- Quantitative Analysis/Regression
- Razor

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### Systems/Networks
- Active Directory
- Amazon Elastic Kubernetes Service
- Ansible
- Apache Flume
- Arista
- ATM
- Azure Active Directory
- Azure Logic Apps
- 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 UCE
- Cisco UCCX
- Citrix Hypervisor (XenServer)
- Citrix Virtual Apps (XenApp)
- Cloud architecture
- Cloud security
- DHCP
- EIGRP
- Ethernet
- Fast Ethernet
- Gigabit Ethernet
- Grafana
- HP ConvergedSystem
- HP Quality Center
- HTTPS
- IaaS (Infrastructure as a Service)
- Infrastructure architecture
- Intrusion prevention/detection sys
- IPX/SPX
- Juniper
- Kubernetes
- LAN
- Microsoft Application Virtualization
- Microsoft Azure Sentinel
- 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 mgt systems
- Network security management
- Novell Netware
- PaaS
- Performance Analysis/Tuning
- Performance Management/Metrics
- 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
- SMTP
- SNA
- Software-Defined Networking
- SolarWinds
- Storage virtualization/administration
- TCP/IP
- Terraform
- Tivoli
- Vagrant
- iCenter Server
- 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
- Allergy Designer
- Amazon Athena
- Amazon DynamoDB
- Amazon RedShift
- Apache Cassandra
- Apache CouchDB
- Apache Hive
- Apache Spark SQL
- Azure Cosmos DB
- Azure Data Factory
- Azure SQL Data Warehouse
- Azure SQL Database
- Azure Synapse Analytics
- Base SAS
- Big Data
- Blockchain
- Cloudera Impala
- Couchbase Server
- Data mining
- Data security
- Database management
- DB2
- dBASE\JAVA
- ETL (Extract, transform, load)
- GIS
- Google Big Query
- Google Data Studio
- Hive
- Informatica
- Java Database Connectivity
- Kibana
- Looker
- Master data management
- Microsoft Access
- Microsoft SQL Server Integration Services
- Microsoft SQL Server 2019/2016/2014/2012
- MongoDB
- MySQL
- NoSQL
- OpenEdge ABL
- Oracle Application Server
- Oracle Business Intelligence Enterprise Edition
- Oracle Coherence
- Oracle DB 9/10g/11/12c
- Oracle Enterprise Manager
- Oracle Exadata
- Oracle Forms
- Oracle Reports
- PostgreSQL
- Redis
- Riak
- Riak
- Smart Contracts
- Sqoop
- Sybase Adaptive Server
- Teradata
- TIBCO Spotfire
- Visual SQL
- Amazon Athena
- Amazon Redshift
- Apache Cassandra
- Apache CouchDB
- Apache Hive
- Apache Spark SQL
- Azure Cosmos DB
- Azure Data Factory
- Azure SQL Data Warehouse
- Azure SQL Database
- Azure Synapse Analytics
- Base SAS
- Big Data
- Blockchain
- Cloudera Impala
- Couchbase Server
- Data mining
- Data security
- Database management
- DB2
dBASE\JAVA
- ETL (Extract, transform, load)
- GIS
- Google Big Query
- Google Data Studio
- Hive
- Informatica
- Java Database Connectivity
- Kibana
- Looker
- Master data management
- Microsoft Access
- Microsoft SQL Server Integration Services
- Microsoft SQL Server 2019/2016/2014/2012
- MongoDB
- MySQL
- NoSQL
- OpenEdge ABL
- Oracle Application Server
- Oracle Business Intelligence Enterprise Edition
- Oracle Coherence

### Messaging & Communications
- ActiveMQ
- Apache Kafka
- HCL 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

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IT NONCERTIFIED SKILLS PAY SUMMARY – Through January 1, 2022

A. NONCERTIFIED TECH SKILLS PAY PERFORMANCE: By Category

NON-CERTIFIED TECH SKILLS. 202 of 630 non-certified tech skills changed cash market value from October 1, 2021 to January 1, 2022 compared to 195 and 178 skills in the prior two calendar quarters. Average cash pay premium for 630 non-certified skills declined slightly last quarter, with pay performance in the 4th quarter of 2021 higher for only two of eight non-certified tech skills categories reported.

Noncertified IT Skills - % Growth/Decline
3 months & 12 months
(642 skills, data through 1/1/2022)

Figure 2

Source: Foote Partners IT Skills & Certifications Pay Index™, 4th Quarter 2021 data
18-YEAR QUARTERLY NONCERTIFIED IT SKILLS PAY TRENDS BY CATEGORY

Average quarterly median cash pay premium for a single non-certified IT skill. Data through January 1, 2022 – 87,223 IT Professionals

Pay data supporting these charts available in the IT Skills and Certifications Pay Index™ – 4Q 2021 data edition
HIGHEST PAYING Noncertified IT Skills (cash pay premiums, all 630 skills surveyed, ranked)

These non-certified IT skills are among those earning the highest pay premiums (data collected October 1, 2021 to January 1, 2022). Shown in alphabetical order grouped by overall market value rank in descending order including ties. Green/Red = increased/decreased in market value this quarter. Purple = Made the list this quarter for first time.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethereum</td>
<td>Apache Cassandra</td>
<td>Cloudera software</td>
<td>Business analytics</td>
</tr>
<tr>
<td>Google TensorFlow</td>
<td>Apache Hive</td>
<td>Configuration Management</td>
<td>COBIT</td>
</tr>
<tr>
<td>MLOps</td>
<td>Artificial Intelligence</td>
<td>Continuous Integration</td>
<td>Continuous Improvement</td>
</tr>
<tr>
<td>Site Reliability Engineering</td>
<td>Artificial Intelligence for IT</td>
<td>Cryptography (encryption, VPN, SSL/TLS, Hybrids)</td>
<td>Couchbase Server</td>
</tr>
<tr>
<td>Smart Contracts</td>
<td>Operations (AIOps)</td>
<td>Cybersecurity</td>
<td>Data Migration</td>
</tr>
<tr>
<td></td>
<td>Bioinformatics</td>
<td>Data Analytics</td>
<td>Data Quality</td>
</tr>
<tr>
<td>2.[Tie] Apache Pig</td>
<td>Clojure</td>
<td>Data Governance</td>
<td>Data Transformation</td>
</tr>
<tr>
<td>Apache Zookeeper</td>
<td>Cloud Foundry PaaS</td>
<td>Data Integration</td>
<td>Database management</td>
</tr>
<tr>
<td>Deep Learning</td>
<td>Cyber Threat Intelligence</td>
<td>Data Management</td>
<td>Deployment Automation</td>
</tr>
<tr>
<td>Prescriptive Analytics</td>
<td>Data Engineering</td>
<td>Data Modelling</td>
<td>Digital Forensics</td>
</tr>
<tr>
<td>PyTorch</td>
<td>Data Strategy</td>
<td>Go language (Golang)</td>
<td>E-Discovery</td>
</tr>
<tr>
<td>Risk analytics/assessment</td>
<td>DataOps</td>
<td>Google Big Query</td>
<td>Erlang</td>
</tr>
<tr>
<td>Security architecture and models</td>
<td>DevOps</td>
<td>Informatica</td>
<td>GitLab</td>
</tr>
<tr>
<td></td>
<td>Functional Programming</td>
<td>Kanban</td>
<td>IT Governance</td>
</tr>
<tr>
<td></td>
<td>HBase</td>
<td>Marketo</td>
<td>Kotlin</td>
</tr>
<tr>
<td>3.[Tie] Amazon Athena</td>
<td>Kibana</td>
<td>Metadata design and development</td>
<td>Master data management</td>
</tr>
<tr>
<td>Amazon DynamoDB</td>
<td>Machine Learning</td>
<td>Network Architecture</td>
<td>MongoDB</td>
</tr>
<tr>
<td>Big Data analytics</td>
<td>Oracle Coherence</td>
<td>Neural Networks</td>
<td>NoSQL</td>
</tr>
<tr>
<td>Blockchain</td>
<td>Oracle Exadata</td>
<td>NIST</td>
<td>Penetration testing</td>
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<tr>
<td>Caffe</td>
<td>Program Management</td>
<td>Predictive Analytics and Modeling</td>
<td>PostgreSQL</td>
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<td>Complex Event Processing/Event Correlation 17</td>
<td>Risk management</td>
<td>Scala</td>
<td>Quality management/TQM</td>
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<tr>
<td>Data Architecture</td>
<td>Rust</td>
<td>Security skills (DW/BI, ERP, Web, project assignments)</td>
<td>Quantitative Analysis/Regression Analysis</td>
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<tr>
<td>Data Science</td>
<td>Zachman Framework</td>
<td>Test Driven Development/Scripting</td>
<td>Redis</td>
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<tr>
<td>Elixir</td>
<td></td>
<td>Threat Detection/Modelling/Mgt.</td>
<td>Security management</td>
</tr>
<tr>
<td>Flink</td>
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<td>Usability Research/Human Factors</td>
<td>Security testing</td>
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<tr>
<td>Identity and access management</td>
<td>Microservices</td>
<td>Research</td>
<td>Software development lifecycle management</td>
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<tr>
<td>Microservices</td>
<td>Natural language processing</td>
<td></td>
<td>Teradata</td>
</tr>
<tr>
<td>Splunk</td>
<td>Scaled Agile Framework (SAFe)</td>
<td></td>
<td>Test automation</td>
</tr>
<tr>
<td></td>
<td>Splunk</td>
<td>Scaled Agile Framework (SAFe)</td>
<td>User Experience/User-Centered Design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(software/systems)</td>
<td>Vulnerability Scanning/Assessment/Mgt.</td>
</tr>
</tbody>
</table>
NONCERTIFIED IT SKILLS TREND HIGHLIGHTS: Market Value Gainers & Highest Paying – 4th Quarter 2021 data

These non-certified tech skills gained 10% or more in market value in the three months ending January 1, 2022 vs. prior quarter (see 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>IT SKILLS (noncertified)</th>
<th>Systems/Networking skills</th>
<th>Web/SOA/E-Commerce skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloudera software</td>
<td>vCloud</td>
<td>JavaBeans/EJB 3.0</td>
</tr>
<tr>
<td>Cobol</td>
<td>Cisco ISE (Identity Services Engine)</td>
<td>Pandas</td>
</tr>
<tr>
<td>Red Hat Fuse</td>
<td>WAN 4G/5G services</td>
<td>UDDI (Universal Description, Discovery and Integration)</td>
</tr>
<tr>
<td>Elixir</td>
<td>Wireless sensors/RFID</td>
<td>Magnolia</td>
</tr>
<tr>
<td>Apache Zookeeper</td>
<td>Apache Flume</td>
<td>WebSphere Datapower</td>
</tr>
<tr>
<td>HP ALM (Application Lifecycle Management)</td>
<td>SAP BOXI (Business Objects XI)</td>
<td>Backbone.js</td>
</tr>
<tr>
<td>Base SAS</td>
<td>SAP MDM (Master Data Management)</td>
<td>Microsoft Silverlight</td>
</tr>
<tr>
<td>Smart Contracts</td>
<td>SAP Security</td>
<td>Web Content Development</td>
</tr>
<tr>
<td>Oracle Coherence</td>
<td>Web Dynpro</td>
<td>Apache Velocity</td>
</tr>
<tr>
<td>Amazon Athena</td>
<td>Oracle CRM</td>
<td>WSDL (Web Services Description Language)</td>
</tr>
<tr>
<td>Operating System skills</td>
<td>SAP GTS (Global Trade Services)</td>
<td>XAML/XACML</td>
</tr>
<tr>
<td>Solaris</td>
<td>SAP Hybris</td>
<td>Jetty</td>
</tr>
<tr>
<td>OpenStack</td>
<td>SAP UI development toolkit for HTML5</td>
<td></td>
</tr>
<tr>
<td>Management, Process &amp; Methodology skills</td>
<td>(SAP UI5) SuccessFactors</td>
<td></td>
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<tr>
<td>Bioinformatics</td>
<td>Oracle BPM</td>
<td></td>
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<tr>
<td>Deployment Automation</td>
<td>Oracle Retail</td>
<td></td>
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<tr>
<td>Complex Event Processing/Event Correlation</td>
<td>SAP CAR (Customer Activity Repository)</td>
<td></td>
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<tr>
<td>Google TensorFlow</td>
<td>SAP QM (Quality Management)</td>
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<tr>
<td>Marketo</td>
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<tr>
<td>Caffe</td>
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</tbody>
</table>

Source: Foote Partners IT Skills & Certifications Pay Index™, 4th Quarter 2021 data edition
NONCERTIFIED IT SKILLS TREND HIGHLIGHTS: Market Value Losers – 4th Quarter 2021 data

These noncertified IT skills *declined 10% or more in market value in the three months ending January 1, 2022* vs. prior quarter (seen below grouped by segment). *Listed in descending order of amount of % decline in cash pay premium*, including ties.

<table>
<thead>
<tr>
<th>IT SKILLS (Non-certified)</th>
<th>SAP &amp; Enterprise Business Applications skills</th>
<th>Management, Process &amp; Methodology</th>
<th>Systems/Networking skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications Development skills</td>
<td>SAP Exchange Infrastructure (XI)</td>
<td>E-Procurement</td>
<td>Cisco CUCM</td>
</tr>
<tr>
<td>Visual C++</td>
<td>SAP FI - CA (Contract Accounting)</td>
<td>E-Discovery</td>
<td>Novell Netware</td>
</tr>
<tr>
<td>BusinessObjects</td>
<td>SAP PSCD (Collection and Disbursement)</td>
<td>Keras</td>
<td>Business continuity and disaster recovery planning</td>
</tr>
<tr>
<td>CA.PPM(Clarity PPM)</td>
<td>SAP IBP (Integrated Business Planning)</td>
<td>Security auditing</td>
<td>Gigabit Ethernet</td>
</tr>
<tr>
<td>NIM</td>
<td>Remedy ITSM</td>
<td>Risk analytics/assessment</td>
<td>Active Directory</td>
</tr>
<tr>
<td>Apache Ant</td>
<td>SAP WEBI (BusinessObjects Web Intelligence)</td>
<td></td>
<td>Cisco Prime</td>
</tr>
<tr>
<td>PowerBuilder</td>
<td>Oracle NetSuite</td>
<td></td>
<td>Citrix Hypervisor (XenServer)</td>
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<tr>
<td>SSPP</td>
<td>SAP BSP (Business Server Pages)</td>
<td>ActiveMQ</td>
<td>Dynamic Host Configuration Protocol</td>
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<tr>
<td>NetWeaver</td>
<td>SAP Data Services (SAP BODS)</td>
<td>Apache Kafka</td>
<td>Microsoft SCVMM</td>
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<tr>
<td>WebSphere MQ (MQSeries)</td>
<td>SAP HANA (In-Memory Analytics Appliance)</td>
<td>TIBCO Enterprise Message Service</td>
<td>HTTPS</td>
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<tr>
<td>Td</td>
<td>SAP HR-PP (Payroll)</td>
<td></td>
<td>SAN/Storage Area Networking</td>
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<tr>
<td>Oracle APEX</td>
<td>SAP IS-U (Utilities)</td>
<td></td>
<td>vCenter Server</td>
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<tr>
<td>Visual Basic 6.0</td>
<td>Oracle Eloqua</td>
<td></td>
<td>Azure Logic Apps</td>
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<tr>
<td></td>
<td>Oracle Financials</td>
<td></td>
<td>Cisco Nexus</td>
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<td></td>
<td>Oracle Payables</td>
<td></td>
<td>Cisco UCCE</td>
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<td></td>
<td>Oracle Payroll/Receivables</td>
<td></td>
<td>EIGRP</td>
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<tr>
<td></td>
<td>SAP MDG (Master Data Governance)</td>
<td></td>
<td>Virtualization (various)</td>
</tr>
<tr>
<td></td>
<td>SAP MM (Materials Management)</td>
<td></td>
<td>Amazon Elastic Kubernetes Service</td>
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<tr>
<td></td>
<td>SAP Smart Forms</td>
<td></td>
<td>(Amazon EKS)</td>
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<tr>
<td></td>
<td>SAP SRM (Supplier Relationship Management)</td>
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<td>Ansible</td>
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<td></td>
<td>SAP WM (Warehouse Management)</td>
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<td></td>
<td>Workday HCM</td>
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<td></td>
<td>Oracle ERP</td>
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<td></td>
<td>SAP GRC (Governance, Risk, and Compliance)</td>
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<td></td>
<td>SAP Manufacturing</td>
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<td></td>
<td>SAP NetWeaver BW (Business Information Warehouse)</td>
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<td></td>
<td>SAP PS (Project Systems)</td>
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<td></td>
<td>SAP S/HANA</td>
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<td></td>
<td>SAP SCM (Supply Chain Management)</td>
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</tbody>
</table>

Source: Foote Partners *IT Skills & Certifications Pay Index™*, 4th Quarter 2021 data edition
A. NON-CERTIFIED TECH SKILLS EARNING HIGH PAY—AND STILL GROWING IN VALUE

The following noncertified tech skills meet two prerequisites:

☑ They **recorded substantial gains in cash market value in the six months** ending October 1, 2021.

☑ They **earned workers cash pay premiums well above the average** of all 630 skills reported in our IT Skills and Certifications Pay Index™ in quarter ending October 1, 2021

No skill below is earning less than the equivalent of **16 percent of base salary**—significant considering the average for all skills reported is 9.4 percent of base. Not surprising, the list contains a number of security, database/data management, analytics, UX, and artificial intelligence related skills.

Here is the noncertified IT skills winners list (in alphabetical order):

<table>
<thead>
<tr>
<th>Amazon Athena</th>
<th>Elixir</th>
<th>Prescriptive Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apache Zookeeper</td>
<td>Ethereum</td>
<td>Program Management</td>
</tr>
<tr>
<td>Artificial Intelligence for IT Operations (AIOps)</td>
<td>Functional Programming</td>
<td>PyTorch</td>
</tr>
<tr>
<td>Bioinformatics</td>
<td>Google TensorFlow</td>
<td>Scaled Agile Framework (SAFe)</td>
</tr>
<tr>
<td>Complex Event Processing/Event Correlation</td>
<td>Kibana</td>
<td>Security architecture and models</td>
</tr>
<tr>
<td>Cyber Threat Intelligence</td>
<td>Machine Learning</td>
<td>Site Reliability Engineering</td>
</tr>
<tr>
<td>DevOps</td>
<td>MLOps</td>
<td>Smart Contracts</td>
</tr>
<tr>
<td>DevSecOps</td>
<td>Oracle Coherence</td>
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</tbody>
</table>

* * *

Below is the same list, but in **descending ranked order of cash premium first and market value increase second** (including ties) and a brief description of each.

1. **[Tie] Google TensorFlow**
   Smart Contracts
   **Market Value Increase:** 26.7 percent (in the six months through January 1, 2022)

Developed by the Google Brain team for internal Google use in research and production, **TensorFlow** is a free and open-source software library for machine learning and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks. TensorFlow can be used in a wide variety of programming languages, most notably Python, as well as Javascript, C++, and Java. This flexibility lends itself to a range of applications in many different sectors. 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; and without API, backwards compatibility guaranteed 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.
Smart contracts help you exchange money, property, shares, or anything of value in a transparent, conflict-free way while avoiding the services of a middleman. They’re the product of the decentralized ledger systems that run the blockchain and so skills in smart contracts are be catapulted along with Ethereum and others for an almost unlimited number of uses ranging from financial derivatives to insurance premiums, breach contracts, property law, credit enforcement, financial services, legal processes and crowdfunding agreements.

3. [Tie] MLOps
   Ethereum

   **Market Value Increase:** 11.8 percent (in the three months through January 1, 2022)

MLOps is a set of practices that aims to deploy and maintain machine learning models in production reliably and efficiently. The word is a compound of "machine learning" and the continuous development practice of DevOps in the software field. Machine learning models are tested and developed in isolated experimental systems. When an algorithm is ready to be launched, MLOps is practiced between Data Scientists, DevOps, and Machine Learning engineers to transition the algorithm to production systems. Similar to DevOps or DataOps approaches, MLOps seeks to increase automation and improve the quality of production models, while also focusing on business and regulatory requirements. While MLOps started as a set of best practices, it is slowly evolving into an independent approach to ML lifecycle management. MLOps applies to the entire lifecycle—from integrating with model generation (software development lifecycle, continuous integration/continuous delivery), orchestration, and deployment, to health, diagnostics, governance, and business metrics.

Ethereum is one of the most popular decentralized open source, public blockchain-based distributed computing platforms and OS for smart contract functionality. If you want to become a blockchain expert, learning how to build apps on Ethereum is a great place to start. It is the second-largest cryptocurrency platform (behind Bitcoin) by market share and market capitalization, serving as the platform for over 1,900 different cryptocurrencies and tokens, including 47 of the top 100 cryptocurrencies. Driving Ethereum skills demand most recently is the rising popularity of NFTs (non-fungible tokens) that run on a blockchain network. Many NFTs are priced in ether, which has helped drive up the price of Ethereum to 2,963 USD as of the early February, up from 2,372 in July.

5. [Tie] DevSecOps
   Site Reliability Engineering

   **Market Value Increase:** 5.6 percent (in the six months through January 1, 2022)

DevOps is a set of practices that combines software development (Dev) and IT operations (Ops). It aims to shorten the systems development life cycle and provide continuous delivery with high software quality. But DevOps isn’t just about development and operations teams: If you want to take full advantage of the agility and responsiveness of a DevOps approach, IT security must also play an integrated role in the full lifecycle cycle of your apps. Why? Because effective DevOps ensures rapid and frequent development cycles (sometimes weeks or days), but outdated security practices can undo even the most efficient DevOps initiatives.

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
NON-CERTIFIED IT SKILLS ANALYSIS – Winners, cont’d.

- 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

**Site Reliability Engineering (SRE)** is a set of principles and practices that incorporates aspects of software engineering and applies them to infrastructure and operation problems. The main goals are to create scalable and highly reliable software systems. Site reliability engineering is closely related to DevOps, a set of practices that combine software development and IT operations, and SRE has also been described as a specific implementation of DevOps.

As a set of principles and practices, SRE can be performed by anyone. This makes it similar to security engineering, for example, in the way that anyone is expected to contribute to good security practices but a company may decide to eventually staff specialists for the job. As a job role, SRE may be performed by solo practitioners or organized in teams usually being responsible for a combination of the following within a broader engineering organization: System availability, latency, performance, efficiency, change management, monitoring, emergency response, and capacity planning. Site reliability engineers often have backgrounds in software engineering, system engineering, or system administration. Focuses of site reliability engineering include automation, system design, and improvements to system resilience.

7. **Prescriptive Analytics**

   **Market Value Increase:** 28.6 percent (in the six months through January 1, 2022)

Prescriptive analytics, an area of business analytics dedicated to finding the best course of action for a given situation, is related to both descriptive and predictive analytics. While descriptive analytics aims to provide insight into what has happened and predictive analytics helps model and forecast what might happen, prescriptive analytics seeks to determine the best solution or outcome among various choices given the known parameters. It can also suggest decision options for how to take advantage of a future opportunity or mitigate a future risk and illustrate the implications of each decision option. In practice, prescriptive analytics can continually and automatically process new data to improve the accuracy of predictions and provide better decision options. Specific techniques used in prescriptive analytics include optimization, simulation, game theory and decision-analysis methods. Advancements in the speed of computing and the development of complex mathematical algorithms applied to the data sets have boosted demand for prescriptive analysis skills.

8. **PyTorch**

   **Average Pay Premium:** 18 percent of base salary equivalent
   **Market Value Increase:** 20 percent (in the six months through January 1, 2022)

**PyTorch** is an open source machine learning framework based on the Torch library that accelerates the path from research prototyping to production deployments. It is used for applications such as computer vision and natural language processing, primarily developed by Facebook's AI Research lab (FAIR). Although the Python interface is more polished and the primary focus of development, PyTorch also has a C++ interface. A number of pieces of Deep Learning software are built on top of PyTorch, including Tesla Autopilot, Uber’s Pyro, PyTorch Lightning, and Catalyst.
PyTorch provides two high-level features:

- Tensor computing (like NumPy) with strong acceleration via graphics processing units (GPU)
- Deep neural networks built on a tape-based automatic differentiation system

Key features and capabilities of PyTorch include:

- *Production Ready*, Transition seamlessly between eager and graph modes with TorchScript, and accelerate the path to production with TorchServe
- *Distributed Training*. Scalable distributed training and performance optimization in research and production is enabled by the Torch.distributed backend.
- *Robust Ecosystem*. A rich ecosystem of tools and libraries extends PyTorch and supports development in computer vision, NLP and more.
- *Cloud Support*. PyTorch is well supported on major cloud platforms, providing frictionless development and easy scaling.

9. **Apache Zookeeper**

*Market Value Increase: 12.5 percent* (in the six months through January 1, 2022)

**Apache ZooKeeper** is an open source Apache project that provides a centralized service for providing configuration information, naming, synchronization and group services over large clusters in distributed systems. The goal is to make these systems easier to manage with improved, more reliable propagation of changes.

If you had a Hadoop cluster spanning 500 or more commodity servers, you would need centralized management of the entire cluster in terms of name, group and synchronization services, configuration management, and more. Other open source projects using Hadoop clusters require cross-cluster services. Embedding ZooKeeper means you don’t have to build synchronization services from scratch. Interaction with ZooKeeper occurs by way of Java™ or C interface time.

For applications, ZooKeeper provides an infrastructure for cross-node synchronization by maintaining status type information in memory on ZooKeeper servers. A ZooKeeper server keeps a copy of the state of the entire system and persists this information in local log files. Large Hadoop clusters are supported by multiple ZooKeeper servers, with a master server synchronizing the top-level servers.

Put simply, applications can synchronize their tasks across the distributed cluster by updating their status in a ZooKeeper file that persists in memory on the ZooKeeper servers (called a ‘znode’). The znode then informs the rest of the cluster of a specific node’s status change. This cluster-wide status centralization service is critical for management and serialization tasks across a large distributed set of servers.

10. **Security architecture and models**

*Market Value Increase: 5.9 percent* (in the six months through January 1, 2022)

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.
11. Scaled Agile Framework (SAFe)

**Market Value Increase:** 6.3 percent (in the three months through January 1, 2022)

The Scaled Agile Framework (SAFe) is a set of organization and workflow patterns intended to guide enterprises in scaling lean and agile practices. Along with large-scale Scrum (LeSS), disciplined agile delivery (DAD), and Nexus, SAFe is one of a growing number of frameworks that seek to address the problems encountered when scaling beyond a single team. SAFe promotes alignment, collaboration, and delivery across large numbers of agile teams. It was developed by and for practitioners, by leveraging three primary bodies of knowledge: agile software development, lean product development, and systems thinking.

12. [Tie] Complex Event Processing/Event Correlation

**Elixir**

**Market Value Increase:** 21.4 percent (in the six months through January 1, 2022)

Complex event processing, or CEP, consists of a set of concepts and techniques developed in the early 1990s for processing real-time events and extracting information from event streams as they arrive. The goal of complex event processing is to identify and analyze meaningful events (such as opportunities or threats) in real-time situations and respond to them as quickly as possible. At the root of CEP is event correlation, a technique for making sense of a large number of events and pinpointing the few events that are most important in that mass of information. This is accomplished by looking for and analyzing relationships between events. These events may be happening across the various layers of an organization as sales leads, orders, or customer service calls. Or, they may be news items, text messages, social media posts, stock market feeds, traffic reports, weather reports, or other kinds of data. An event may also be defined as a "change of state," when a measurement exceeds a predefined threshold of time, temperature, or other value. The vast amount of information available about events is sometimes referred to as the event cloud.

CEP has become an enabling technology in many systems that are used to take immediate action in response to incoming streams of events, effectively helping the business side communicate better with IT and service departments. Applications can be found in many sectors of business including stock market trading systems, mobile devices, internet operations, fraud detection, security monitoring, business activity monitoring, and governmental intelligence gathering.

Event correlation plays a role in integrated service management and, as a lean version of ITIL, is a popular way of managing IT operations as a service using a set of standardized methods. Integrated service management. Within integrated service management, there are six key processes: service level management, change management, operations management, incident management, configuration management, and quality management. Event correlation falls under incident management but relates to virtually all six processes. For example, IT operations staff, DevOps teams, and network operations center (NOC) managers cannot keep up with the volume of alerts and detect incidents and outages in time, before they affect revenue-generating applications and services or other critical back-end systems. These factors raise the risk that incidents and outages will hurt the company's business, however event correlation software tackles this challenge by collecting monitoring data from across the managed environment and using AI to consolidate those monitoring alerts into clusters related to the same issue. As part of that process, the event correlation platform makes use of the latest, up-to-date topology data to identify, compares these clusters with system data on changes and network topology. The software uses this information to identify the causes and solutions for issues much faster and thoroughly than human technicians could.

Advances in artificial intelligence, including machine learning, have strengthened event correlation. AI enables platforms to continuously improve correlation algorithms using the data they ingest and user input or user actions. This innovation, part of a trend called Artificial Intelligence for IT Operations (AIOps), makes the analysis of event data, the detection of problems and the surfacing of their root cause more efficient.
**Elixir** is a dynamic, functional, concurrent general-purpose programming language that runs on the BEAM virtual machine used to implement the Erlang programming language. Elixir builds on top of Erlang and shares the same abstractions for building distributed, fault-tolerant scalable and maintainable applications while also being successfully used in web development, embedded software, data ingestion, and multimedia processing domains. Elixir also provides productive tooling and an extensible design. The latter is supported by compile-time metaprogramming with macros and polymorphism via protocols.

**Platform features of Elixir:**

- **Scalability.** All Elixir code runs inside lightweight threads of execution (called processes) that are isolated and exchange information via messages. Due to their lightweight nature, it is not uncommon to have hundreds of thousands of processes running concurrently in the same machine. Isolation allows processes to be garbage collected independently, reducing system-wide pauses, and using all machine resources as efficiently as possible (vertical scaling). Processes are also able to communicate with other processes running on different machines in the same network. This provides the foundation for distribution, allowing developers to coordinate work across multiple nodes (horizontal scaling).

- **Fault-tolerance.** The unavoidable truth about software running in production is that things will go wrong. Even more when we take network, file systems, and other third-party resources into account. To cope with failures, Elixir provides supervisors which describe how to restart parts of your system when things go awry, going back to a known initial state that is guaranteed to work.

**Language features of Elixir:**

- **Functional programming.** Functional programming promotes a coding style that helps developers write code that is short, concise, and maintainable. For example, pattern matching allows developers to easily destructure data and access its contents. When mixed with guards, pattern matching allows us to elegantly match and assert specific conditions for some code to execute. Elixir relies heavily on those features to ensure your software is working under the expected constraints.

- **Extensibility and DSLs.** Elixir has been designed to be extensible, letting developers naturally extend the language to particular domains, in order to increase their productivity.

**Tooling features of Elixir:**

- **A growing ecosystem.** Elixir ships with a great set of tools to ease development. Mix is a build tool that allows you to easily create projects, manage tasks, run tests, manage dependencies, and integrates with the Hex package manager, which performs dependency resolution, fetches remote packages, and [host documentation](https://hexdoc.sulfur.lisp.buddy/) for the whole ecosystem.

- **Interactive development.** Tools like IEx (Elixir's interactive shell) are able to leverage many aspects of the language and platform to provide auto-complete, debugging tools, code reloading, as well as nicely formatted documentation.

- **Erlang compatible.** Elixir runs on the Erlang VM giving developers complete access to Erlang's ecosystem, used by companies like Heroku, WhatsApp, Klarna and many more to build distributed, fault-tolerant applications. An Elixir programmer can invoke any Erlang function with no runtime cost.
14. **Amazon Athena**  
*Market Value Increase:* **13.3 percent** (in the six months through January 1, 2022)

*Amazon Athena* is an ETL-like serverless interactive query cloud service that makes it easy to analyze data directly in Amazon Simple Storage Service (Amazon S3) using standard SQL. With no infrastructure to set up or manage and with the ability to scale automatically—running queries in parallel—results are fast, even with large datasets and complex queries. Athena helps analyze unstructured, semi-structured, and structured data. Examples include CSV, JSON, or columnar data formats such as Apache Parquet and Apache ORC. It can be used to run ad-hoc queries using ANSI SQL, without the need to aggregate or load the data into Athena. It also integrates with Amazon QuickSight for easy data visualization and can generate reports or explore data with business intelligence tools or SQL clients connected with a JDBC or an ODBC driver.

15. **Oracle Coherence**  
*Market Value Increase:* **14.3 percent** (in the three months through January 1, 2022)

*Oracle Coherence* is a popular Java-based distributed cache and in-memory data grid solution that enables organizations to predictably scale mission-critical applications by providing fast access to frequently used data. As data volumes and customer expectations increase, driven by the “internet of things”, social, mobile, cloud and always-connected devices, so does the need to handle more data in real-time, offload over-burdened shared data services and provide availability guarantees. Coherence is intended for systems that require high availability, high scalability and low latency, particularly in cases that traditional relational database management systems provide insufficient throughput, or insufficient performance.

Coherence provides several core services:

- **Reliable messaging and cluster membership services.** Originally built using a combination of UDP multicast and unicast, more recent versions of Coherence introduced non-blocking TCP/IP support.
- **Replicated and partitioned data management and caching services.** At its core Oracle Coherence is a highly scalable and fault-tolerant distributed cache engine, using a specialized scalable protocol and many inexpensive computers to create a cluster which can be seamlessly expanded to add more memory, processing power or both. As a result, it has no single point of failure and transparently fails only if a cluster member fails.
- **Replicated data processing engine.** In addition to caching Coherence provides a rich data processing model so processing can be farmed out to where the data is, and results returned to the client.
- **Event model** allowing developers to interact with data as it changes.
- **Support for clients** written in Java, C++, .NET as well as other languages using REST.

*Market Value Increase:* **6.7 percent** (in the three months through January 1, 2022)

*Artificial intelligence for IT operations (AIOps)* is an umbrella term coined by Gartner for the use of big data analytics, machine learning (ML) and other artificial intelligence (AI) technologies to automate the identification and resolution of common IT issues. As the systems, services and applications in a large enterprise especially produce immense volumes of log and performance data, AIOps can use this data to monitor assets and gain visibility into dependencies within and outside of IT systems. AIOps is also an acronym of “Algorithmic IT Operations” which includes automation, performance monitoring and event correlations among others.
AIOps is generally used in companies that use DevOps or cloud computing and in large, complex enterprises. AIOps aids teams that use a DevOps model by giving development teams additional insight into their IT environment, which then gives the operations teams more visibility into changes in production. AIOps also removes a lot of risks involved in hybrid cloud platforms by aiding operators across their IT infrastructure. In many cases, it can help any large company that has an extensive IT environment. Being able to automate processes, recognize problems in an IT environment earlier and aid in smoothing communications between teams, AIOps will help most large companies with extensive or complicated IT environments.

Generally, the main areas of use for AIOps platforms and principles are

- Automation of tasks (DevOps)
- Machine learning platforms
- Augmented reality
- Agent-based simulations
- Internet of things (IoT)
- AI Optimized Hardware
- Natural language generation
- Streaming data platforms
- Conversational BI and analytics

An AIOps skills are hot because this platform brings three capabilities to an enterprise:

- **Automate routine practices.** Routine practices include user requests, as well as non-critical IT system alerts. For example, AIOps can enable a help desk system to process and fulfill a user request to provision a resource automatically. AIOps platforms can also evaluate an alert and determine that it does not require action because the relevant metrics and supporting data available are within normal parameters.

- **Recognize serious issues faster and with greater accuracy than humans.** IT professionals might address a known malware event on a noncritical system but ignore an unusual download or process starting on a critical server because they are not watching for this threat. AIOps addresses this scenario differently, prioritizing the event on the critical system as a possible attack or infection because the behavior is out of the norm, and deprioritizing the known malware event by running an antimalware function.

- **Streamline the interactions between data center groups and teams.** AIOps provides each functional IT group with relevant data and perspectives. Without AI-enabled operations, teams must share, parse and process information by meeting or manually sending around data. AIOps should learn what analysis and monitoring data to show each group or team from the large pool of resource metrics.

AIOps is an emerging area but skills in these product offerings are helping to give IT professionals a start in managing their careers:

- Splunk’s IT Service Intelligence (ITSI) tool
- BMC’s TrueSight platform
- Cisco’s Crosswork Situation Manager
- Moogsoft AIOps
- DRYICE AIOps from HCL Technologies Ltd
- ScienceLogic AIOps
- Micro Focus AIOps
- BigPanda AIOps
- Microsoft Azure AIOps
- LogicMonitor AIOps
- Autointelli AIOps
- Federator.ai AIOps
- CloudFabrix AIOps
- Zenoss AIOps
Kibana is a proprietary data visualization dashboard software for Elasticsearch, whose open source successor in OpenSearch is OpenSearch Dashboards, providing visualization capabilities on top of the content indexed on an Elasticsearch cluster. Users can create bar, line and scatter plots, or pie charts and maps on top of large volumes of data. Kibana also provides a presentation tool, Canvas, which allows users to create slide decks that pull live data directly from Elasticsearch. The combination of Elasticsearch, Logstash, and Kibana, referred to as the "Elastic Stack" (or "ELK stack"), is available as a product or service. Logstash provides an input stream to Elasticsearch for storage and search, and Kibana accesses the data for visualizations such as dashboards. Elastic also provides "Beats" packages which can be configured to provide pre-made Kibana visualizations and dashboards about various database and application technologies.

18. [Tie] Bioinformatics
   Cyber Threat Intelligence
   DevOps
   Functional Programming
   Machine Learning
   Program Management

*Market Value Increase:* 6.7 percent (in the six months through January 1, 2022)

Bioinformatics is an interdisciplinary field that develops methods and software tools for understanding biological data, in particular when the data sets are large and complex. As an interdisciplinary field of science, bioinformatics combines biology, chemistry, physics, computer science, information engineering, mathematics, and statistics to analyze and interpret the biological data. It includes biological studies that use computer programming as part of their methodology, as well as a specific analysis "pipeline" that are repeatedly used, particularly in the field of genomics. In experimental molecular biology, bioinformatics techniques such as image and signal processing allow extraction of useful results from large amounts of raw data. In the field of genetics, it aids in sequencing and annotating genomes and their observed mutations. It plays a role in the text mining of biological literature and the development of biological and gene ontologies to organize and query biological data.

Bioinformatics tools aid in comparing, analyzing and interpreting genetic and genomic data and more generally in the understanding of evolutionary aspects of molecular biology. At a more integrative level, it helps analyze and catalogue the biological pathways and networks that are an important part of systems biology. Databases are essential for bioinformatics research and applications. Many databases exist, covering various information types: for example, DNA and protein sequences, molecular structures, phenotypes and biodiversity. They may contain empirical data (obtained directly from experiments), predicted data (obtained from analysis), or, most commonly, both. They can incorporate data compiled from multiple other databases. These databases vary in their format, access mechanism, and whether they are public or not. Analyzing biological data to produce meaningful information involves writing and running software programs that use algorithms from graph theory, artificial intelligence, soft computing, data mining, image processing, and computer simulation. The algorithms in turn depend on theoretical foundations such as discrete mathematics, control theory, system theory, information theory, and statistics.

Software tools for bioinformatics range from simple command-line tools to more complex graphical programs and standalone web-services available from various bioinformatics companies or public institutions. The combination of a continued need for new algorithms for the analysis of emerging types of biological readouts, the potential for innovative computer simulation experiments, and freely available open code bases have helped to create opportunities for all research groups to contribute to both bioinformatics and the range of open-source software available.

The range of open-source software packages includes titles such as Bioconductor, BioPerl, Biopython, BioJava, BioJS, BioRuby, Bioclipse, EMBOSS, .NET Bio, Orange with its bioinformatics add-on, Apache Taverna, UGENE and GenoCAD. SOAP- and REST-based interfaces have been developed for a wide variety of bioinformatics applications allowing an application running on one computer in one part of the world to use algorithms, data and computing resources on servers in other parts of the world. Then there
are Bioinformatics workflow management systems, specialized forms of workflow management systems designed specifically to compose and execute a series of computational or data manipulation steps, or a workflow, in a Bioinformatics application.

**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 technique frameworks 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.

**DevOps** is a set of practices that combines software development (Dev) and IT operations (Ops). It aims to shorten the systems development life cycle and provide continuous delivery with high software quality. DevOps is complementary with Agile software development and in fact several DevOps aspects come from the Agile methodology. In its broadest meaning, DevOps is a philosophy that promotes better communication and collaboration between developers and systems administrators and aligning technological projects to business requirements. DevOps can change the software delivery chain, services, job roles, IT tools and best practices.
While DevOps is not a technology, DevOps environments generally apply common methodologies. These include the following:

- Continuous integration and continuous delivery or continuous deployment (CI/CD) tools, with an emphasis on task automation.
- Systems and tools that support DevOps adoption, including real-time monitoring, incident management, configuration management and collaboration platforms; and
- Cloud computing, microservices and containers implemented concurrently with DevOps methodologies.

DevOps is a methodology meant to improve work throughout the software development lifecycle. You can visualize a DevOps process as an infinite loop, comprising these steps: plan, code, build, test, release, deploy, operate, monitor and -- through feedback -- plan, which resets the loop. To align software to expectations, developers and stakeholders communicate about the project, and developers work on small updates that go live independently of each other. To avoid wait times, IT teams use CI/CD pipelines and other automation to move code from one step of development and deployment to another. Teams review changes immediately and can enforce policies to ensure releases meet standards. To deploy good code to production, DevOps adherents use containers or other methods to make the software behave the same way from development through testing and into production. They deploy changes individually so that problems are traceable. Teams rely on configuration management for consistent deployment and hosting environments. Problems they discover in live operations lead to code improvements, often through a blameless post-mortem investigation and continuous feedback channels.

**What problems does DevOps solve?** Releases that take too long, software that doesn't meet expectations, and IT that limits business growth are problems that DevOps solves by moving faster from requirements to live software, with shorter cycle times keeping requirements from shifting so that the product delivers what customers want. DevOps solves communication and priority problems between IT specializations. To build viable software, development teams must understand the production environment and test their code in realistic conditions. A traditional structure puts development and operations teams in silos, meaning developers are satisfied when their code delivers functionality -- and if the release breaks in production, it's up to the operations team to fix the problems. With a DevOps culture, changes rolled out to production are small and reversible. Plus, the whole team understands the changes, which greatly simplifies incident management.

**DevOps vs. Agile development.** Agile teams focus on incremental and rapid cycles of code creation and delivery, referred to as sprints. Each sprint iterates upon the last, which makes the software highly flexible and adaptable to changing requirements. It is possible for the original vision of a project to be lost through this cycle. DevOps arose from Agile's success at improving development speed, and the realization that disconnects between development and operations teams -- as well as between IT and the business side of the organization -- significantly hindered the Agile software's delivery to users.

**DevOps vs. SRE.** Site reliability engineering arose concurrently with Agile and DevOps. It is essentially a programming- and automation-focused approach to the software development lifecycle. Problems should be solved in a way that prevents them from occurring again. Rote tasks should be minimized. The SRE toolbox closely matches that for DevOps; both disciplines aim for continuous improvement. SRE and DevOps engineers seek to abolish silos between development and operations. While DevOps also can extend to business stakeholders, SRE typically stays within the confines of IT processes.

**DevOps jobs and skills.** DevOps is often said to be more of a philosophy or collaborative IT culture, rather than a strictly defined job description or skill set. Because the area is so broad, DevOps positions suit IT generalists better than specialists.

The role of DevOps engineer does not fall along one career track. Professionals can enter into the position from a variety of backgrounds. For example, a software developer can gain skills in operations, such as configuration of the hosting infrastructure, to become a DevOps engineer. Similarly, a systems administrator with coding, scripting and testing knowledge can become a DevOps engineer. Candidates benefit from knowledge of containers, cloud and CI/CD, as well as soft skills. A DevOps engineer might also need to change processes and solve organizational problems to achieve business outcomes. Other titles often found in DevOps organizations include infrastructure developer; site reliability engineer; build and release engineer; full-stack developer; automation specialist; and CI/CD platform engineer.
Most entry-level DevOps jobs require a degree in computer science or a related field that covers coding, QA testing and IT infrastructure components. Higher-level positions may require advanced degrees in systems architecture and software design. People on this career path who choose to take a more vendor-dependent path should these certifications, among other:

- Google Cloud DevOps Engineer
- AWS Certified DevOps Engineer - Professional
- IBM Certified Solution Advisor - DevOps V2
- Microsoft Certified DevOps Engineer Expert

**Functional programming** has become a really hot topic in the JavaScript world. Just a few years ago, few JavaScript programmers even knew what functional programming is, but every large application codebase I've seen in the past 3 years makes heavy use of functional programming ideas. Often abbreviated FP, functional programming is the process of building software by composing pure functions, avoiding shared state, mutable data, and side-effects. Functional programming is declarative rather than imperative, and application state flows through pure functions. Contrast with object-oriented programming, where application state is usually shared and collocated with methods in objects.

Functional programming is a programming paradigm, meaning that it is a way of thinking about software construction based on some fundamental, defining principles (listed above). Other examples of programming paradigms include object-oriented programming and procedural programming.

Functional code tends to be more concise, more predictable, and easier to test than imperative or object-oriented code — but if you’re unfamiliar with it and the common patterns associated with it, functional code can also seem a lot denser, and the related literature can be impenetrable to newcomers.

**Machine learning (ML)** is a type of artificial intelligence (AI) that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Machine learning algorithms build a model based on historical sample data, known as training data, to make predictions or decisions without being explicitly programmed to do so. Machine learning algorithms are used in a wide variety of applications, such as in medicine, email spam filtering, speech recognition, malware threat and fraud detection, business process automation, predictive maintenance, and computer vision, where it is difficult or unfeasible to develop conventional algorithms to perform the needed tasks. Data mining is a related field of study, focusing on exploratory data analysis through unsupervised learning. Some implementations of machine learning use data and neural networks in a way that mimics the working of a biological brain. In its application across business problems, machine learning is also referred to as predictive analytics. Machine learning is important because it gives enterprises a view of trends in customer behavior and business operational patterns, as well as supports the development of new products. Many of today's leading companies make machine learning a central part of their operations. Machine learning has become a significant competitive differentiator for many companies.

There are different types of machine learning, with classical machine learning often categorized by how an algorithm learns to become more accurate in its predictions. There are four basic approaches: supervised learning, unsupervised learning, semi-supervised learning and reinforcement learning, with the type of algorithm chosen by data scientists depending on what type of data they want to predict.

- **Supervised learning**: In this type of machine learning, data scientists supply algorithms with labeled training data and define the variables they want the algorithm to assess for correlations. Both the input and the output of the algorithm is specified.

- **Unsupervised learning**: This type of machine learning involves algorithms that train on unlabeled data. The algorithm scans through data sets looking for any meaningful connection. The data that algorithms train on as well as the predictions or recommendations they output are predetermined. This is most useful for clustering (splitting datasets into groups based on similarity); anomaly detection (identifying unusual data points in a data set); association mining (identifying sets of items in a data set that frequently occur together); dimensionality reduction (reducing the number of variables in a data set).
• **Semi-supervised learning:** This approach to machine learning involves a mix of the two preceding types. Data scientists may feed an algorithm mostly labeled training data, but the model is free to explore the data on its own and develop its own understanding of the data set. Areas where this is used include: *machine translation:* Teaching algorithms to translate language based on less than a full dictionary of words; *fraud detection:* Identifying cases of fraud when you only have a few positive examples; *labelling data:* Algorithms trained on small data sets can learn to apply data labels to larger sets automatically.

• **Reinforcement learning:** Data scientists typically use reinforcement learning to teach a machine to complete a multi-step process for which there are clearly defined rules. Data scientists program an algorithm to complete a task and give it positive or negative cues as it works out how to complete a task. But for the most part, the algorithm decides on its own what steps to take along the way. Reinforcement learning is often used in areas such as: *Robotics:* Robots can learn to perform tasks the physical world using this technique; *video gameplay:* Reinforcement learning has been used to teach bots to play a number of video games. *Resource management:* Given finite resources and a defined goal, reinforcement learning can help enterprises plan out how to allocate resources.

Other popular uses for machine learning include the following:

• **Customer relationship management.** Using machine learning models to analyze email and prompt sales team members to respond to the most important messages first. More advanced systems can recommend potentially effective responses.

• **Business intelligence.** BI and analytics vendors use machine learning in their software to identify potentially important data points, patterns of data points and anomalies.

• **Human resource information systems.** Using machine learning models to filter through applications and identify the best candidates.

• **Self-driving cars.** Machine learning algorithms make it possible for a semi-autonomous car to recognize a partially visible object and alert the driver.

• **Virtual assistants.** Smart assistants typically combine supervised and unsupervised machine learning models to interpret natural speech and supply context.

Machine learning algorithms have been around for decades, but they've attained new popularity: Our research indicates that jobs and skills in AI and machine learning (and especially deep learning) will maintain their 'hotness' and support job creation and cash market values for skills for the foreseeable future. The fact is that machine learning platforms are among enterprise technology's most competitive realms, with many major vendors—Amazon, Google, Microsoft, IBM and others—racing to sign up hungry customers for platform services that cover the spectrum of machine learning activities, including data collection, data preparation, data classification, model building, training and application deployment.

Machine learning has already seen so many use cases and they will increase in number. Continued research into deep learning and AI is increasingly focused on developing more general applications. Today's AI models require extensive training in order to produce an algorithm that is highly optimized to perform one task. As machine learning continues to increase in importance to business operations and AI becomes more practical in enterprise settings, the machine learning platform wars will only intensify. Companies are exploring ways to make models more flexible and are seeking techniques that allow a machine to apply context learned from one task to future, different tasks.

**Program management** is the process of managing programs mapped to business objectives that improve organizational performance. Program managers oversee and coordinate the various projects and other strategic initiatives throughout an organization. Program managers also help to drive organizational change by helping with agile transformations, including helping to implement DevOps practices and principles. Program managers may align program management practices and processes with agile values such as collaboration, team autonomy and empowerment, delivering value to customers, and adapting to change in the moment. A program manager can bring agile and DevOps to life for teams across large programs or individual projects by tailoring programs to the specific requirements and opportunities of the business.
Program management is sometimes confused with project management. Project management is the process of leading a project performed by a team to achieve certain goals, such as building a new product. Program management entails managing a program with multiple, related projects. Since programs are linked to strategic initiatives, they are often long running and possibly permanent. Programs continue through organizational change, contribute to multiple goals, and contain many projects that deliver specific components of the larger strategic initiative.
IT Certification Data Trend Charts & Analysis

(Data collected through January 1, 2022)
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Avaya Certified Design Specialist
Avaya Certified Implementation Specialist
Avaya Certified Integration Specialist
Avaya Certified Solution Specialist
Avaya Professional Design Specialist
AWS Certified Advanced Network – Specialty
AWS Certified Data Analytics – Specialty
AWS Certified Developer - Associate
AWS Certified DevOps Engineer - Professional
AWS Certified Security - Specialty
AWS Certified Solutions Architect - Associate (Cloud)
AWS Certified Solutions Architect - Professional (Cloud)
AXELOS ITIL 4 certifications
BICSI ITS Technician
BICSI Technician and Registered Communications Distribution Designer
Brocade Certified Network Engineer
Brocade Certified Network Professional
Brocade Certified Fabric Designer
Brocade Certified Fabric Professional (BCFP)
Certification 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 Cisco Systems Instructor (CCSI)
Certified Cloud Architect
Certified Cloud Security Professional (CCSP)
Certified Cloud Technology Professional
Certified Compliance Professional
Certified Computer Examiner (CCE)
Certified Computing Professional (CCP-ISC2)
Certified Data Centre Management Professional (CDCMP)
Certified Data Professional (CDP)
Certified Disaster Recovery Engineer (C/DR E)
Certified Forensic Computer Examiner (CFCE)
Certified Fraud Examiner
Certified Healthcare Information Security and Privacy Practitioner (HCISP P)
Certified in Convergent Network Technologies (CCNT)
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 Technologist- all countries
Certified Information Security Manager (CISM)
Certified Information Systems Auditor (CISA)
Certified Information Systems Risk Manager/Mile2
Certified Information Systems Security Professional (CISSP)
Certified IP Telecom Network Specialist (CIPTS)
Certified IT Architect (IASA CIT A)
Certified Manager of Software Quality (CMSQ)
Certified Penetration Testing Engineer (CPTE)
Certified Project Management Practitioner
Certified Protection Professional
Certified Scrum Developer
Certified Scrum Master
Certified Scrum Product Owner
Certified Scrum Professional
Certified Scrum Team Coach
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 (Network Designing and Engineering)
Cisco Certified Network Associate (Networking automation and programmability)
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
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 Advanced HTML5 and CSS3 Specialist
CIW Certified Database Design Specialist
CIW Certified Web Design Professional
CIW Web Development Professional
CIW Web Foundations Associate
CIW Web Security Professional
Cloud U (Rackspace)
Cloudera Certified Associate Administrator
Cloudera Certified Associate Data Analyst
Cloudera Certified Associate Spark and Hadoop Developer
Cloudera 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+
CompTIA System Administration Certificate (CTP)
CSX CyberSecurity Practitioner (CSXP)
CWNP Certified Wireless Security Professional (CWSP)
CWNP/Certified Wireless Analysis Professional (CWAP)
CWNP/Certified Wireless Design Professional (CWDP)
CWNP/Certified Wireless Network Administrator (CWNA)
CWNP/Certified Wireless Network Trainer (CWNT)
CWNP/Certified Wireless Network Expert (CWNNE)
CWNP/Certified Wireless Technology Specialist (CWTS)
Cyber Security
Dell Cloud Infrastructure - Specialist (DCS - CA)
Dell Cloud Services Architect - Expert (DCE - CA)
Dell Data Science Associate (DCA-DS)
Dell Data Science Specialist - Advanced Analytics (DCS-DA)
Dell EMC Technology Architect - Expert (DCE-TA)

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Foote Partners News Release – February 4, 2022

Dell EMC Technology Architect - Specialist (DCS-TA)
Dell Implementation Engineer - Expert (DCE - IE)
Dell Implementation Engineer - Specialist (DCS - IE)
Dell Information Storage and Management Associate (DCA-ISM)
Dell Information Storage and Management Expert (DCE-ISM)
Dell Information Storage and Management Specialist (DCE-ISM)
Dell Platform Engineer/PowerScale - Specialist (DCS-PE)
EC-Council Certified Application Security Engineer (CASE)
EC-Council Certified Encryption Specialist (ECES)
EC-Council Certified Ethical Hacker (CEH)
EC-Council Certified Incident Handler V2 (ECHIP)
EC-Council Certified Network Defender
EC-Council Certified Network Defense Architect (CNDP)
EC-Council Certified Solution Architect (ECSA)
EC-Council Computer Hacking Forensic Investigator (CHFI)
EC-Council Disaster Recovery Professional (EDRP)
EC-Council Licensed Penetration Tester (LPT)
Fortinet Network Security Expert (NSE) Level 1
Fortinet Network Security Expert (NSE) Level 2
Fortinet Network Security Expert (NSE) Level 3
GIAC Assessing and Auditing Wireless Networks
GIAC Certified Defending Advanced Threats (GDAT)
GIAC Certified Detection Analyst (GCDA)
GIAC Certified Enterprise Defender (GCED)
GIAC Certified Forensics Analyst (GCFI)
GIAC Certified Forensics Examiner (GCQF)
GIAC Certified Incident Handler (GCHI)
GIAC Certified Intrusion Analyst (GCIA)
GIAC Certified Penetration Tester (GPEN)
GIAC Certified Project Manager (GCPM)
GIAC Certified Web Application Defender
GIAC Certified Windows Security Administrator (GCWN)
GIAC Critical Controls Certifications (GCCC)
GIAC Cyber Threat Intelligence (GCTI)
GIAC Exploit Researcher and Advanced Penetration Tester (GWAPT)
GIAC Information Security Fundamentals (GISF)

GIAC Information Security Professional (GISP)
GIAC Mobile Device Security Analyst (GMOB)
GIAC Network Forensic Analyst (GNFA)
GIAC Python Coder (GPYC)
GIAC Reverse Engineering Malware (GREM)
GIAC Security Essentials (GSEC)
GIAC Security Expert (GSE)
GIAC Security Leadership (GSLC)
GIAC Systems and Network Auditor (GNSA)
GIAC Web Application Penetration Tester (GWAPT)
Google Associate Cloud Engineer
Google Certified Professional Cloud Architect
Google Cloud Certified - Professional Data Engineer
Google Cloud DevOps Engineer
Google Professional Cloud Developer
Google Professional Cloud Network Engineer
Google Professional Cloud Security Engineer
HDI Customer Service Representative
HDI Desktop Support Manager
HDI Desktop Support Technician
HDI Support Center Analyst
HDI Support Center Director
HDI Support Center Manager
HDI Support Center Team Lead
HDI Technical Support Professional
Help Desk Analyst: Tier 1 Support Specialist/Ed2Go
Help Desk Team Lead/RCCSP
Hitachi Qualified Professional - Storage Administration
HP Accredited Solutions Expert (ASE - all)
HP Accredited Technical Professional (ATP - all)
HP ASE - Storage Solutions V4
HP ATP - Hybrid IT Solutions V2
HP ATP - Storage Solutions V1 / V2
HP Master Accredited Solutions Expert (MASE - all)
HP Master ASE - Hybrid IT Solutions Architect V1
HP Master ASE - Storage Solutions Architect V3
Huawei Certified Network Associate (all)
Huawei Certified Network Professional (all)
Huawei Certified Network Expert (all)
IAPP Certified Information Privacy Professional
IBM Advanced Systems Administrator (all)
IBM Certified Administrator - Cognos Analytics
IBM Certified Application Developer - Cloud Solutions v3
IBM Certified Application Developer - DB2 9.7 for Linux, Unix and Windows
IBM Certified Application Developer (all)
IBM Certified Data Architect - Big Data
IBM Certified Data Engineer - Big Data
IBM Certified Database Administrator - DB2 11.1 for Linux, UNIX and Windows
IBM Certified Developer - Cognos Analytics
IBM Certified Professional Developer - Cloud v4
IBM Certified Professional SRE - Cloud v1
IBM Certified Solution Advisor - Blockchain Platform V2
IBM Certified Solution Advisor - DevOps V2
IBM Certified Solution Architect – Cloud v4
IBM Certified Solution Architect - Data Warehouse V1
IBM Certified Solution Designer (all)
IBM Certified Specialist - AI Enterprise Workflow V1
IBM Certified Systems Administrator:
WebSphere Application Server Network Deployment
IBM Certified Systems Administrator (all)
Information Systems Security Architecture Professional (ISSAP/CISSP)
Information Systems Security Engineering Professional (ISSEP/CISSP)
InfoSys Security Management Professional (ISSMP/CISSP)
ITIL Expert Certification
ITIL Foundation Certification
ITIL Intermediate Certification
ITIL Master Certification
JBoss Certified Developer (Seam, Persistence, ESB)
Juniper Networks Certified Internet Associate
Juniper Networks Certified Internet Professional
Juniper Networks Certified Internet Specialist
Linux Foundation Certified Engineer
Linux Foundation Certified System Administrator
Linux Professional Institute certification (LPIC-2)
Linux Professional Institute certification (LPIC-3)
Magento 2 Certified Professional Developer
Magento 2 Certified Associate Developer
McCSE: Core Infrastructure
Microsoft Certified Azure Administrator
Microsoft Certified Azure Administrator Associate
Microsoft Certified Azure AI Engineer Associate
Microsoft Certified Azure Data Engineer Associate
Microsoft Certified Azure Data Scientist Associate
Microsoft Certified Azure Developer Associate
Microsoft Certified Azure Fundamentals
Microsoft Certified Azure Security Engineer Associate
Microsoft Certified Azure Solutions Architect
Microsoft Certified Azure Solutions Architect Expert
Microsoft Certified DevOps Engineer Expert
Microsoft Certified Professional
Microsoft Certified Solutions Associate (all)
Microsoft Certified Solutions Associate: Biz Reporting
Microsoft Certified Solutions Associate: SQL 2016 DBA
Microsoft Certified Solutions Associate: SQL Server 2012/2014/2016
Microsoft Certified Solutions Associate: Web Applications
Microsoft Certified Solutions Associate: Windows Server 2012/2016
Microsoft Certified Solutions Developer (MCSD)
Microsoft Certified Solutions Developer: Applications Builder
Microsoft Certified Solutions Expert: Business Applications
Microsoft Certified Solutions Expert: Data Platform
Microsoft Certified Solutions Expert: Desktop Infrastructure
Microsoft Certified Solutions Expert: Server Infrastructure
Microsoft Certified Trainer (MCT)
Microsoft MTA: Windows OS
Microsoft Office Specialist
Mongo DB Certified DBA
Mongo DB Certified Developer
MongoDB Certified Developer Associate

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NetApp Certified Data Administrator, ONTAP (NCDA)
NetApp Certified Implementation Engineer (NCIE)
NetApp Certified Storage Associates – Hybrid Cloud
NetScout/nGenius Certified Analyst (nCA)
NetScout/nGenius Certified Associate (nCA)
NetScout/nGenius Certified Expert (nCE)
NetScout/nGenius Certified Specialist (nCS)
Novell Certified Administrator (CNA)
Novell Certified Novell Engineer (CNE)
Novell Certified Instructor
Novell Certified Linux Engineer (Novell CLE)
Novell Certified Linux Professional (Novell CLP)
Novell Identity Manager Administrator
Offensive Security Experience Penetration Tester (OSEP)
Offensive Security Exploitation Expert (OSEE)
Offensive Security Wireless Professional (OSWP)
Okta Certified Administrator
Okta Certified Consultant
Okta Certified Developer
Open Group Certified Architect (Open CA)
Open Group Certified IT Specialist (Open CITs)
Oracle Business Intelligence Foundation Suite 11G Certified Implementation Specialist
Oracle Certified Associate - DBA (OCA)
Oracle Certified Associate - Java SE Programmer
Oracle Certified Associate - MySQL 5
Oracle Certified Associate – WebLogic Server Administrator
Oracle Certified Expert - Java Platform EE Developer (all)
Oracle Certified Expert - MySQL 5.1 Cluster Database Administrator
Oracle Certified Expert - Siebel CRM Business Analyst
Oracle Certified Expert - Solaris 10 Network Administrator for Solaris
Oracle Certified Master - DBA (OCM)
Oracle Certified Master - Java EE Enterprise Architect
Oracle Certified Master - Java SE Developer
Oracle Certified Professional - Advanced PL/SQL Developer
Oracle Certified Professional - Application Server Administrator
Oracle Certified Professional - Database Cloud Administrator
Oracle Certified Professional - DBA (OCP)
Oracle Certified Professional - E-Business Suite Administrator
Oracle Certified Professional - Fusion Middleware 11g Forms Developer
Oracle Certified Professional - Java EE Web Component Developer
Oracle Certified Professional - Java EE Web Services Developer
Oracle Certified Professional - Java SE Programmer
Oracle Certified Professional - MySQL 5.x Database Administrator
Oracle Certified Professional - MySQL 5.x Developer
Oracle Certified Professional - PL/SQL Developer
Oracle Certified Professional - Solaris 10 Systems Administrator
Oracle Certified WebLogic Server System Administrator Certified Expert
Oracle Cloud Infrastructure 2021 Certified Architect Professional
Oracle Linux Certified Administrator (OCA)
Oracle SOA 12c Certified Implementation Specialist
Oracle VM 3.0 for x86 Certified Implementation Specialist
Pegasystems Certified Data Scientist
Pegasystems Certified Decisioning Consultant
Pegasystems Certified Lead System Architect
Pegasystems Certified Senior Systems Architect
Pegasystems Certified System Architect
Pegasystems Certified Pega Business Architect
Pegasystems Certified Robotics System Architect
PHP Certification
Pivot Application Architect
Pivot Cloud Foundry Operator certification
Pivot Developer
PMI Agile Certified Practitioner (PMI-ACP)
PMI Certified Associate in Project Management (CAPM)
PMI Portfolio Management Professional (PMP)
PMI Professional in Business Analysis (PMI-PBA)
PMI Program Management Professional (PgMP)
PMI Project Management Professional (PMP)
PMI Risk Management Professional (PMI-RMP)
Prince2 Foundation
Prince2 Practitioner
Professional Certified Investigator
Professional in Project Management (GAQM)
Qlik Sense Business Analyst
Qlik Sense Data Architect
Qualified Information Security Professional
QISP
Rackspace Certified Technician
Red Hat Certified Architect (RHCA)
Red Hat Certified Architect: Cloud
Red Hat Certified Architect: Enterprise Applications
Red Hat Certified Architect: Infrastructure
Red Hat Certified Engineer in Red Hat OpenStack
Red Hat Certified Engineer (RHCE)
Red Hat Certified Enterprise Application Developer
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)
SAFE Certification
Salesforce B2C Commerce Developer
Salesforce Certified Application Architect
Salesforce Certified Data Architecture and Management Designer
Salesforce Certified Integration Architecture Designer
Salesforce Certified Platform Developer
Salesforce Certified Systems Architect
Salesforce Certified Technical Architect
Salesforce Development Lifecycle and Deployment Designer
Salesforce Identity and Access Management Designer
Salesforce Platform App Builder
Salesforce.com Certified Administrator
Salesforce.com Certified Advanced Administrator
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 Professional: Advanced Programming/SAS 9.4
SAS Certified Specialist Base Programming/SAS 9.4
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®
SAS® Certified Professional: AI and Machine Learning
SAS® Certified Professional: Data Curation for SAS Data Scientists
SAS® Certified Specialist: Visual Business Analytics 7.5/8.3
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)
Splunk Core Certified User
SUSE Certified Administrator
SUSE Enterprise Engineer (SCE)
SUSE Enterprise Architect or (SEA)
Systems Security Certified Practitioner (SSCP)
Tableau Desktop Certified Professional
Tableau Server Certified Professional
Teradata 14 Certified Associate
Teradata 14 Certified Database Administrator
Teradata 14 Certified Database Developer

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567 Tech Certifications Reported

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 - Digital Workspace
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 Mgt and Automation Deployment
VMware Certified Advanced Professional 6/7 - Cloud Mgt and Automation Design
VMware Certified Design Expert – Network Virtualization
VMware Certified Design Expert - Cloud Mgt and Automation
VMware Certified Design Expert (all)
VMware Certified Design Expert 6 - Data Center Virtualization
VMware Certified Professional - Digital Workspace
VMware Certified Professional – Desktop Management 2021
VMware Certified Professional - Network Virtualization
VMware Certified Professional - Security 2021
VMware Certified Professional 6 - Data Center Virtualization (VCP6-DCV)
VMware Certified Professional 6.5 - Data Center Virtualization (VCP6.5-DCV)
VMware Certified Professional 6/6.5
VMware Certified Professional 6/7 - Cloud Mgt and Automation
VMware Certified Technical Associate - Data Center Virtualization
Zachman Certified Enterprise Architect
18-YEAR QUARTERLY IT CERTIFICATION PAY TRENDS BY CATEGORY

Average quarterly median cash pay premium for a single IT certification. Data through January 1, 2022 – 87,223 IT Professionals

Pay data supporting these charts available in the IT Skills and Certifications Pay Index™ – 4Q 2021 data edition
HIGHEST PAYING IT Certifications (cash pay premiums, all 567 certifications surveyed, ranked)

These IT certifications are among those earning the highest pay premiums (data collected October 1, 2021 to January 1, 2022). Shown in alphabetical order by overall market value rank in descending order including ties. **Green/Red** = increased/decreased in market value this quarter. **Purple** = Made the list this quarter for first time.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>[Tie] Certified Secure Software Lifecycle Professional (CSSLP)</td>
</tr>
<tr>
<td></td>
<td>Cisco Certified Architect</td>
</tr>
<tr>
<td>2.</td>
<td>[Tie] Certified Cloud Security Professional (ISC2-CCSP)</td>
</tr>
<tr>
<td></td>
<td>Certified Computer Examiner (CCE)</td>
</tr>
<tr>
<td></td>
<td>EC-Council Certified Encryption Specialist (ECES)</td>
</tr>
<tr>
<td></td>
<td>GIAC Security Expert (GSE)</td>
</tr>
<tr>
<td></td>
<td>GIAC Security Leadership (GSLC)</td>
</tr>
<tr>
<td></td>
<td>InfoSys Security Engineering Professional (ISSEP/CISSP)</td>
</tr>
<tr>
<td></td>
<td>Zachman Certified - Enterprise Architect</td>
</tr>
<tr>
<td>3.</td>
<td>[Tie] Certified Forensic Computer Examiner (CFCE)</td>
</tr>
<tr>
<td></td>
<td>Certified Manager of Software Quality (CMSQ)</td>
</tr>
<tr>
<td></td>
<td>Certified Scrum Master</td>
</tr>
<tr>
<td></td>
<td>Certified Scrum Professional</td>
</tr>
<tr>
<td></td>
<td>Cloudera Certified Professional: Data Engineer</td>
</tr>
<tr>
<td></td>
<td>CompTIA Cybersecurity Analyst+ (CySA+)</td>
</tr>
<tr>
<td></td>
<td>CyberSecurity Forensic Analyst (CSFA)</td>
</tr>
<tr>
<td></td>
<td>EC-Council Certified Ethical Hacker (CEH)</td>
</tr>
<tr>
<td></td>
<td>InfoSys Security Architecture Professional (ISSAP/CISSP)</td>
</tr>
<tr>
<td></td>
<td>Oracle Certified Master - DBA (OCM)</td>
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<tr>
<td></td>
<td>Oracle Certified Professional - DBA (OCP)</td>
</tr>
<tr>
<td></td>
<td>PMI Risk Management Professional (PMI-RMP)</td>
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<tr>
<td></td>
<td>SAS® Certified Advanced Analytics Professional Using SAS 9</td>
</tr>
<tr>
<td></td>
<td>Six Sigma Master Black Belt</td>
</tr>
<tr>
<td>4.</td>
<td>[Tie] Certified in Risk and Information Systems Control (CRISC)</td>
</tr>
<tr>
<td></td>
<td>Certified in the Governance of Enterprise IT (CGEIT)</td>
</tr>
<tr>
<td></td>
<td>Certified Information Security Manager (CISM)</td>
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<tr>
<td></td>
<td>Certified Information Systems Auditor (CISA)</td>
</tr>
<tr>
<td></td>
<td>Certified Information Systems Security Professional (CISSP)</td>
</tr>
<tr>
<td></td>
<td>Certified Scrum Product Owner</td>
</tr>
<tr>
<td></td>
<td>Check Point Certified Security Expert (CCSE)</td>
</tr>
<tr>
<td></td>
<td>Check Point Certified Security Master (CCSM)</td>
</tr>
<tr>
<td></td>
<td>Cisco Certified Network Professional - Security</td>
</tr>
<tr>
<td></td>
<td>Cloudera Certified Associate Data Analyst</td>
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<tr>
<td></td>
<td>GIAC Certified Forensics Analyst (GCFA)</td>
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<tr>
<td></td>
<td>GIAC Certified Penetration Tester (GPEN)</td>
</tr>
<tr>
<td></td>
<td>InfoSys Security Management Professional (ISSAP/CISSP)</td>
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<tr>
<td></td>
<td>Offensive Security Experienced Penetration Tester (OSEP)</td>
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<tr>
<td></td>
<td>Okta Certified Developer</td>
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<td>Pegasystems Certified Robotics System Architect 16</td>
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<tr>
<td></td>
<td>PMI Program Management Professional (PgMP)</td>
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<tr>
<td></td>
<td>Salesforce Certified Technical Architect</td>
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<tr>
<td></td>
<td>SAS Certified Data Scientist Using SAS 9</td>
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<tr>
<td></td>
<td>Systems Security Certified Practitioner (SSCP)</td>
</tr>
<tr>
<td></td>
<td>Teradata 14 Certified Master</td>
</tr>
<tr>
<td></td>
<td>TOGAF 9 Certified</td>
</tr>
</tbody>
</table>

SOURCE: Foote Partners IT Skills & Certifications Pay Index™, 4th Quarter 2021 data edition
IT CERTIFICATION PAY TREND HIGHLIGHTS: Market Value Gainers & Highest Paying – 4th Quarter 2021 data

These IT certifications gained 10% or more in market value in the three months ending January 1, 2022 vs. prior quarter (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>IT CERTIFICATION Gainers</th>
<th>Highest Paying – Cash Premiums (A-Z)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Info/Cyber Security certifications</strong></td>
<td>- Certified Cloud Security Professional (ISC2-CCSP)</td>
</tr>
<tr>
<td>GIAC Security Expert (GSE)</td>
<td>- Certified Computer Examiner (CCE)</td>
</tr>
<tr>
<td>Certified Penetration Testing Engineer (CPTE)</td>
<td>- Certified Forensic Computer Examiner (CFCE)</td>
</tr>
<tr>
<td>InfoSys Security Management Professional (ISSMP/CISSP)</td>
<td>- Certified Manager of Software Quality (CMSQ)</td>
</tr>
<tr>
<td>AWS Certified Security - Specialty</td>
<td>- Certified Scrum Master</td>
</tr>
<tr>
<td>Check Point Certified Security Administrator (CCSA)</td>
<td>- Certified Scrum Professional</td>
</tr>
<tr>
<td>GIAC Certified Intrusion Analyst (GCIA)</td>
<td>- Certified Secure Software Lifecycle Professional (CSSLP)</td>
</tr>
<tr>
<td>GIAC Certified Project Manager (GCPM)</td>
<td>- Cisco Certified Architect</td>
</tr>
<tr>
<td><strong>Networking and Communications certifications</strong></td>
<td>- Cloudera Certified Professional: Data Engineer</td>
</tr>
<tr>
<td>Avaya Certified Integration Specialist (ACIS)</td>
<td>- CompTIA Cybersecurity Analyst+ (CySA+)</td>
</tr>
<tr>
<td>Avaya Certified Design Specialist (ACDS)</td>
<td>- CyberSecurity Forensic Analyst (CSFA)</td>
</tr>
<tr>
<td>CWNP/Certified Wireless Network Expert (CWNE)</td>
<td>- EC-Council Certified Encryption Specialist (ECES)</td>
</tr>
<tr>
<td>Juniper Networks Certified Professional (JNCIP - all specializations)</td>
<td>- EC-Council Certified Ethical Hacker (CEH)</td>
</tr>
<tr>
<td><strong>Application Development/Programming Languages certifications</strong></td>
<td>- GIAC Security Expert (GSE)</td>
</tr>
<tr>
<td>IBM Certified Administrator - Cognos Analytics</td>
<td>- GIAC Security Leadership (GSLC)</td>
</tr>
<tr>
<td>IBM Certified Developer - Cognos Analytics</td>
<td>- InfoSys Security Architecture Professional (ISSAP/CISSP)</td>
</tr>
<tr>
<td>JBoss Certified Developer (Seam, Persistence, ESB)</td>
<td>- InfoSys Security Engineering Professional (ISSEP/CISSP)</td>
</tr>
<tr>
<td>Microsoft Certified Solutions Developer (MCSD)</td>
<td>- Oracle Certified Master - DBA (OCA)</td>
</tr>
<tr>
<td>Pivotal Application Architect</td>
<td>- Oracle Certified Professional - DBA (OCM)</td>
</tr>
<tr>
<td></td>
<td>- PMI Risk Management Professional (PMI-RMP)</td>
</tr>
<tr>
<td></td>
<td>- SAS® Certified Advanced Analytics Professional Using SAS 9</td>
</tr>
<tr>
<td></td>
<td>- Six Sigma Master Black Belt</td>
</tr>
<tr>
<td></td>
<td>- Zachman Certified - Enterprise Architect</td>
</tr>
<tr>
<td><strong>Systems Administration certifications</strong></td>
<td></td>
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<tr>
<td>SUSE Certified Administrator</td>
<td></td>
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<tr>
<td>SUSE Enterprise Architect (SEA)</td>
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<tr>
<td>SUSE Enterprise Engineer (SCE)</td>
<td></td>
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<tr>
<td>Red Hat Certified Engineer (RHCE)</td>
<td></td>
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<tr>
<td>Red Hat Certified Architect: Cloud</td>
<td></td>
</tr>
<tr>
<td><strong>Architecture, Project Management, and Process Certifications</strong></td>
<td></td>
</tr>
<tr>
<td>IBM Certified Solution Architect - Data Warehouse V1</td>
<td></td>
</tr>
<tr>
<td><strong>Data/Database certifications</strong></td>
<td></td>
</tr>
<tr>
<td>Oracle Certified Associate - DBA (OCA)</td>
<td></td>
</tr>
<tr>
<td>Oracle Certified Master - DBA (OCM)</td>
<td></td>
</tr>
<tr>
<td>Dell Data Science Associate (DCA-DS)</td>
<td></td>
</tr>
<tr>
<td>Cloudera Certified Associate Data Analyst</td>
<td></td>
</tr>
<tr>
<td>Cloudera Certified Professional: Data Engineer</td>
<td></td>
</tr>
</tbody>
</table>

Source: Foote Partners IT Skills & Certifications Pay Index™, 4th Quarter 2021 data edition
**IT CERTIFICATION PAY TREND HIGHLIGHTS: Market Value Losers – 4th Quarter 2021 data**

These IT certifications **declined 10% or more in market value in the three months ending January 1, 2022** vs. prior quarter (seen below grouped by segment). **Listed in descending order of amount of % decline in cash pay premium**, including ties.

### IT CERTIFICATIONS Losers

<table>
<thead>
<tr>
<th><strong>Application Development/Programming Languages</strong></th>
<th><strong>Systems Administration certifications</strong></th>
<th><strong>Networking and Communications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Magento 2 Certified Professional Developer</td>
<td>Citrix Certified Associate - Virtualization</td>
<td>Cisco Certified Network Associate - Data Center</td>
</tr>
<tr>
<td>AWS Certified DevOps Engineer – Professional</td>
<td>Citrix XenServer Certified (CC-XenServer)</td>
<td>Cisco Certified Network Associate (was CCNA Wireless)</td>
</tr>
<tr>
<td></td>
<td>Citrix Certified Professional - Networking</td>
<td>Cisco Certified Network Associate (was Design Associate)</td>
</tr>
<tr>
<td></td>
<td>Linux Foundation Certified Engineer</td>
<td>Cisco Certified Network Professional - Data Center (CCNP Cloud)</td>
</tr>
<tr>
<td><strong>Info/Cyber Security certifications</strong></td>
<td>Linux Foundation Certified System Administrator</td>
<td>Cisco Certified Network Professional - Enterprise (was CCNP Wireless)</td>
</tr>
<tr>
<td>Cisco Certified Network Professional - Security</td>
<td>Citrix Certified Expert - Networking</td>
<td>CWNP/Certified Wireless Network Administrator (CWNA)</td>
</tr>
<tr>
<td>Cisco Certified CyberOps Associate</td>
<td>Linux Professional Institute certification (LPIC-Level 2)</td>
<td></td>
</tr>
<tr>
<td>CompTIA PenTest (CPT+)</td>
<td>Linux Professional Institute certification (LPIC-Level 3)</td>
<td></td>
</tr>
<tr>
<td>Okta Certified Professional</td>
<td>RedHat Certified Specialist in Virtualization</td>
<td></td>
</tr>
<tr>
<td>Okta Certified Consultant</td>
<td>VMware Certified Advanced Professional 6.5 - Data Center</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Virtualization Design</td>
<td></td>
</tr>
<tr>
<td><strong>Architecture, Project Management, and Process Certifications</strong></td>
<td>AWS Certified SysOpsAdministrator-Associate (Cloud)</td>
<td></td>
</tr>
<tr>
<td>Certification of Capability in Business Analysis (CCBA)</td>
<td>Red Hat Certified Systems Administrator (RHCSA)</td>
<td></td>
</tr>
<tr>
<td>PMI Agile Certified Practitioner (PMI-ACP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PMI Certified Associate in Project Management (CAPM)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certified Business Analysis Professional (CBAP)</td>
<td></td>
<td></td>
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<tr>
<td>ITIL Master</td>
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<td></td>
</tr>
</tbody>
</table>

### General/Foundation and Training Certifications

<table>
<thead>
<tr>
<th><strong>Certifications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>CompTIA A+</td>
</tr>
</tbody>
</table>

Source: Foote Partners *IT Skills & Certifications Pay Index™*, 4th Quarter 2021 data edition
B. IT CERTIFICATIONS LEADING THE NEW RESURGENCE: Paying well above average + gaining the most in market value

As a group, the 567 IT certifications tracked in our IT Skills and Certifications Pay Index™ had declined in market value every calendar quarter since 3rd quarter 2018—until the past two quarters, when they grew by more than a half of a percent on average. That doesn't sound like much but keep in mind that a long-term sustained negative trend has been reversed. So which IT certifications can be singled out as leading this new trend?

The following IT certifications meet two prerequisites:

- First, they recorded substantial gains in cash market value in the six months ending January 1, 2022.
- Second, they earned workers cash pay premiums well above the average of all 567 certifications in our IT Skills and Certifications Pay Index™.

No IT certification that follows is earning less than the equivalent of 9 percent of base salary—significant considering the average for all skills reported is 6.6 percent of base—and every certification listed below grew between 9 percent and 30 percent in cash market value in the six months ending January 1st. They are listed in descending ranked order of market value gain (including ties).

<table>
<thead>
<tr>
<th>Certification</th>
<th>Market Value Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified Penetration Testing Engineer (CPTE)</td>
<td>30 percent</td>
</tr>
<tr>
<td>Certified Scrum Product Owner</td>
<td>30 percent</td>
</tr>
<tr>
<td>Certified Scrum Professional</td>
<td>30 percent</td>
</tr>
<tr>
<td>Certified Secure Software Lifecycle Professional (CSSLP)</td>
<td>30 percent</td>
</tr>
<tr>
<td>Cloudera Certified Associate Data Analyst</td>
<td>30 percent</td>
</tr>
<tr>
<td>GIAC Certified Forensics Analyst (GCFA)</td>
<td>30 percent</td>
</tr>
<tr>
<td>GIAC Certified Forensics Examiner (GCFE)</td>
<td>30 percent</td>
</tr>
<tr>
<td>GIAC Certified Penetration Tester (GPEN)</td>
<td>30 percent</td>
</tr>
<tr>
<td>InfoSys Security Management Professional (ISSMP/CISSP)</td>
<td>30 percent</td>
</tr>
<tr>
<td>Okta Certified Administrator</td>
<td>30 percent</td>
</tr>
<tr>
<td>Oracle Certified Professional - DBA (OCP)</td>
<td>30 percent</td>
</tr>
<tr>
<td>Oracle Certified Professional - DBA (OCP)</td>
<td>30 percent</td>
</tr>
<tr>
<td>Pegasystems Certified Data Scientist</td>
<td>30 percent</td>
</tr>
<tr>
<td>Pegasystems Certified Robotics System Architect</td>
<td>30 percent</td>
</tr>
<tr>
<td>Salesforce Certified Application Architect</td>
<td>30 percent</td>
</tr>
<tr>
<td>Salesforce Certified Technical Architect</td>
<td>30 percent</td>
</tr>
<tr>
<td>SAS Certified Big Data Professional Using SAS 9</td>
<td>30 percent</td>
</tr>
<tr>
<td>SAS® Certified Advanced Analytics Professional Using SAS 9</td>
<td>30 percent</td>
</tr>
<tr>
<td>Systems Security Certified Practitioner (SSCP)</td>
<td>30 percent</td>
</tr>
</tbody>
</table>

1. Certified Secure Software Lifecycle Professional (CSSLP)

**Market Value Increase:** 30 percent (in the six months through January 1, 2022)

Like other certifications from the Information Security Consortium (ISC2), the Certified Secure Software Lifecycle Professional 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. There is one required exam that 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, operations and maintenance, along with supply chain and software acquisition. Prerequisites include at least four years’ full-time work-related experience in the software development lifecycle (in at least one of the 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.
IT CERTIFICATIONS ANALYSIS – Winners, cont’d.

Certified Penetration Testing Engineer (CPTE)

*Market Value Increase:* 28.6 percent (in the six months through January 1, 2022)

Professionals whose workdays (or career aspirations) revolve more around managing data and platforms rather than deep statistics, analysis and modeling will gravitate to data management credentials like the *SAS Certified Big Data Professional Using SAS 9*. This credential is designed for professionals who conduct statistical analyses using SAS and open source data-management tools. It requires passing two separate exams: (1) Big Data Preparation, Statistics and Visual Exploration, and (2) SAS Big Data Programming and Loading. Successful candidates will be able to:

- Recognize and overcome big data challenges.
- Implement critical SAS programming techniques.
- Access, transform and manipulate data.
- Improve data quality for reporting and analytics.
- Apply fundamental statistical techniques.
- Work with SAS, Hadoop and Hive.
- Explore and visualize data.

**Certified Penetration Testing Engineer** is an internationally recognized cyber security certification administered by the Mile2. The accreditation maps to the Committee on National Security Systems’ 4013 education certification. The CPTE certification is considered one of five core cyber security certifications. Obtaining it requires proven proficiency and knowledge of five key information security elements: penetration testing, data collection, scanning, enumeration, exploitation and reporting. The CPTE certification is one of several information assurance accreditations recognized by the U.S. National Security Agency. The certification has also been approved by the U.S. Department of Homeland Security’s National Initiative for Cyber Security Studies and Careers (NICSS) and the U.S.-based National Security Systems Committee.


*Market Value Increase:* 25 percent (in the six months through January 1, 2022)

Despite corporate America and the U.S. government sounding the cybersecurity alarm bell for years, there’s a significant shortage of skilled information security professionals globally. Although numbers vary among various sources, a conservative estimate is that the number of unfilled cybersecurity jobs grew by 350 percent in the last eight years, from one million positions in 2013 to 3.5 million in 2021. In the U.S. alone the cybersecurity workforce has more than 950,000 open and 465,000 of them yet to be filled.

Almost every day, around 10,000 positions are available on U.S. job sites that request a Certified Information Systems Security Professional (CISSP). This clearly points to a need for skilled infosec workers, and CISSPs in particular, which is great news for aspiring CISSP candidates. A CISSP is a seasoned employee or consultant, usually with a title such as security manager, security analyst or chief information security officer, to name just a few. This person has been on the job for five or more years, and has thorough knowledge of the IT threat landscape, including emerging and advanced persistent threats, as well as controls and technology to minimize attack surfaces. A CISSP also creates policies that set a framework for proper controls and can perform or oversee risk management and software development security.

The **Information Systems Security Management Professional** shows excellence at establishing, presenting and governing information security programs, demonstrating deep management and leadership skills whether you’re leading incident handling and/or a breach mitigation team. It allows CISSPs to concentrate further in security management areas and stresses the following elements of the CBK: Enterprise security management practices; enterprise-wide system development security; overseeing compliance of operations security; understanding BCP, DRP and continuity of operations planning (COOP); law, investigations, forensics and ethics. A CISSP-ISSMP certification is ideal for those working in roles such as: Chief information officer; Chief information security officer; Chief technology officer; Senior security executive.
5. [Tie] SAS® Certified Advanced Analytics Professional Using SAS 9
   Certified Scrum Professional
   Oracle Certified Professional - DBA (OCP)
   
   Market Value Increase: 22.2 percent (in the six months through January 1, 2022)

SAS Advanced Analytics credentials are designed for SAS professionals who gather, manipulate, and analyze big data using SAS tools, run reports and make business recommendations based on complex models. The SAS Certified Advanced Analytics Professional Using SAS 9 certification uses predictive modeling and statistical analysis methods and techniques to analyze big data sets. Candidates must pass three exams:

- Predictive Monitoring Using SAS Enterprise Miner 7, 13 or 14
- Advanced Predictive Modeling
- Text Analytics, Time Series, Experimentation and Optimization

The Certified Scrum Professional (CSP) is an advanced certification that indicates the recipient is both knowledgeable and experienced in the practical and theoretical use of Scrum. These certificants challenge their teams to improve the way Scrum and Agile principles are applied. They have demonstrated experience, documented training, and proven knowledge in Scrum. Therefore, candidates must already have obtained one or more of the foundational Scrum certifications: Certified Scrum Master (CSM), Certified Scrum Product Owner (CSPO), Certified Scrum Developer (CSD). Moreover, to qualify for the CSP certification you need to demonstrate “a minimum of 36 months of successful Agile/Scrum work experience gained within the past 5 years implementing Scrum inside organizations as team member, product owner, ScrumMaster, or “Other.” Becoming a CSP is not just a matter of book knowledge crammed before a test. Rather, it’s a formal acknowledgment of both the knowledge and the experience you have applying that knowledge in real-world Agile environments.

With the 12c release, Oracle Certified Professional – DBA has been re-engineered for cloud computing. This includes a multitenant architecture, enterprise hardware and software efficiencies, performance and manageability benefits, and fast and efficient cloud provisioning. Building upon the competencies in the Oracle Database 12c OCA certification, the Oracle Certified Professional for Oracle Database 12c includes the advanced knowledge and skills required of top-performing database administrators, including development and deployment of backup, recovery and Cloud computing strategies.

8. [Tie] GIAC Certified Forensics Examiner (GCFE)
   Okta Certified Administrator
   Pegasystems Certified Data Scientist
   Salesforce Certified Application Architect
   
   Market Value Increase: 12.5 percent (in the six months through January 1, 2022)

SANS is the organization behind the Global Information Assurance Certification (GIAC) program. It is a well-respected and highly regarded player in the information security field in general. SANS not only teaches and researches in this area, but it also provides breaking news, operates a security alert service, and serves on all kinds of government, research and academic information security task forces, working groups, and industry organizations.

The intermediate-level GIAC Certified Forensics Examiner (GCFE) certification focuses on computer forensics in the context of investigation and incident response, and thus also focuses on the skills and knowledge needed to collect and analyze data from Windows and/or Linux computer systems during such activities. 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:
IT CERTIFICATIONS ANALYSIS – Winners, 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, Wованware, SQLite, ESEDatabaseView and Hindsight)

Candidates must possess the necessary skills, knowledge, and ability to conduct formal incident investigations and advanced incident handling, including dealing with internal and external data breaches, intrusions, and cyberthreats; collecting and preserving evidence; understanding anti-forensic techniques; and building and documenting advanced digital forensic cases.

Okta certified professionals possess knowledge about secure identity management and mobility concepts. They have hands-on experience completing day-to-day operational tasks to support users of the Okta service and have familiarity with Okta technology and processes related to simple directory integration, single sign on federation, and application provisioning aspects of User Life Cycle Management.

Those holding the **Okta Certified Administrator** credential are technically proficient at managing the Okta service. They have extensive knowledge about how Okta enables advanced User Lifecycle Management scenarios involving mobile devices, security policy frameworks, supported SSO options, and advanced directory integration for cloud and on-premises access. Okta Certified Administrators use the Okta Policy framework to control user access, understand how to map identity attributes and data transformations using Universal Directory, and troubleshoot issues.

Pegasystems develops software for customer relationship management (CRM), digital process automation, and business process management (BPM). The Pegasystems Professional Certification Program attests to individuals having the appropriate skills and body of knowledge to be a primary contributor for a successful Pega implementation and roll-out. The **Pega Certified Data Scientist** certification is for data scientists who wish to acquaint themselves with the skills and knowledge needed to successfully apply the AI in Pega Customer Decision Hub. This credential ensures the candidate is familiar with Pega’s Next-Best-Action paradigm and has the skills to build and simulate decision strategies and use predictive, adaptive and text analytics in those strategies.

Salesforce.com is one of the top vendors of customer relationship management (CRM) products for all size companies but especially for small businesses. You’ll find Salesforce products and services in use across a wide swath of industries, from automotive and healthcare, to nonprofits, retail, media and communications, and finance. Initially offered as sales automation software, Salesforce is now best known for its Intelligent Customer Success Platform, which provides cloud solutions for sales, communities, service, analytics, marketing, platform, apps, the internet of things (IoT) and artificial intelligence.

The senior-level **Salesforce Certified Application Architect** has a deep understanding of native Salesforce features and functionality, as well as the ability to model a role hierarchy, data model, and appropriate sharing mechanisms. It is recommended that candidates have 5 or more years of Salesforce experience and they must have already achieved these Salesforce certifications: Certified Platform Developer I, Certified Platform Application Builder, Certified Data Architecture and Management Designer, and Certified Sharing and Visibility Designer.

12. [Tie] **Certified Scrum Product Owner**
   - Cloudera Certified Associate Data Analyst
   - GIAC Certified Forensics Analyst (GCFA)
   - GIAC Certified Penetration Tester (GPEN)
   - Pegasystems Certified Robotics System Architect
   - Salesforce Certified Technical Architect
   - Systems Security Certified Practitioner (SSCP)

   **Market Value Increase:** 11.1 percent (in the six months through January 1, 2022)

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® helps the Scrum Team work together to learn and implement Scrum, as a Certified Scrum Product Owner® you create the product vision; write or participate 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® or receives private coaching from a Certified Agile Coach.

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

Candidates for Cloudera Certified Associate Data Analyst certification are typically SQL developers, data analysts, business intelligence specialists, developers, system architects, and database administrators. The exam for this certification was created to identify talented SQL developers looking to stand out and be recognized, and this is tapping into job market demand that has driven up pay premiums. Candidates are given eight to twelve customer problems with a unique large data set, a CDH cluster, and 120 minutes to analyze the problem and arrive at an optimal approach given the time allowed. For each problem, a technical solution must be implemented with a high degree of precision that meets all the requirements, therefore candidates must possess sufficient knowledge to succeed.

The GIAC Certified Forensics Analyst focuses on computer forensics in the context of investigation and incident response, and thus also focus on the skills and knowledge needed to collect and analyze data from Windows and/or Linux computer systems during such activities. It certifies that candidates have the knowledge, skills, and ability to conduct formal incident investigations and handle advanced incident handling scenarios, including internal and external data breach intrusions, advanced persistent threats, anti-forensic techniques used by attackers, and complex digital forensic cases. The GCFA certification focuses on core skills required to collect and analyze data from Windows and Linux computer systems.

GCFAs are front line investigators during computer intrusion breaches across the enterprise. They can help identify and secure compromised systems even if the adversary uses anti-forensic techniques. Using advanced techniques such as file system timeline analysis, registry analysis, and memory inspection, GCFAs are adept at finding unknown malware, rootkits, and data that the intruders thought had been eliminated from the system.

Areas of expertise covered in this certification include:
- Advanced Incident Response and Digital Forensics
- Memory Forensics, Timeline Analysis, and Anti-Forensics Detection
- Threat Hunting and APT Intrusion Incident Response

These are the most common roles for GPEN certifications:
- Incident Response Team Members - Federal Agents and Law Enforcement Professionals
- Threat Hunters - Red Team Members, Penetration Testers, and Exploit Developers
- SOC Analysts - GCFE and GCIH Cert Holders
- Experienced Digital Forensic Analysts - Information Security Professionals
- Information Security Professionals - Forensics

The GIAC Certified Penetration Tester 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.
The **GIAC Certified Penetration Tester 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.

Areas of expertise covered in the 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 and Blue Team members
- Defenders, auditors, and forensic specialists who want to better understand offensive tactics

Pegasystems develops software for customer relationship management (CRM), digital process automation, and business process management (BPM). The **Pegasystems Professional Certification Program** attests that individuals have the appropriate skills and body of knowledge to be a primary contributor for a successful Pega implementation and roll-out.

The **Pegasystems Certified Robotics System Architect (PCRSA)** credential is for system architects and software developers who are looking to enhance their skills in robotic automation and workforce intelligence. They have the basic functionality, process flow, terminology, and core building blocks of Pega Robot Studio and know how to integrate robotic automations with Windows and web applications and how to use debugging tools to test solutions.

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.

There are eleven Salesforce architect credentials, including the Salesforce Certified Application Architect mentioned earlier in this report. The **Salesforce Certified Technical Architect** is arguably the crème de la crème of the Salesforce architect portfolio. This pinnacle credential recognizes professionals who implement and design custom customer solutions on the Force.com platform, a more specialized platform as a service (PaaS) built specifically to integrate custom apps with Salesforce cloud offerings. Certificants must demonstrate the knowledge, skills, and capabilities to design and build high-performance technical solutions on the Salesforce platform across all areas of domain expertise. They 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 that maximize the potential of the Salesforce.

To obtain this designation, you must first earn the other two domain architecture credentials (Salesforce Certified Application Architect, Salesforce Certified System Architect). At that point, you are qualified to take the Salesforce Certified Technical Architect Certification Review Board Exam. During the exam, you will be provided with a hypothetical scenario, with detailed customer requirements, and be asked to present and justify your recommended architecture solution. Candidates must complete each task in order and may not move on to the next item until the prior task has been successfully completed.

The **Systems Security Certified Practitioner (SSCP)** certification demonstrates advanced technical skills and knowledge to implement, monitor and administer IT infrastructure using security best practices, policies and procedures established by the cybersecurity experts at (ISC)². It is aimed at IT administrators, managers, directors, and network security professionals responsible for the hands-on operational security of their organization’s critical assets, specifically: Database Administrators; Network Security Engineers; Security Administrators; Security Analysts; Security Consultants/ Specialists; Systems Administrators; Systems Engineers; and Systems/Network Analysts.
To qualify for the SSCP, candidates must pass an exam and have at least one year of cumulative, paid work experience in one or more of the seven domains of the (ISC)² SSCP Common Body of Knowledge (CBK®), which are also tested and evaluated in the exam itself:

- Domain 1: Access Controls
- Domain 2: Security Operations and Administration
- Domain 3: Risk Identification, Monitoring and Analysis
- Domain 4: Incident Response and Recovery
- Domain 5: Cryptography
- Domain 6: Network and Communications Security
- Domain 7: Systems and Application Security

A candidate who does not yet have the required experience to become a SSCP may become an Associate of (ISC)² after successfully passing the SSCP exam. The Associate of (ISC)² will then have two years to earn the experience needed for SSCP certification.
IT CERTIFICATIONS ANALYSIS – Losers

IT CERTIFICATIONS THAT HAVE LOST THE MOST MARKET VALUE: Last 2 years

The average market value for 567 tech certifications may have increased in each of the last two calendar quarters, the first increases in several years. But this doesn’t obviate the fact that they have been on a steady decline for much of the past several years.

The following tech certifications lost the most in cash market value in the 24 months ending January 1, 2022.

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 other 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 (or less) 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 is 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 frequently 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.

LOsing GROUND: Listed below in descending order of 24-month percent market value decline, grouped alphabetically in cases of a tie. Loss range: -33% to -60%

- Citrix Certified Associate - Virtualization
- IBM Certified Administrator - Cognos Analytics
- [Tie] GIAC Systems and Network Auditor (GSNA)
  NetApp Certified Data Administrator, ONTAP (NCDA)
- HDI Desktop Support Manager
- [Tie] Citrix XenServer Certified (CC-XenServer)
  EC-Council Certified Security Analyst (ECSA)
  HP ATP - Storage Solutions V1 /V2
- [Tie] CompTIA Mobile App Security+
  HDI Desktop Support Technician
  Six Sigma Master Black Belt
- [Tie] Certified Business Analysis Professional (CBAP)
  CompTIA PenTest (CPT+)
- [Tie] Avaya Certified Integration Specialist (ACIS)
  Certified in Governance, Risk and Compliance
  Check Point Certified Security Expert (CCSE)
  Citrix Certified Expert - Virtualization
  EC-Council Certified Network Defense Architect (CNDA)
  Microsoft Certified Solutions Associate: SQL Server 2012/2014/2016
  Microsoft Certified Trainer (MCT)
  Novell Identity Manager Administrator
  Oracle Certified Professional - Fusion Middleware 11g Forms Developer
  PMI Professional in Business Analysis (PMI-PBA)
  Prince2 Practitioner
  SUSE Enterprise Engineer (SCE)
  TIBCO Certified Professional
2022 IT Skills & Certifications Volatility Index™
(Data collected through January 1, 2022)
Demand dynamics in benchmarked certified and non-certified IT skills pay

What is skills and certifications volatility?
Skills volatility is defined as the incidence of gains or declines in premium pay earned by tech professionals for specific certified and noncertified technical and business skills. Tracking volatility is useful for both analyzing and forecasting demand for skills, for monitoring IT workforce transition, and for understanding IT management decision making. Volatility offers valuable insights that salary movements and hiring behavior do not. Important in this distinction is that skills can be segmented and benchmarked more meaningfully than jobs. Similar to IT positions, there are the broad categories (e.g., security, networking, systems, database, applications development). But also, more narrow areas, for example—web/e-commerce development, storage area networking, virtualization, architecture, business process, project management, methodology. But unlike most jobs, within categories or niche are very specific vendor-specific or vendor independent niches and skill specializations that provide more granular analysis (e.g., SAP, AJAX, Ruby on Rails, Microsoft Sharepoint, collaboration appliances, Oracle database).
**TRENDS**

### Cash Pay Premium Volatility for IT Skills and Certifications

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 October 1, 2021 to January 1, 2022 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.

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**Current Quarterly Recap (data collected through January 1, 2022)**

**TOTAL: All Skills and Certifications**

- **22.4%** of skills and certifications (266 of 1,185) changed in market value in 4th Quarter 2021 compared to 26.7% in the prior quarter. Average volatility in the prior year 2020 measured **27.3%**.
- **110** gained value and **156** declined in value in the 4th quarter of 2021 compared to 142 and 171, respectively, in the prior quarter—a significant change from the prior quarter’s pay performance.

**CERTIFIED SKILLS**

- **11.5%** of reported certifications (64 of 555) changed market value in 4th Quarter 2021, dramatically lower than the **21.4%** volatility in the prior quarter in which 117 certs changed value.
- **27** certifications gained market value; **37** declined in value in Q4 compared to 62 and 55, respectively, in the prior quarter—a significant change in volatility.

**NON-CERTIFIED SKILLS**

- **32.1%** of reported skills (202 of 630) changed value in 4th Quarter 2021, slightly higher than the **31.4%** volatility in the prior quarter. Compare this to average volatility of **33.5% for the 2020 calendar year**.
- **83** noncertified skills gained in market value; **119** declined in value in the 4th Quarter compared to 79 and 116, respectively, in the prior quarter.

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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.

Quarterly volatility for all 1,209 certified and non-certified skills in the last two years has been widely variable, in the 17% to 28% range. This is an important shift trend 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 AI/Machine Learning, Data Analytics 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 news release.*
VOLATILITY HIGHLIGHTS - 15 Year Trending

IT Skills and Certifications Volatility Index™ – 1,209 Skills and Certifications

Recent IT skills and certifications volatility trends

QUARTERLY SUMMARY

4th Quarter 2021 volatility in skills and certifications values is four points lower than the prior quarter, primarily the result of a significant decline in certifications volatility.

NONCERTIFIED SKILLS VOLATILITY in 4Q 2021 (32.1%) was virtually unchanged from the prior quarter (31.4%) but still lower than the average volatility in the 2000 calendar year (33.5%).

IT CERTIFICATIONS VOLATILITY in 4Q 2021 fell dramatically, to 11.5% from 21.4% in the prior quarter. This is lowest rate since 3rd quarter 2019.

(Pay data supporting these charts available in the IT Skills and Certifications Pay Index™ – 2007 to 2021 quarterly data edition)
VOLATILITY HIGHLIGHTS  IT Certifications – 4th Quarter 2021 data

### VOLATILITY INDEX: How Many of 567 IT Certifications Changed Market Value in 4th Quarter 2021?

<table>
<thead>
<tr>
<th>Category</th>
<th>% of Certifications</th>
<th>% Changed Market Value (Gain or Decline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture/Project Management/Process</td>
<td>1.4%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Info/Cyber Security</td>
<td>7.4%</td>
<td>13.9%</td>
</tr>
<tr>
<td>System Admin &amp; Engineering</td>
<td>4.1%</td>
<td>14.8%</td>
</tr>
<tr>
<td>Networking &amp; Communications</td>
<td>3.8%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Web Development</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Data/Database</td>
<td>0.0%</td>
<td>8.3%</td>
</tr>
<tr>
<td>Apps Development/Prog. Languages</td>
<td>13.1%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Beginner and Training</td>
<td>5.0%</td>
<td>12.5%</td>
</tr>
<tr>
<td>ALL CERTIFICATIONS SURVEYED</td>
<td>4.9%</td>
<td>11.5%</td>
</tr>
</tbody>
</table>

(Source: Foote Partners LLC, [2021 IT Skills & Certifications Pay Index™](https://footepartners.com/)

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**IT Skills and Certifications Volatility Index™**

4Q 2021 data edition findings: Tech Certifications

#### Certifications Volatility Highlights

Among all 567 certifications surveyed, highest volatility (>10%) occurred in these segments (ranked highest to lowest):

- Systems Admin & Engineering
- Info/Cybersecurity
- Beginner & Training
- Networking & Communication
- Applications Development
- Architecture/Project Mgt/Methodology

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

- Data/Database
- Info/Cybersecurity
- Applications Development

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

- Beginner & Training
- Systems Admin & Engineering
- Architecture/Project Mgt/Methodology

(Pay data supporting these charts available in the IT Skills and Certifications Pay Index™ – 2007 to 2021 quarterly data edition)
Non-certified IT Skills – 4th Quarter 2021 data

Among all 642 non-certified IT skills surveyed, high volatility (>20%) occurred in all but one segment (ranked highest to lowest):

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

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

- Management/Methodology/Process
- Operating Systems

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

- Messaging and Communications
- Applications Development Tools & Platforms
- SAP & Enterprise Business Apps
- Systems/Networking
- Web/E-commerce Development

(Pay data supporting these charts available in the IT Skills and Certifications Pay Index™ – 2007 to 2021 quarterly data edition)
2022 IT Skills and Certifications Pay Index™ (4th Quarter data edition)

- Pay premiums for **1,209 certified and noncertified IT skills**
  - Three data points for each position: 10th, 50th, 90th percentile
- Verified and validated IT skills pay data from **87,223 IT professionals at 3,934 employers** in US and Canada
- Current data collected through January 1, 2022 (updated quarterly)
- Excel format data tables allowing for data loading into third-party data analytics tools from PayScale, MarketPay, PayFactors, CompAnalyst, WillisTowersWatson, Mercer, et. al.
- 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 360,794 tech professionals at 3,934 employers in 83 U.S. and Canada cities are reported for IT salaries and skills pay earned for 255 positions and 1,209 certified and noncertified technical and business skills. Verified and validated pay data for 87,223 tech workers has been included in the 4th Quarter 2021 data edition of the ITSCPI, compiled from data collected through January 1, 2022.

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 2022 IT Compensation Survey Product Map

**Survey Demographics**
- 65 US/18 Canadian cities (360,794 IT workers~3,934 employers)
- 174 Europe/UK cities (189,888 IT workers, 2,065 employers)
- 46+ industries
- Updated continuously.

**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-form Job Descriptions**
- updated continuously
- comprehensive, includes internal/external relationships key to job success; skills and certification; detailed experience factors.

**Short-form Job Profiles**
- JD excerpts

**IT Infrastructure Survey**
- IT Base Positions Survey

**IT Professional Salary Survey**
(255 Jobs, 36 IT job families)

**IT Skills & Certification Pay Index™**
(1,209 skills/certs)

**IT Skills Demand and Pay Trends Report**

**IT Skills HOT LISTS Forecast**

**IT Skills Volatility Index**

**IT Salary+Skills Pay Survey Reports**

**Salary+Skills Reports Available**
- Applications Development
- Big Data
- Business Analyst/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/I-net
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.

Headquarters:

4445 North A1A, Suite 200
Vero Beach, FL 32963
Tel: 772-234-2787
www.footepartners.com
Twitter: @FPview
Blog: Tech People Architecture