FOR IMMEDIATE RELEASE

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NOTE: This news release is a summary extract of content from the 4th Quarter 2021 update edition of both the Foote Partners' *2021 IT Skills Demand and Pay Trends Report* and *2021 IT Skills and Certification Volatility Index*, two market intelligence trend reports updated every 3 months from data contributed by 3,866 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[TM]* and deep-dive supply/demand benchmark analysis from Foote Partners field interviews.

Average market value for 630 noncertified tech skills decreased slightly in the third quarter of 2021 compared to the prior quarter, with 195 (31 percent) changing in value—less than the 33 percent average quarterly price volatility in the 2020 calendar year.

Growth in pay premiums for Management/Methodology/Process and Web/eCommerce skills kept the averages from slipping further.

November 26, 2021 – Vero Beach, FL. Extra pay awarded by employers to talented tech professionals for **630 noncertified tech skills** ---also known as cash pay premiums---decreased slightly in the third calendar quarter of 2021, contributing to a 2.1 percent overall decline in the last twelve months. The current average for a single skill is the equivalent of 9.4 percent of base salary.

Conversely, average market values for **555 tech certifications** increased for the first time since 2nd Quarter 2018, up 0.4 percent, for the equivalent of 6.6 percent of base salary on average for a single certification. **Still, certifications have lost nearly 9 percent of market value on average over the past two years.**

This according to the latest quarterly update of Foote Partners' *IT Skills and Certifications Pay Index[TM]* (ITSCPI) based on compensation data provided by 3,866 private and public-sector employers in 83 U.S. and Canadian cities who partner with the firm to report pay for their 350,849 technology professionals in the U.S. and Canada.

Since its launch in 1999, the *IT Skills and Certifications Pay Index[TM]* 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 1,185 certifications and non-certified skills.

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

(86,814 IT professionals, data through 10/1/2021)
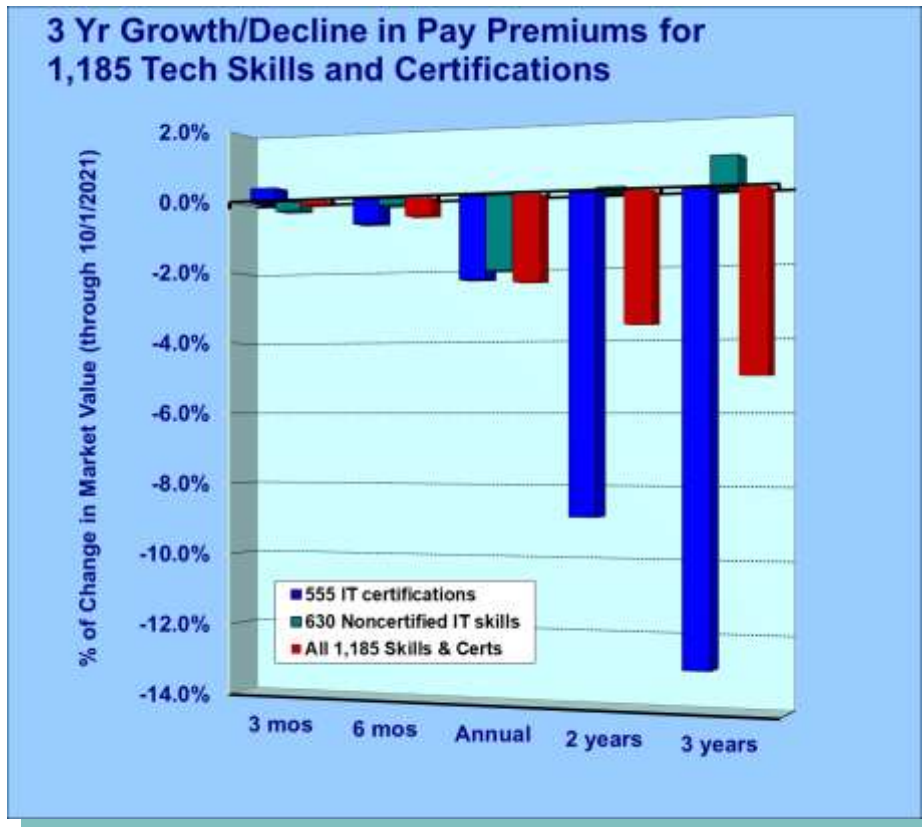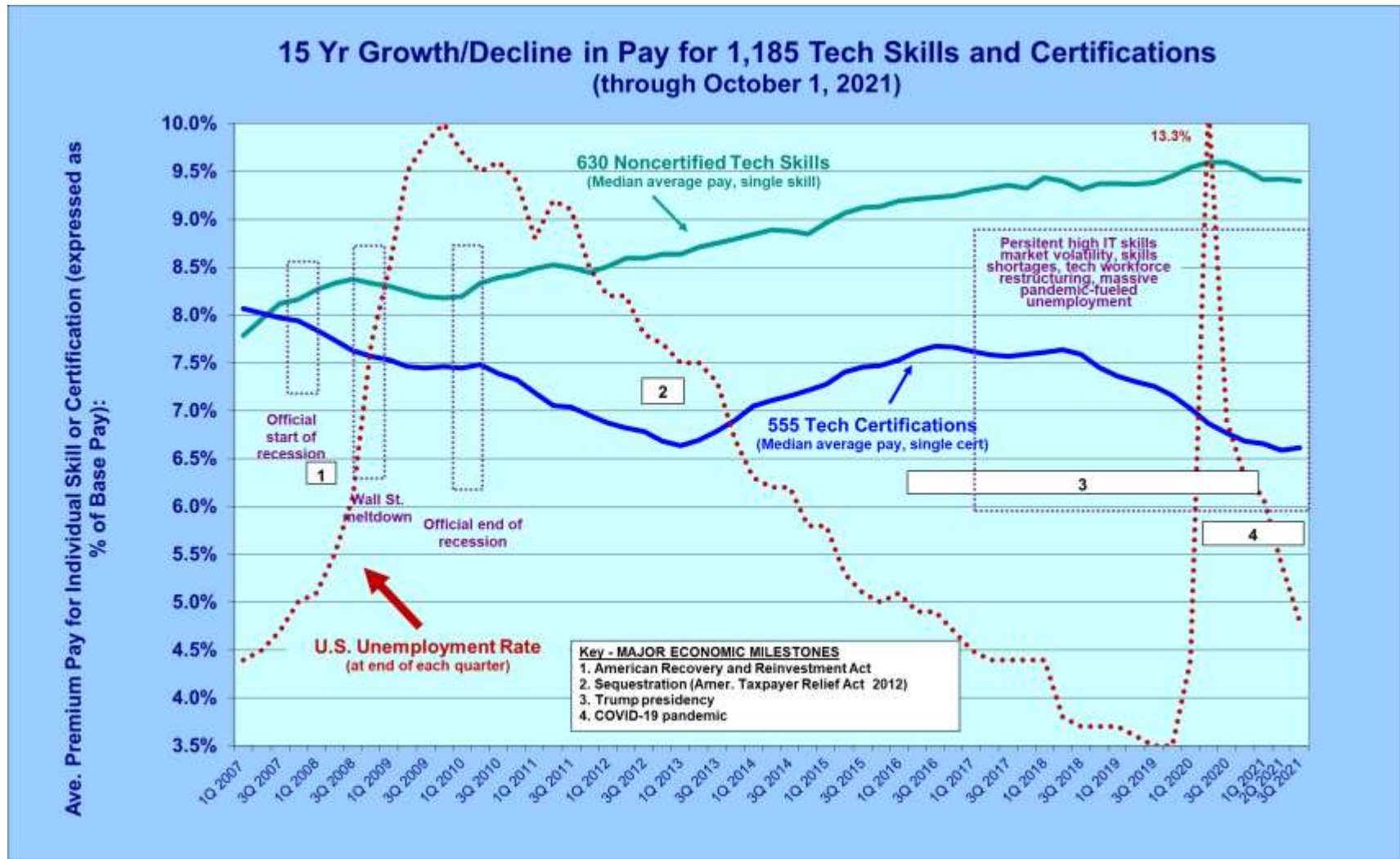

Figure 1

Source: Foote Partners, *IT Skills and Certifications Pay Index™* (3Q2018 – 3Q2021 datasets)

MULTI-YEAR PAY PREMIUM TRENDS: Certified versus Noncertified IT Skills

Average median cash pay premiums for a single certified or noncertified IT skill. 86,814 IT Professionals

Pay data supporting these charts available in the *IT Skills and Certifications Pay Index™* - 3Q 2021 data edition

Foote Partners, LLC
Foote Research Group

IT Skills & Certifications Pay Data Trend Charts & Analysis

IT Skills and Certifications Pay Index™ – 3rd Quarter 2021 data edition

(Data collected through October 1, 2021)

- **Noncertified IT Skills** (Page 6)
- **IT Skills & Certifications Volatility Index™** (Page 28)

How to interpret gains and losses in IT skills and certifications pay premiums

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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 October 1, 2021)

Apps Dev. Tools/Platforms

Agile software development
Amazon Kinesis
Amazon Web Services
Apache Airflow
Apache Ant
Apache Camel
Apache Cloudstack
Apache Cordova
Apache Flex
Apache Hadoop
Apache Lucene
Apache Maven
Apache Pig
Apache Spark
Apache Struts/Struts2
Apache Tomcat
Apache Zookeeper
Appium
Automated Testing
AWS CloudFormation
AWS Lambda
Bamboo
Behavior-Driven Development
Bitbucket
Boost C++
Business Objects
C
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
GitLab
Go language (Golang)
Gosu/Guidewire
Gradle
Groovy/Grails
Grunt
Hibernate/NHibernate
HP ALM (App. Lifecycle Mgt)
HP Unified Functional Testing
Integration Testing
iRise
Jasmine
Java SE/Java EE
JBehave
Jenkins
JIRA
JUnit
Kotlin
MapReduce
MATLAB
Microsoft Azure
Microsoft SQL Server Mgt Studio
Microsoft Team Foundation Server
NetWeaver
Next.js
Nim
NUnit
Objective-C
Objective Caml (Ocaml)
OpenShift
Oracle APEX
Oracle Apps Developer Framework
PL/SQL
Powerbuilder
Progress 4GL/Development tools
R language
Red Hat Fuse
Rstudio
Ruby
Ruby on Rails
Rust
SaaS
SAS
Scala
Scrum

Selenium
ServiceNow ITSM
SPSS
SQL Swift
Tcl
TestNG
TransacT-SQL/tSQLt
UML (unified modeling language)
Visual Basic 6.0
Visual C++
WebSphereMQ
Xcode

Web/e-Commerce Development

Active Server Pages
ActiveX
Adobe Experience Manager
Ajax
Amazon Cloudwatch
AngularJS
Apache Solr
Apache web server
Apache Velocity
Apache Wicket
Apex Code
Backbone.js
CGI
Cold Fusion MX
Content management systems
CSS/CSS3
Django
Docker /Docker Swarm
Documentum
Elasticsearch
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
Jetty

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 (formerly ISA)
Microsoft SharePoint/SharePoint Server
Microsoft Silverlight
Microsoft Visual Studio
Mobile applications development
Mule/MuleESB
Node.js
Oracle Fusion
Oracle WebLogic/
Oracle Workflow
Pandas
Perl
PHP (all)
PySpark
Python
React
Redux
REST
RESTful
SailPoint
Scalable Vector Graphics (SVG)
Secure software development/coding
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
VoiceXML
Web collaboration appliances
Web Content Development
Web Design
WebSphere
WebSphere Datapower
Wikis
WSDL
XAML/XACML
XHTML MP
XML (all variants)

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

SAP & Enterprise Bus. Apps.

ABAP (all modules)
Baan (Infor LN ERP)
Enterprise Application Integration (EAI)
IBM Sterling
J.D. Edwards /Oracle
Lawson
Microsoft Dynamics/Dynamics 365
NetWeaver
NetWeaver Portal (SAP EP)
Oracle BPM
Oracle CRM
Oracle E-Business suite
Oracle Eloqua
Oracle ERP
Oracle Financials
Oracle HFM (Hyperion Fin. Mgt)
Oracle HRMS
Oracle NetSuite
Oracle Payables
Oracle Payroll
Oracle Retail
Oracle SCM
Oracle SOA Suite
Pega
PeopleSoft (CRM/Financials/HCM)
Remedy ITSM
Salesforce
Salesforce CRM
Salesforce Sales Cloud
Salesforce Service Cloud
Accelerated SAP (SLM)
SAP AFS
SAP ALE
SAP APO
SAP Auto-ID infrastructure
SAP Basis Components
SAP BI Accelerator
SAP BODI
SAP Data Services (SAP BODS)
SAP BOXI (aka Crystal Reports)
SAP BPC
SAP BSP
SAP Business One
SAP Business Workflow/Webflow
SAP CA
SAP CAF

SAP CAR
SAP CCM
SAP CE
SAP CFM
SAP CO
SAP CO-PA
SAP CRM
SAP Crystal Reports
SAP CS
SAP Digital Banking
SAP 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 Fiori
SAP F&R
SAP FS (Insurance)
SAP GRC
SAP GTS
SAP HANA
SAP HCM (SAP HR)
SAP HCM ESS/MSS
SAP HR-PA
SAP Hybris
SAP IBP (Integrated Business Planning)
SAP IS-U (Utilities)
SAP ITS
SAP Leonardo
SAP LES
SAP LO
SAP Lumira
SAP Manufacturing
SAP MDG (Master Data Governance)
SAP MDM
SAP MDX
SAP MI
SAP MII
SAP MM

SAP MRO
SAP MRS
SAP Netweaver Applications Server
SAP Netweaver BW (BIW)
SAP NetWeaver Visual Composer
SAP NWDI
SAP NWDS
SAP Oil & Gas
SAP PI (NetWeaver Process Integ.)
SAP PLM
SAP PM
SAP POSDM
SAP PP
SAP PS
SAP PSCD
SAP Public Sector Management
SAP PY (Payroll)
SAP QM
SAP for Retail
SAP Service & Asset Mgt
SAP S/4HANA
SAP SCM
SAP SD
SAP SD - GTS
SAP Security
SAP SEM
SAP SM
SAP Smart Forms
SAP Solution Manager
SAP SRM
SAP TM
SAP UI5 (UI development toolkit for HTML5)
SAP Web Application Server
SAP WEBI
SAP WM
SAP WM – EWM
SAP Xcelsius
Siebel/Siebel Analytics
Software AG webMethods
SuccessFactors
Web Dynpro
Workday HCM

Data/Database

Amazon Athena
Amazon DynamoDB
Amazon RedShift
Apache Cassandra
Apache CouchDB
Apache Hive
Azure Cosmos DB
Azure Data Factory
Azure SQL Database
Azure Synapse Analytics
Base SAS
Big Data
Blockchain
Cloudera Impala
Couchbase Server
Data mining
Data security
Database management
DB2
dBASE/xBASE
ETL (Extract, transform, load)
GIS
Google Big Query
Google Data Studio
Hbase
Informatica
Java Database Connectivity
Kibana
Master data management
Microsoft Access
Microsoft Exchange Server 2007/2010/2013
Microsoft SQL Server Integration Services
Microsoft SQL Server 2016/2014/2012/2008
MongoDB
MySQL
NewSQL
NoSQL
OpenEdge ABL
Oracle Application Server
Oracle Business Intelligence Enterprise Edition Plus
Oracle Coherence
Oracle DB 9i/10g/11i/12c
Oracle Enterprise Manager
Oracle Exadata

Oracle Forms
Oracle Reports
PostgreSQL
Redis
Riak
Smart Contracts
Sqoop
Sybase Adaptive Server
Teradata
TIBCO Spotfire
Visual SQL

Operating Systems

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

Systems/Networks

- Active Directory
- Amazon Elastic Kubernetes Service
- Ansible
- Apache Flume
- Arista
- ATM
- Azure Active Directory
- 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
- CiscoNexus
- Cisco Prime
- Cisco UCCE
- 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 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 (SIEM)
- SMTP
- SNA
- Software-Defined Networking
- SolarWinds
- Storage virtualization/administration
- TCP/IP
- Terraform
- Tivoli
- Vagrant
- vCloud
- Virtualization (various)
- vCenter Server
- Virtual security
- VMware ESXi Server
- VMware NSX
- VoIP/IP telephony
- VPN/OpenVPN
- WAN/3G/4G services
- Web Infrastructure
- Web services security
- Wireless Network Mgmnt
- Wireless security
- Wireless sensors/RFID
- Wireline Networking/Telecomm.
- WML

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 management
- Business process anagement/ modeling/improvement
- Caffe
- Capacity Planning/Management
- Change management
- COBIT
- Collaboration software
- Complex Event Processing/Event Correlation
- Configuration Management
- Continuous Improvement
- Continuous Integration
- CRM
- Cryptography (encryption, VPN)
- Cybersecurity
- Cyber Threat Intelligence
- Data Acquisition and Control Systems
- Data Analytics
- Data Architecture
- Data Cleansing
- Data Engineering
- Data Governance
- Data Integration
- Data Management
- Data Migration
- Data Mining
- Data Modelling
- Data Privacy
- Data Protection
- Data Quality
- Data Science
- Data Security
- Data Strategy
- Data Transformation
- Data Visualization

- Deep Learning
- Deployment Automation
- DevOps
- DevSecOps
- Digital Analytics
- Digital Forensics
- Digital Marketing
- eDiscovery
- 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 SQL Server Analysis Services
- Microsoft Visio
- MLOps
- Natural language processing
- Network Architecture
- Neural Networks
- NIST
- Penetration testing
- Power BI
- Predictive Analytics and Modeling
- Prescriptive Analytics
- Program Management
- Project management/governance
- PyTorch
- QlikView
- Quality Assurance/QA Automation
- Quality management/TQM

- Quantitative Analysis/Regression Analysis
- Razor
- Requirements Engineering/Analysis
- Risk analytics/assessment
- Risk management
- Robotic Process Automation
- Security architecture and models
- Security auditing
- Security management
- Security testing
- Scaled Agile Framework (SAFe)
- SEO
- Service Management
- Site Reliability Engineering
- Six Sigma/Lean Six Sigma
- Splunk
- Social media analysis/analytics
- Software development lifecycle management
- Tableau
- Test automation
- Test Driven Development/Scripting
- TIBCO ActiveMatrix BusinessWorks
- TOGAF (Enterprise Architecture)
- Unit Testing
- Usability Research/Human Factors Research
- User Acceptance Testing
- User Experience/Interface Design
- Vulnerability Scanning/Assessment/ Management
- Waterfall
- Web Analytics
- Webtrends analytics
- Zachman Framework

IT NONCERTIFIED SKILLS PAY SUMMARY – Through October 1, 2021

A. NONCERTIFIED TECH SKILLS PAY PERFORMANCE: By Category

NON-CERTIFIED TECH SKILLS. 195 of 621 non-certified tech skills changed cash market value from July 1 to October 1 compared to 178 and 220 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 3rd quarter of 2021 higher for only two of eight non-certified tech skills categories reported: ***Management/Methodology/Process*** and ***Web/eCommerce*** skills.

Noncertified IT Skills - % Growth/Decline
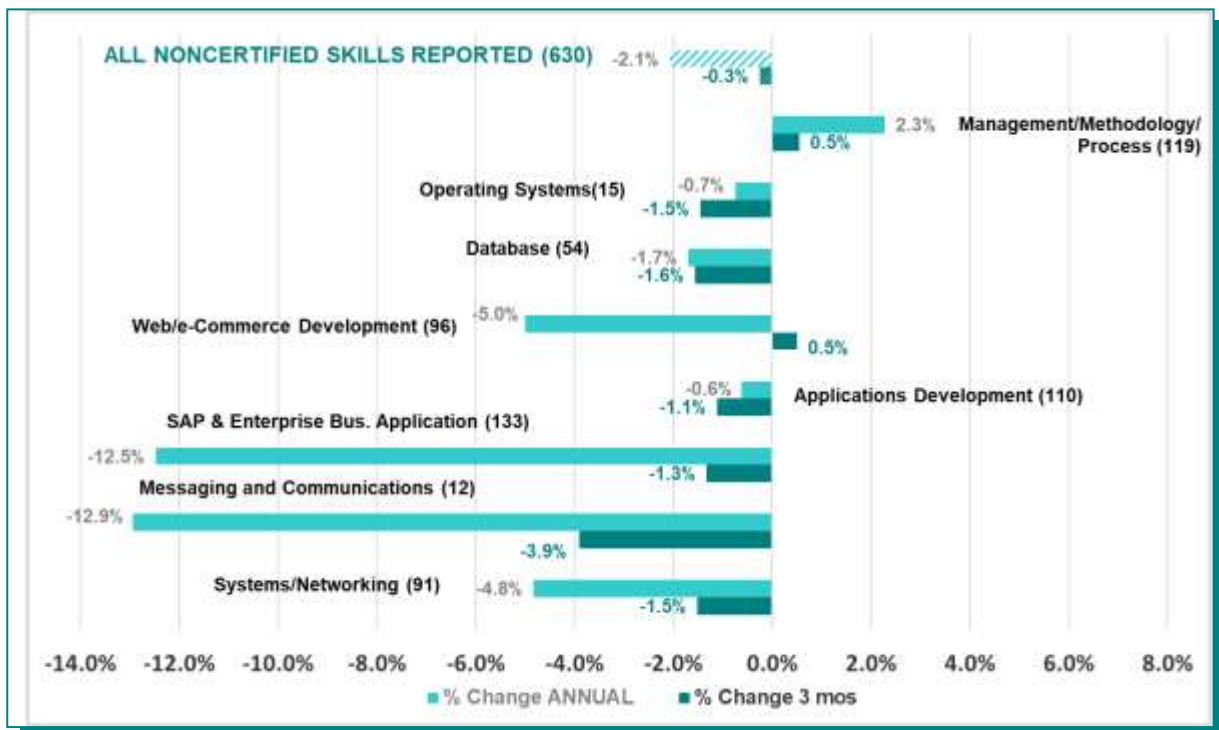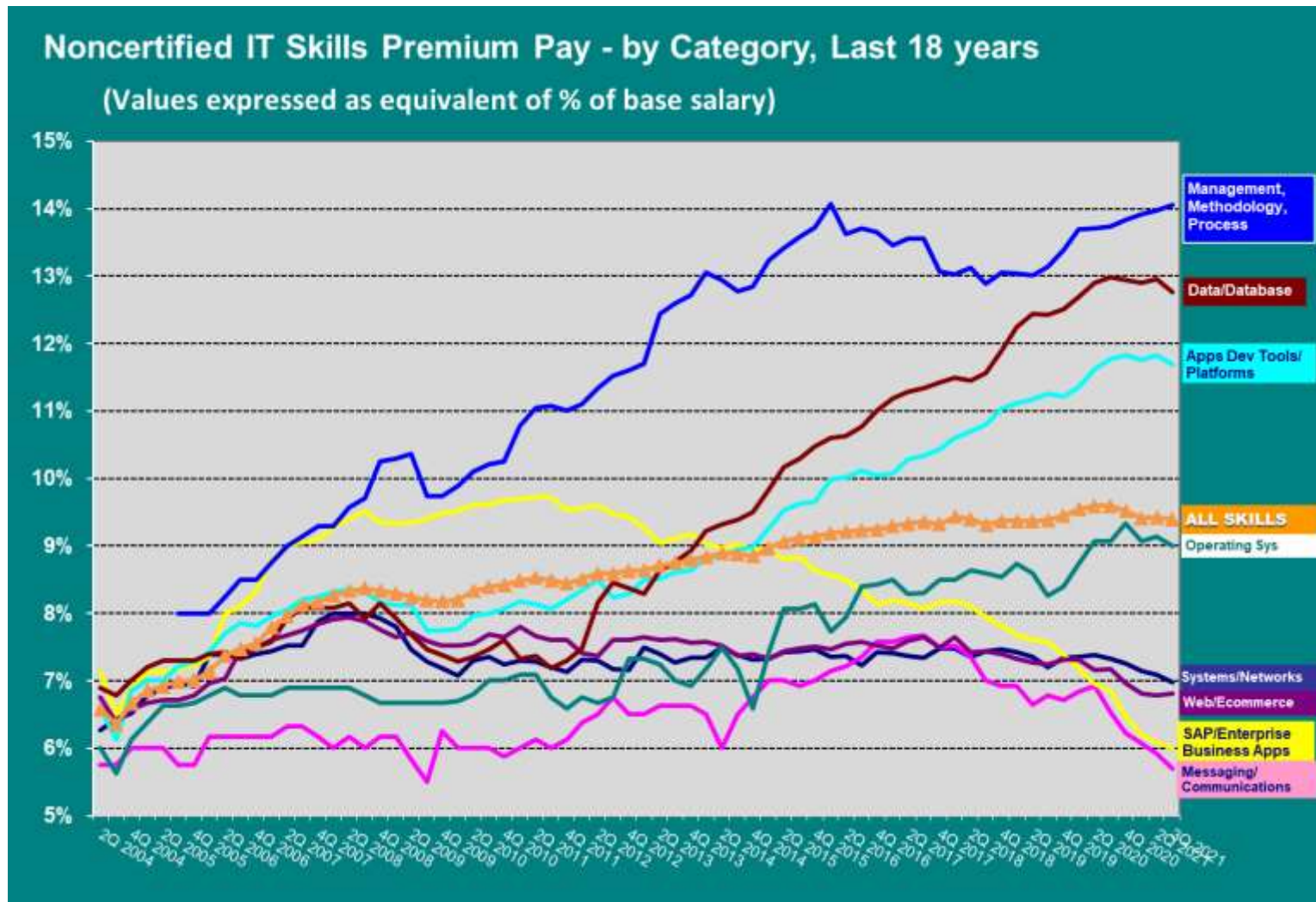### 3 months & 12 months
(630 skills, data through 10/1/2021)

Figure 1

Source: Foote Partners *IT Skills & Certifications Pay Index*[TM], 3rd 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 October 1, 2021 – 86,814 IT Professionals

Pay data supporting these charts available in the *IT Skills and Certifications Pay Index*[TM] – 3Q 2021 data edition

Foote Partners, LLC
Foote Research Group

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 July 1, 2021 to October 1, 2021). **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.

1. Risk analytics/assessment

2.[Tie] Ethereum
   Site Reliability Engineering

3.[Tie] Amazon DynamoDB
   Apache Pig
   Deep Learning
   DevSecOps
   HBase
   MLOps
   Oracle Exadata

4.[Tie] Big Data analytics
   Blockchain
   Cloud Foundry PaaS
   Data Architecture
   Data Science
   E-Discovery
   Flink
   Identity and access management
   Microservices
   Natural language processing
   Prescriptive Analytics
   PyTorch
   Security architecture and models
   Splunk

5.[Tie] Apache Cassandra
   Apache Hive
   Apache Zookeeper
   Artificial Intelligence
   Clojure
   Cyber Threat Intelligence
   Data Engineering
   Data Strategy

5.[Tie] Google TensorFlow
   Machine Learning
   Metadata design and development
   Oracle Application Server
   Program Management
   Risk management
   Rust
   Scala
   Scaled Agile Framework (SAFe)
   Usability Research/Human Factors
      Research
   Zachman Framework

6.[Tie] Amazon Athena
   Amazon RedShift
   Apache Airflow
   Apache Spark
   Apache Struts/Struts2
   Artificial Intelligence for IT
   Operations
   Bamboo
   Big Data
   Caffe
   CircleCI
   Configuration Management
   Continuous Integration
   Cryptography (encryption, VPN,
   SSL/TLS,   Hybrids)
   Cybersecurity
   Data Analytics
   Data Governance
   Data Integration
   Data Management
   Data Modelling
   Data Transformation
   DevOps

6.[Tie] Digital Forensics
   Elixir
   Functional Programming
   Go language (Golang)
   Google Big Query
   Informatica
   IT Governance
   Kanban
   Keras
   Kibana
   Kotlin
   NIST
   Penetration testing
   Predictive Analytics and Modeling
   Security auditing
   Security skills (DW/BI, ERP, Web, project
      assignments)
   Smart Contracts
   Sqoop
   Test Driven Development/Scripting
   User Experience/Interface Design
   Vulnerability Scanning/Assessment/
      Management/Network Architecture

7. [Tie] Amazon Kinesis
   Amazon Web Services (EC2, ECS, S3, SQS,
      ELB, et. al.)
   Apache Cloudstack
   Apache Hadoop
   Apache Lucene
   AWS CloudFront/CloudFront Functions
   AWS Lambda
   Business analytics
   Business performance management
      (software/systems)
   Complex Event Processing/Event Correlation

7. [Tie] Continuous Improvement
   Couchbase Server
   Data Migration
   Data Quality
   Database management
   Erlang
   GitLab
   Master data management
   MongoDB
   Network Architecture
   Neural Networks
   NoSQL
   Oracle Coherence
   PostgreSQL
   Quantitative Analysis/Regression Analysis
   Security management
   Security testing
   Software development lifecycle management
   Teradata
   Test automation

NONCERTIFIED IT SKILLS TREND HIGHLIGHTS: Market Value Gainers & Highest Paying – 3rd Quarter 2021 data

These noncertified tech skills *gained 10% or more in market value in the three months ending October 1, 2021* 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**.

IT SKILLS (noncertified)			Highest Paying – Cash Premiums (A-Z)

Applications Development skills
Boost C++
Swift
Ethereum
Drupal
TestNG
 	
Database Skills
Data mining
HBase
Oracle Forms
 	
Operating System skills
SUSE
Linux
 	
**Management, Process &
Methodology skills**
E-Procurement
Prescriptive Analytics
Usability Research/Human Factors
    Research
PyTorch
TOGAF (Enterprise Architecture)
	Systems/Networking skills
	Network access control/Identity mgt sys.
	SMTP
	SolarWinds
	Wireless security
	Vagrant
	
	**SAP & Enterprise Business
	Applications skills**
	SAP SM (Service Management)
	SAP TM (Transportation Management)
	SAP CS (Customer Service)
	Web Dynpro
	SAP LES (Logistics Execution System)
	SuccessFactors
	Oracle Eloqua
	Oracle HFM (Hyperion Financial
	    Management)
	PeopleSoft (CRM/Financials/HCM)
	Salesforce CRM
	SAP Forecasting and Replenishment
	SAP SD
	Oracle ERP
	SAP GRC
	SAP SCM
		Web/SOA/E-Commerce skills
		Magnolia
		JavaFX
		Laravel PHP
		JBoss /WildFly
		RESTful
		Spring Integration
		Social Media/Networks
		Spring Security
		Adobe Experience Manager
		Docker/Docker Swarm
		Mobile applications development
		Mule/MuleESB
		Microsoft Forefront Threat Management
		    Gateway (formerly ISA)
			• Amazon DynamoDB
			• Apache Pig
			• Big Data analytics
			• Blockchain
			• Cloud Foundry PaaS
			• Data Architecture
			• Data Science
			• Deep Learning
			• DevSecOps
			• E-Discovery
			• Ethereum
			• Flink
			• HBase
			• Identity and access management
			• Microservices
			• MLOps
			• Natural language processing
			• Oracle Exadata
			• Prescriptive Analytics
			• PyTorch
			• Risk analytics/assessment
			• Security architecture and models
			• Site Reliability Engineering
			• Splunk

Source: Foote Partners *IT Skills & Certifications Pay Index*[TM], 3rd Quarter 2021 data edition

NONCERTIFIED IT SKILLS TREND HIGHLIGHTS: Market Value Losers – 3rd Quarter 2021 data

These noncertified IT skills *declined 10% or more in market value in the three months ending October 1, 2021* vs. prior quarter (seen below grouped by segment). *Listed in descending order of amount of % decline in cash pay premium*, including ties.

IT SKILLS (Noncertified) osers

Applications Development skills
WebSphere MQ (MQSeries)
Red Hat Fuse
Rstudio
Erlang

Web/E-commerce Development skills
JavaBeans/EJB 3.0
Google Analytics
Ajax (Asynchronous JavaScript and XML)
SOAP
Umbraco
Microsoft Sharepoint/Sharepoint Server
Redux
Node.js
React
XAML/XACML
Oracle Workflow

Data/Database
Smart Contracts
TIBCO Spotfire
Java Database Connectivity (JDBC)
Microsoft Exchange Server 2007/2010/2013
NewSQL

SAP & Enterprise Business Applications skills
Remedy ITSM
SAP Oil & Gas
SAP MDG
Oracle SCM
SAP WEBI (BusinessObjects Web Intelligence)
Lawson
SAP Business Workflow/Webflow
SAP Hybris
SAP APO
ABAP
Microsoft Dynamics/Dynamics 365
SAP ERP Operations (multi-skills)
SAP HANA
SAP HR-PY (Payroll)
SAP PI (NetWeaver Process Integration)
SAP CRM
SAP PP
Salesforce Sales Cloud
Oracle BPM
Workday HCM
SAP QM
Salesforce Service Cloud
Pega
SAP IBP

Management, Process & Methodology
Webtrends analytics
Bioinformatics
Business process mapping/modeling/ improvement
Digital Analytics
Functional Testing

Messaging & Communications skills
TIBCO Rendezvous
Message-oriented Middleware (Wave, XMPP/Jabber, etc.)
Java Messaging Service

Operating Systems
Windows NT
Windows Server 2019/2016/2012
AIX
VMware vSphere

Systems/Networking skills
VMware NSX
HTTPS
Web services security
Microsoft SCCM
Cisco Prime
Cisco UCCX
Azure Active Directory
Microsoft SCVMM
NAS/Network Attached Storage
VPN/OpenVPN
Cisco ISE (Identity Services Engine)
vCloud
PaaS
RedHat OpenShift
Cisco CUCM
Arista

Source: Foote Partners *IT Skills & Certifications Pay Index*[TM], 3rd Quarter 2021 data edition

NON-CERTIFIED IT SKILLS ANALYSIS – Winners

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 winners list on noncertified IT skills (in alphabetical order):

- Apache Hive	- Cyber Threat Intelligence	- Microservices
- Amazon Dynamo DB	- Data Engineering	- MLOps
- Oracle Exadata	- Data Science	- Prescriptive Analytics
- Apache Pig	- Data Strategy	- Program Management
- Apache Zookeeper	- Deep Learning	- PyTorch
- Artificial Intelligence	- Ethereum	- Risk analytics/assessment
- Big Data Analytics	- Google TensorFlow	- Site Reliability Engineering
- CloudFoundry PaaS	- HBase	- Usability Research/Human Factors Research
- Splunk		

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

1. Risk analytics/assessment
Market Value Increase: 5.3 percent (in the six months through October 1, 2021)

Risk analytics is a form of business intelligence that serves as a component in a risk management environment. Invaluable in any industry, risk analytics exploits internal and external structured and unstructured data to model scenarios and outcomes, providing insights into areas such as:

- Fraud risk
- Market risk
- Credit risk
- Transportation and logistics risk
- IT risk
- Financial risk
- Investment risk
- Supply chain risk

Risk analytics does not have to be a digital solution, and indeed, businesses have been analyzing and assessing risk for years using manual or semi-automated methods. But digital risk analytics is growing in popularity as a niche of BI development due to increased interest among risk-management professionals. As a discipline it has changed—and vastly improved—the way risk managers evaluate potential scenarios and predict risk-laden events.

Foote Partners, LLC
Foote Research Group

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

Digital risk analytics minimizes the need for reliance on human intuition, allows enterprise-wide assessment of risk exposure, and enables management precision, which would have been unimaginable not so long ago. Capturing, storing, and extracting data relating to all the risk strands in a particular business environment enables risk managers to amass targeted intelligence, visualize scenarios, and prepare for them. The resulting insights provide an organization with a plethora of benefits to security, operational continuity, and competitive advantage.

Machine learning technology is probably the biggest game-changer in digital risk analytics, primarily due to its ability to reduce the margins of error in predicting risk likelihoods and severities. When a cognitive solution, powered by the latest in artificial intelligence, creates a risk alert, human verification requirements still exist. However, as risk specialists increasingly weed out false positives and update the algorithms, the application learns from the inputs and becomes more accurate in evaluating the risk of fraud. Additional accuracy comes with AI technology's ability to process unstructured data using natural language processing, text analysis, and image recognition. That makes the need for rule-based analysis far less prominent and enables near real-time risk identification—and ultimately, faster responses.

Of late, risk analytics applications are beginning to cross the boundaries of prediction into more actionable realms of prescriptive analysis. The most sophisticated solutions help risk managers to identify the best course of action to prevent, circumvent, or at least mitigate potential harm arising from disruptive events and criminal activity.

2. **Ethereum**
    Site Reliability Engineering
    Market Value Increase: 11.8 percent (in the six months through October 1, 2021)

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 4,572 USD as of the end of October, up from 2,372 in July.

Site reliability engineering (SRE) is a set of principles and practices that incorporates aspects of software engineering and applies them to infrastructure and operations 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.

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

4. HBase
Average Pay Premium: 18 percent of base salary equivalent
Market Value Increase: 25 percent (in the six months through October 1, 2021)

Apache HBase is an open source NoSQL database that runs on top of Hadoop Distributed File System (HDFS) and provides real-time read/write access to large datasets. HBase scales linearly to handle huge data sets with billions of rows and millions of columns, and it easily combines data sources that use a wide variety of different structures and schemas. HBase employs a collection of battle-tested technologies from the Hadoop world, and it's a proven winner when building a large, scalable, highly available, distributed database, particularly for those applications where strong consistency is important.

5. Amazon Dynamo DB
Oracle Exadata
Average Pay Premium: 18 percent of base salary equivalent
Market Value Increase: 12.5 percent (in the six months through October 1, 2021)

Amazon DynamoDB is a fully managed proprietary NoSQL database service that supports key-value and document data structures and is part of the Amazon Web Services portfolio. DynamicDB exposes a similar data model to (and derives its name from) Dynamo, but has a different underlying implementation. DynamoDB uses synchronous replication across multiple data centers for high durability and availability. It differs from other Amazon services by allowing developers to purchase a service based on throughput, rather than storage. Administrators can request throughput changes and DynamoDB will spread the data and traffic over a number of servers using solid-state drives, allowing predictable performance. It offers integration with Hadoop via Elastic MapReduce.

The ***Oracle Exadata Database Machine*** is a computing platform optimized for running Oracle database workloads. It was Introduced in 2008 for on-premises deployment and, since October 2015, via the Oracle Cloud as a subscription service known as the Exadata Cloud Service. Historically, specialized database computing platforms were designed for a particular workload, such as Data Warehousing, and poor or unusable for other workloads, such as OLTP. Exadata allows mixed workloads to share system resources fairly with resource management features allowing prioritized allocation, such as always favoring workloads servicing interactive users over reporting and batch, even if they are accessing the same data.

Exadata features a modern cloud-based architecture with scale-out high-performance database servers, scale-out intelligent storage servers, and a fast InfiniBand internal fabric that connects all servers and storage. Unique software algorithms in Exadata implement database intelligence in storage, compute, and InfiniBand networking to deliver higher performance and capacity at lower costs. Exadata runs all types of database workloads including OLTP, data warehousing, in-memory analytics as well as consolidation of mixed workloads. Simple and fast to implement, the Exadata Database Machine powers and protects databases. It can be purchased and deployed on premises as the foundation for a private database cloud or acquired as a subscription and deployed in the Oracle Public Cloud or customer cloud with all infrastructure management performed by Oracle.

7. MLOps
Average Pay Premium: 18 percent of base salary equivalent
Market Value Increase: 5.9 percent (in the three months through October 1, 2021)

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

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

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.

8. **Apache Pig**
   Deep Learning
   Average Pay Premium: 18 percent of base salary equivalent
   Market Value Increase: 5.9 percent (in the six months through October 1, 2021)

Apache Pig is a high-level platform for analyzing large data sets that consists of a high-level language for expressing data analysis programs, coupled with infrastructure for evaluating these programs. The salient property of Pig programs is that their structure is amenable to substantial parallelization, which in turns enables them to handle very large data sets. Right now, Pig's infrastructure layer consists of a compiler that produces sequences of Map-Reduce programs, for which large-scale parallel implementations already exist (e.g., the Hadoop subproject). Pig can execute its Hadoop jobs in MapReduce, Apache Tez, or Apache Spark. Pig's language layer currently consists of a textual language called Pig Latin which abstracts the programming from the Java MapReduce idiom into a notation which makes MapReduce programming high level, similar to that of SQL for relational database management systems. Pig Latin can be extended using user-defined functions (UDFs) which the user can write in Java, Python, JavaScript, Ruby or Groovy and then call directly from the language.

Pig's language layer has the following key properties:

- **Ease of programming.** It is trivial to achieve parallel execution of simple, "embarrassingly parallel" data analysis tasks. Complex tasks comprised of multiple interrelated data transformations are explicitly encoded as data flow sequences, making them easy to write, understand, and maintain.

- **Optimization opportunities.** The way in which tasks are encoded permits the system to optimize their execution automatically, allowing the user to focus on semantics rather than efficiency.

- **Extensibility.** Users can create their own functions to do special-purpose processing

Deep learning is a subset of machine learning, which is essentially a neural network with three or more layers. These neural networks attempt to simulate the behavior of the human brain—albeit far from matching its ability—allowing it to "learn" from large amounts of data. While a neural network with a single layer can still make approximate predictions, additional hidden layers can help to optimize and refine for accuracy. Deep learning drives many artificial intelligence (AI) applications and services that improve automation, performing analytical and physical tasks without human intervention.

Key to skills demand driving up skills premiums is that deep learning technology lies behind everyday products and services (such as digital assistants, voice-enabled TV remotes, and credit card fraud detection) as well as emerging technologies (such as self-driving cars). Among the industries benefitting from this technology:

- *Law enforcement.* Deep learning algorithms can analyze and learn from transactional data to identify dangerous patterns that indicate possible fraudulent or criminal activity. Speech recognition, computer vision, and other deep learning applications can improve the efficiency and effectiveness of investigative analysis by extracting patterns and evidence from sound and video recordings, images, and documents, which helps law enforcement analyze large amounts of data more quickly and accurately.

- *Financial services.* Financial institutions regularly use predictive analytics to drive algorithmic trading of stocks, assess business risks for loan approvals, detect fraud, and help manage credit and investment portfolios for clients.

✓ *Customer service.* Many organizations incorporate deep learning technology into their customer service processes. Chatbots —used in a variety of applications, services, and customer service portals—are a straightforward form of AI. Traditional chatbots use natural language and even visual recognition, commonly found in call center-like menus. However, more sophisticated chatbot solutions attempt to determine, through learning, if there are multiple responses to ambiguous questions. Based on the responses it receives, the chatbot then tries to answer these questions directly or route the conversation to a human user. Virtual assistants like Apple's Siri, Amazon Alexa, or Google Assistant extends the idea of a chatbot by enabling speech recognition functionality. This creates a new method to engage users in a personalized way.

✓ *Healthcare.* The healthcare industry has benefited greatly from deep learning capabilities ever since the digitization of hospital records and images. Image recognition applications can support medical imaging specialists and radiologists, helping them analyze and assess more images in less time.

10. Big Data Analytics
CloudFoundry PaaS
Splunk
Average Pay Premium: 17 percent of base salary equivalent
Market Value Increase: 13.3 percent (in the six months through October 1, 2021)

Big data analytics is the use of advanced analytic techniques against very large, diverse big data sets that include structured, semi-structured and unstructured data, from different sources, and in different sizes from terabytes to zettabytes.

But what is big data exactly? It can be defined as data sets whose size or type is beyond the ability of traditional relational databases to capture, manage and process the data with low latency. Characteristics of big data include high volume, high velocity and high variety. Sources of data are becoming more complex than those for traditional data because they are being driven by artificial intelligence (AI), mobile devices, social media and the Internet of Things (IoT). For example, the different types of data originate from sensors, devices, video/audio, networks, log files, transactional applications, web and social media — much of it generated in real time and at a very large scale.

With big data analytics, you can ultimately fuel better and faster decision-making, modelling and predicting of future outcomes and enhanced business intelligence. As you build your big data solution, consider open source software such as Apache Hadoop, Apache Spark and the entire Hadoop ecosystem as cost-effective, flexible data processing and storage tools designed to handle the volume of data being generated today.

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

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

• Application portability.
• Application auto-scaling.
• Centralized platform administration.

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

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

Splunk is a software platform widely used for monitoring, searching, analyzing and visualizing the machine-generated data in real time. It performs capturing, indexing, and correlating the real time data in a searchable container and produces graphs, alerts, dashboards and visualizations. Splunk provides easy to access data over the whole organization for easy diagnostics and solutions to various business problems.

Important features of Splunk are:

✓ Accelerate Development & Testing
✓ Allows you to build Real-time Data Applications
✓ Generate ROI faster
✓ Agile statistics and reporting with Real-time architecture
✓ Offers search, analysis and visualization capabilities to empower users of all types

The Splunk monitoring tool offers a variety of benefits for an organization:

✓ Enhanced GUI and real-time visibility in a dashboard
✓ Reduces troubleshooting and resolving time by offering instant results
✓ Valued tool for root cause analysis
✓ Allows users to generate graphs, alerts, and dashboards
✓ Easily search and investigate specific results
✓ Troubleshoot any condition of failure for improved performance
✓ Monitor any business metrics and make an informed decisions
✓ Allows users incorporate Artificial Intelligence into their data strategy
✓ Enables gathering Operational Intelligence from machine data

13. PyTorch
Average Pay Premium: 17 percent of base salary equivalent
Market Value Increase: 13.3 percent (in the three months through October 1, 2021

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

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

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.

14. Prescriptive Analytics
Data Science
Microservices
Average Pay Premium: 17 percent of base salary equivalent
Market Value Increase: 6.3 percent (in the six months through October 1, 2021)

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.

Prescriptive analytics can be used in two ways:

- ✓ **Inform decision logic with analytics.** Decision logic needs data as an input to make the decision. The veracity and timeliness of data will ensure that the decision logic will operate as expected. It doesn't matter if the decision logic is that of a person or embedded in an application — in both cases, prescriptive analytics provides the input to the process. Prescriptive analytics can be as simple as aggregate analytics about how much a customer spent on products last month or as sophisticated as a predictive model that predicts the next best offer to a customer. The decision logic may even include an optimization model to determine how much, if any, discount to offer to the customer.

- ✓ **Evolve decision logic.** Decision logic must evolve to improve or maintain its effectiveness. In some cases, decision logic itself may be flawed or degrade over time. Measuring and analyzing the effectiveness or ineffectiveness of enterprises decisions allows developers to refine or redo decision logic to make it even better. It can be as simple as marketing managers reviewing email conversion rates and adjusting the decision logic to target an additional audience. Alternatively, it can be as sophisticated as embedding a machine learning model in the decision logic for an email marketing campaign to automatically adjust what content is sent to target audiences.

Data science is an interdisciplinary field that uses scientific methods, processes, algorithms, and systems to extract knowledge and insights from structured and unstructured data sets, which are typically very large, and apply knowledge and actionable insights from data to solve problems in a wide range of application domains. It uses techniques and theories drawn from many fields within the context of mathematics, statistics, computer science, information science, and domain knowledge. However, data science is different from computer science and information science, often imagined as a "fourth paradigm" of science along with empirical, theoretical, computational, and now data-driven science.

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

Data science encompasses preparing data for analysis, formulating data science problems, analyzing data, developing data-driven solutions, and presenting findings to inform high-level decisions in a broad range of application domains. As such, it incorporates skills from computer science, statistics, information science, mathematics, information visualization, data integration, graphic design, complex systems, communication and business. Data science is also linked to human-computer interaction in that users should be able to intuitively control and explore data.
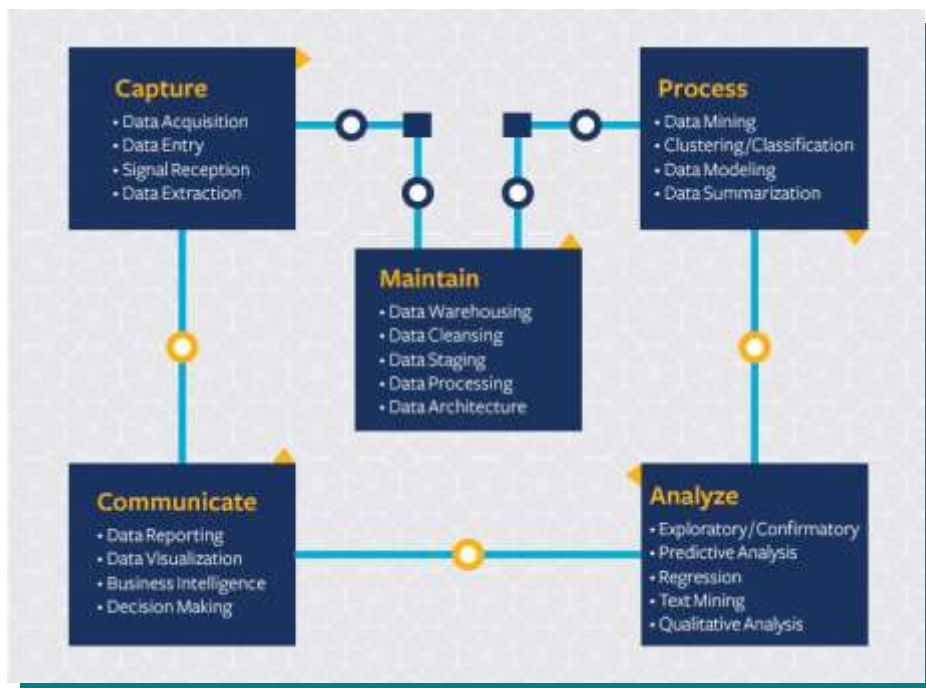
The Data Science Life Cycle

Figure 2

The term "data scientist" was coined as recently as 2008 when companies realized the need for data professionals who are skilled in organizing and analyzing massive amounts of data. Effective data scientists are able to identify relevant questions, collect data from a multitude of different data sources, organize the information, translate results into solutions, and communicate their findings in a way that positively affects business decisions. Over the years it has continued to evolve as one of the most promising and in-demand career paths for skilled professionals---as evidenced by its current market value and impressive growth in cash pay premium in the *IT Skills and Certifications Pay Index*. Today, successful data professionals understand that they must advance past the traditional skills of analyzing large amounts of data, data mining, and programming skills. To uncover useful intelligence for their organizations, data scientists must master the full spectrum of the data science life cycle and possess a level of flexibility and understanding to maximize returns at each phase of the process.

Microservices architecture is a distinctive method of developing software systems that tries to focus on building single-function modules with well-defined interfaces and operations known as containers. By holding an application's complete runtime environment, including libraries, binaries, and configuration files, platform and infrastructure are abstracted, allowing the application to run more or less anywhere. The trend has grown popular in recent years as enterprises look to become more agile and move towards a DevOps and continuous testing. The idea behind microservices is to allow developers to build their applications from various independent components which can easily be changed, removed, or upgraded without affecting the whole application. Microservices create scalable, testable software that can be delivered in very short periods of time. Netflix, eBay, Amazon, Twitter, PayPal, and many other tech stars have all evolved from microservices architecture. Containers are available from all the major cloud providers as well as in on-premises data centers and hybrid clouds.

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

17. Usability Research/Human Factors Research
Average Pay Premium: 16 percent of base salary equivalent
Market Value Increase: 33.3 percent (in the six months through October 1, 2021

For any product or service to succeed, you need to know what your users want as early as possible in your design process. This is where *UX (or usability) research* comes in. What differentiates a product is how good it feels for someone to use that product, and how this experience meets and hopefully exceeds their expectations. The whole point of usability research is to understand who your customers are, what is important to them, and how they actually use your products. Conducting usability research allows designers to gain an understanding of how people interact and perceive their products. It also helps support design decisions by gauging comprehension for various layouts and visual treatments. Whether you are conducting research on a prototype or on a launched product, usability research is a great learning experience.

In software engineering, usability is the degree to which a software can be used by specified consumers to achieve quantified objectives with effectiveness, efficiency, and satisfaction in a quantified context of use. The object of use can be a software application, website, book, tool, machine, process, vehicle, or anything a human interacts with. A usability study may be conducted as a primary job function by a *usability analyst* or as a secondary job function by designers, technical writers, marketing personnel, and others. It is widely used in consumer electronics, communication, and knowledge transfer objects (such as online help) and mechanical objects.

There is a long, comprehensive list of UX research methods employed by user researchers, but at its center is the user and how they think and behave—their needs and motivations. Typically, UX research does this through observation techniques, task analysis, and other feedback methodologies. There are two main types of user research: quantitative (statistics: can be calculated and computed; focuses on numbers and mathematical calculations) and qualitative (insights: concerned with descriptions, which can be observed but cannot be computed).

- *Quantitative research* is primarily exploratory research and is used to quantify the problem by way of generating numerical data or data that can be transformed into usable statistics. Some common data collection methods include various forms of surveys – online surveys, paper surveys, mobile surveys and kiosk surveys, longitudinal studies, website interceptors, online polls, and systematic observations. This form of user research may also include analytics, such as Google Analytics. Quantitative data from analytics platforms should ideally be balanced with qualitative insights gathered from other UX testing methods, such as focus groups or usability testing. The analytical data will show patterns that may be useful for deciding what assumptions to test further.

- *Qualitative user research* is a direct assessment of behavior based on observation. It's about understanding people's beliefs and practices on their terms. It can involve several different methods including contextual observation, ethnographic studies, interviews, field studies, and moderated usability tests.

Here are some examples of the types of usability research performed at each phase of a project.

- *Card Sorting*: Allows users to group and sort a site's information into a logical structure that will typically drive navigation and the site's information architecture. This helps ensure that the site structure matches the way users think.
- *Contextual Interviews*: Enables the observation of users in their natural environment, giving you a better understanding of the way users work.
- *First Click Testing*: A testing method focused on navigation, which can be performed on a functioning website, a prototype, or a wireframe.
- *Focus Groups*: Moderated discussion with a group of users, allowing insight into user attitudes, ideas, and desires.
- *Heuristic Evaluation/Expert Review*: A group of usability experts evaluating a website against a list of established guidelines.
- *Interviews*: One-on-one discussions with users show how a particular user works. They enable you to get detailed information about a user's attitudes, desires, and experiences.

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

- *Parallel Design*: A design methodology that involves several designers pursuing the same effort simultaneously but independently, with the intention to combine the best aspects of each for the ultimate solution.
- *Personas:* The creation of a representative user based on available data and user interviews. Though the personal details of the persona may be fictional, the information used to create the user type is not.
- *Prototyping*: Allows the design team to explore ideas before implementing them by creating a mock-up of the site. A prototype can range from a paper mock-up to interactive HTML pages.
- *Surveys*: A series of questions asked to multiple users of your website that help you learn about the people who visit your site.
- *System Usability Scale (SUS):* SUS is a technology-independent ten-item scale for subjective evaluation of the usability.
- *Usability Testing*: Identifies user frustrations and problems with a site through one-on-one sessions where a "real-life" user performs tasks on the site being studied.
- *Use Cases*: Provide a description of how users use a particular feature of your website. They provide a detailed look at how users interact with the site, including the steps users take to accomplish each task.

Human factors and ergonomics (commonly referred to as human factors) is the application of psychological and physiological principles to the engineering and design of products, processes, and systems. The goal of human factors is to reduce human error, increase productivity, and enhance safety and comfort with a specific focus on the interaction between the human and the thing of interest. The field is a combination of numerous disciplines, such as psychology, sociology, engineering, biomechanics, industrial design, physiology, anthropometry, interaction design, visual design, user experience, and user interface design. In research, human factors employs the scientific method to study human behavior so that the resultant data may be applied to the four primary goals. In essence, it is the study of designing equipment, devices and processes that fit the human body and its cognitive abilities. The two terms "human factors" and "ergonomics" are essentially synonymous.

18. Apache Zookeeper
Average Pay Premium: 16 percent of base salary equivalent
Market Value Increase: 23.1 percent (in the six months through October 1, 2021

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.

19. [Tie] Cyber Threat Intelligence
   Program Management
   Average Pay Premium: 16 percent of base salary equivalent
   Market Value Increase: 14.3 percent (in the six months through October 1, 2021

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

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

The process is a cycle because it identifies intelligence gaps, unanswered questions, which prompt new collection requirements, thus restarting the intelligence cycle. Intelligence analysts identify intelligence gaps during the analysis phase. Intelligence analysts and consumers determine intelligence gaps during the dissemination and re-evaluation phase.

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

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

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

✓ Tactical intelligence assesses real-time events, investigations, and/or activities, and provides day-to-day operational support. Tactical cyber threat intelligence provides support for day-to-day operations and events, such as the development of signatures and indicators of compromise (IOC). It often involves limited application of traditional intelligence analysis techniques.

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.

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

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.

21. **[Tie] Apache Hive**
    Artificial Intelligence
    Data Engineering
    Data Strategy
    Google TensorFlow
    Average Pay Premium: 16 percent of base salary equivalent
    Market Value Increase: 6.7 percent (in the six months through October 1, 2021

Apache Hive is a data warehouse system built on top of Apache Hadoop that facilitates easy data summarization, ad-hoc queries, and the analysis of large datasets stored in various databases and file systems that integrate with Hadoop, including the MapR Data Platform with MapR XD and MapR Database. Hive offers a simple way to apply structure to large amounts of unstructured data and then perform batch SQL-like queries on that data. Hive easily integrates with traditional data center technologies using the familiar JDBC/ODBC interface.

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

Machine learning is typically the first step for organizations that are adding A.I.-related technologies to their IT portfolio and one of the reasons why A.I. skills pay is growing. This is about automating the process of creating algorithms by using data to "train" them rather than human software developers writing code. Basically, what you are doing is showing the algorithm examples, in the form of data. By "looking" at all these examples, the machine learns to recognize patterns and differences.

Deep learning takes machine learning a few steps further by creating layers of machine learning beyond the first decision point. These hidden layers are called a neural network—as described earlier--and are meant to simulate the way human brains operate. Deep learning works by taking the outcome of the first machine learning decision and making it the input for the next machine learning decision. Each of these is a layer. Python is also the language of deep learning and neural networks.

Data engineering is the aspect of data science that focuses on practical applications of data collection and analysis. For all the work that data scientists do to answer questions using large sets of information, there have to be mechanisms for collecting and validating that information. In order for that work to ultimately have any value, there also have to be mechanisms for applying it to real-world operations in some way. Those are both engineering tasks: the application of science to practical, functioning systems.

If you have a business, you have data — but data by itself won't let you optimize and improve your business. You need a *Data Strategy* if you want to turn data into value. A business without a data strategy is poorly positioned to operate efficiently and profitably or to grow successfully.

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

Data strategy refers to the tools, processes, and rules that define how to manage, analyze, and act upon business data. A data strategy helps you to make informed decisions based on your data. It also helps you keep your data safe and compliant.
Virtually every business collects data in multiple forms, and a data strategy enables a business to manage and interpret all of that data.

It also puts a business in a strong position to solve challenges such as:

✓ Slow and inefficient business processes
✓ Data privacy, data integrity, and data quality issues that undercut your ability to analyze data
✓ Lack of deep understanding of critical parts of the business (customers, supply chain, competitive landscape, etc.) and the processes that make them tick
✓ A lack of clarity about current business needs (a problem that descriptive analytics can help solve) and goals (which predictive and prescriptive analytics can help identify)
✓ Inefficient movement of data between different parts of the business, or duplication of data by multiple business units

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TensorFlow is a popular open-source deep learning library, developed at Google, which uses machine learning in all of its products to take advantage of their massive datasets and improving the search engine, translation, image captioning and recommendations. TensorFlow is also used for machine learning applications such as neural networks. Its flexible architecture allows for the easy deployment of computation across a variety of platforms (CPUs, GPUs, TPUs), and from desktops to clusters of servers to mobile and edge devices. TensorFlow provides stable Python and C APIs; 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.

Q3 2021 Trend Charts

2021 IT Skills & Certifications Volatility Index™

(Data collected through October 1, 2021)

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

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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 July 1, 2021 to October 1, 2021 according to the latest update of Foote Partners' long-running *IT Skills and Certifications Pay Index™* of market values for tech skills. Market value is measured by tracking additional cash compensation paid to workers by their employers for specific certified and non-certified skills they possess.

Current Quarterly Recap (data collected through October 1, 2021)

TOTAL: All Skills and Certifications

- **26.7%** of skills and certifications (312 of 1,167) changed in market value in 3rd Quarter 2021 compared to **23.9%** in the prior quarter. Average volatility in the prior year 2020 measured **27.3%**.

- **141** gained value and **171** declined in value in the 3rd quarter of 2021 compared to 155 and 121, respectively, in the prior quarter---a significant **change from the prior quarter's** pay performance.

NON-CERTIFIED SKILLS

- **31.4%** of reported skills (195 of 621) changed value in 3rd Quarter 2021, higher than the 178 volatility in the prior quarter when **29%** changed in value. Compare this to **average volatility of 33.5% for the 2020 calendar year.**

- **79** noncertified skills gained in market value; **116** declined in value in the 2nd Quarter compared to 86 and 92 volatility, respectively, in the prior quarter.

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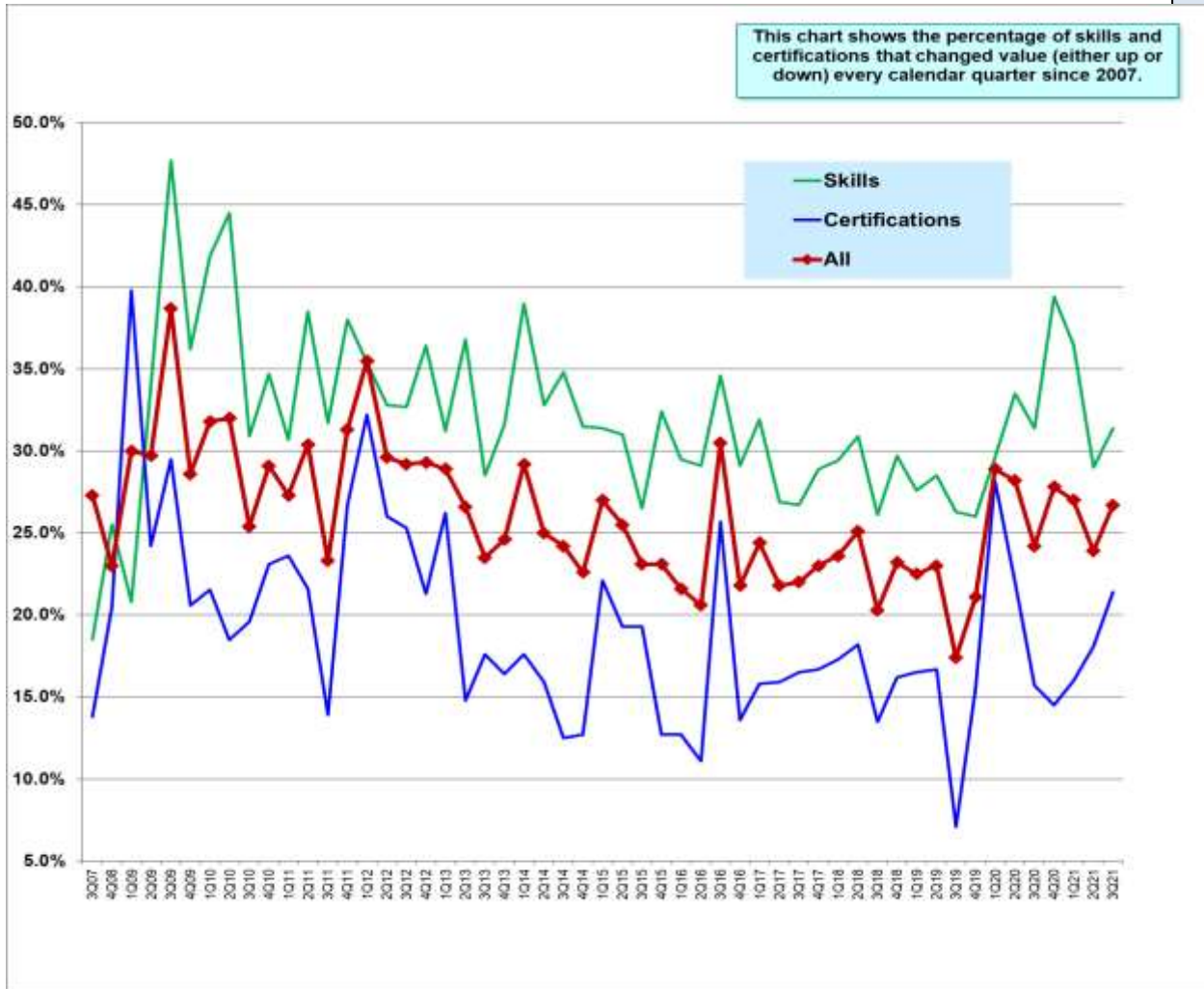
Similar to jobs, IT skills have broad skills categories that can be tracked (e.g., security, networking, systems, database, applications development). But unlike jobs, skills pay can be pinpointed to hundreds of niches and specialization. Also, unlike most job trends analyses, within skills categories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

Quarterly volatility for all 1,185 certified and noncertified 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 report.

VOLATILITY HIGHLIGHTS - 15 Year Trending

IT Skills and Certifications Volatility Index™ – 1,185 Skills and Certifications

This chart shows the percentage of skills and certifications that changed value (either up or down) every calendar quarter since 2007.

— Skills
— Certifications
—◆— All

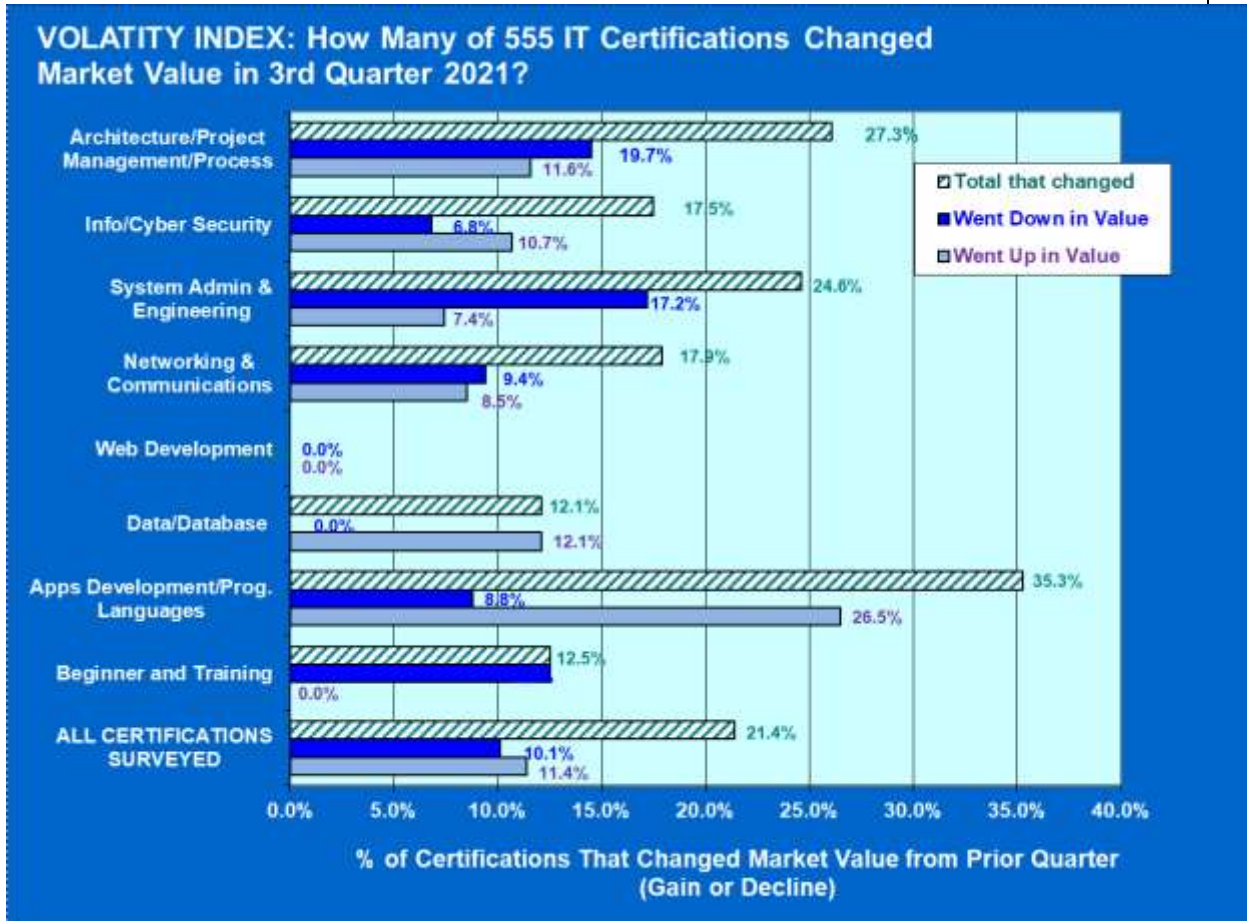**ecent IT skills and certifications volatility trends**

QUARTERLY SUMMARY

Quarter 2021 volatility in skills and certifications values is
ee points higher than the prior quarter and on par with the
3% average volatility for calendar year 2020.

ONCERTIFIED SKILLS VOLATILITY in 3Q 2021 (31.4%) was a few
nts higher than the prior quarter (29%) but still lower than the
erage volatility in the 2000 calendar year (33.5%).

CERTIFICATIONS VOLATILITY in 3Q 2021 rose to 21.4% from
1% in the prior quarter. This is slightly higher than the 2020
endar year average volatility of 20%.

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

VOLATILITY HIGHLIGHTS   **IT Certifications – 3rd Quarter 2021 data**

(Source: Foote Partners LLC, 2021 IT Skills & Certifications Pay Index™)

IT Skills and Certifications Volatility Index™
3Q 2021 data edition findings: Tech Certifications

Certifications Volatility Highlights

Among all 555 certifications surveyed, highest volatility (>15%) occurred in these segments (ranked highest to lowest):

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

Within segments, notable upward volatility (value **gains**) occurred most in these:
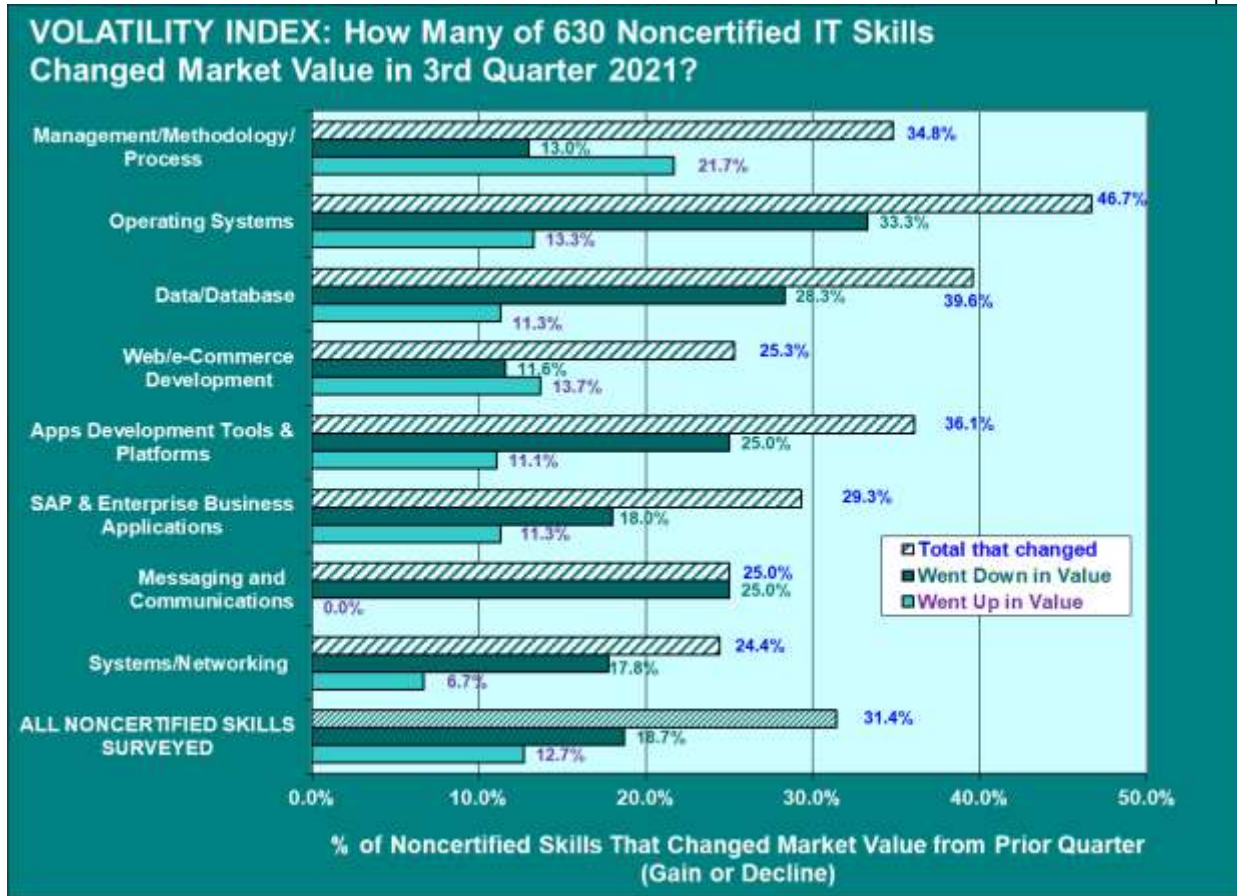
- Applications Development

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

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

(Pay data supporting these charts available in the _IT Skills and Certifications Pay Index™_ – 2007 to 2021 quarterly data edition)

VOLATILITY HIGHLIGHTS **Non-certified IT Skills – 3rd Quarter 2021 data**

VOLATILITY INDEX: How Many of 630 Noncertified IT Skills Changed Market Value in 3rd Quarter 2021?

% of Noncertified Skills That Changed Market Value from Prior Quarter (Gain or Decline)

IT Skills and Certifications Volatility Index™
3Q 2021 data edition findings: Non-certified IT Skills

Noncertified IT Skill Pay Volatility Highlights

Among all 630 noncertified IT skills surveyed, high volatility (>20%) occurred in all but one segments (ranked highest to lowest):

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

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

- Management/Methodology/Process

Within segments, notable downward volatility (value **declines**) occurred most in these (ranked):
- Operating Systems
- Data/Database
- Applications Development Tools & Platforms
- Management/Methodology/Process
- SAP & Enterprise Business Apps
- [Tie] Web/E-commerce Development; Messaging and Communications; Systems/Networking

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

2021 IT Skills and Certifications Pay Index™ (3rd Quarter Data edition)

- Pay premiums for **1,185 certified and noncertified IT skills**
  - Three data points for each position: 10th, 50th, 90th percentile
- Verified and validated IT skills pay data from **86,814 IT professionals at 3,866 employers** in US and Canada
- Current data collected through October 1, 2021 (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

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

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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 350,849 tech professionals at 3,866 employers in 83 U.S. and Canada cities are reported for IT salaries and skills pay earned for 250 positions and 1,185 certified and noncertified technical and business skills. Verified and validated pay data for 86,814 tech workers has been included in the 3rd Quarter 2021 data edition of the ITSCPI, compiled from data collected through October 1, 2021.

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

- 18% of participating organizations have $5 billion+ in sales/$15+ billion in total assets

- 28% of participating organizations earn more than $1 billion in annual revenues or more than $5 billion in total assets

- 46% of participating organizations have $500+ million in sales/$1+ billion in total assets/$500+ million in premiums/$500+ million operating budget (government, educational, not-for-profit)

- 54% of participating organizations fall in the SMB (small-to-medium sized business) segment, generally defined as organization under $500 million in sales.

- [Public sector] 5% have operating budgets of $500 million or more, [nonprofit/educational sectors] 4% with operating budgets $100 million to less than $500 million

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

Please visit the Foote Partners web site: IT Skills and Certifications Pay Index

Foote Partners 3Q 2021 IT Compensation Survey Product Map

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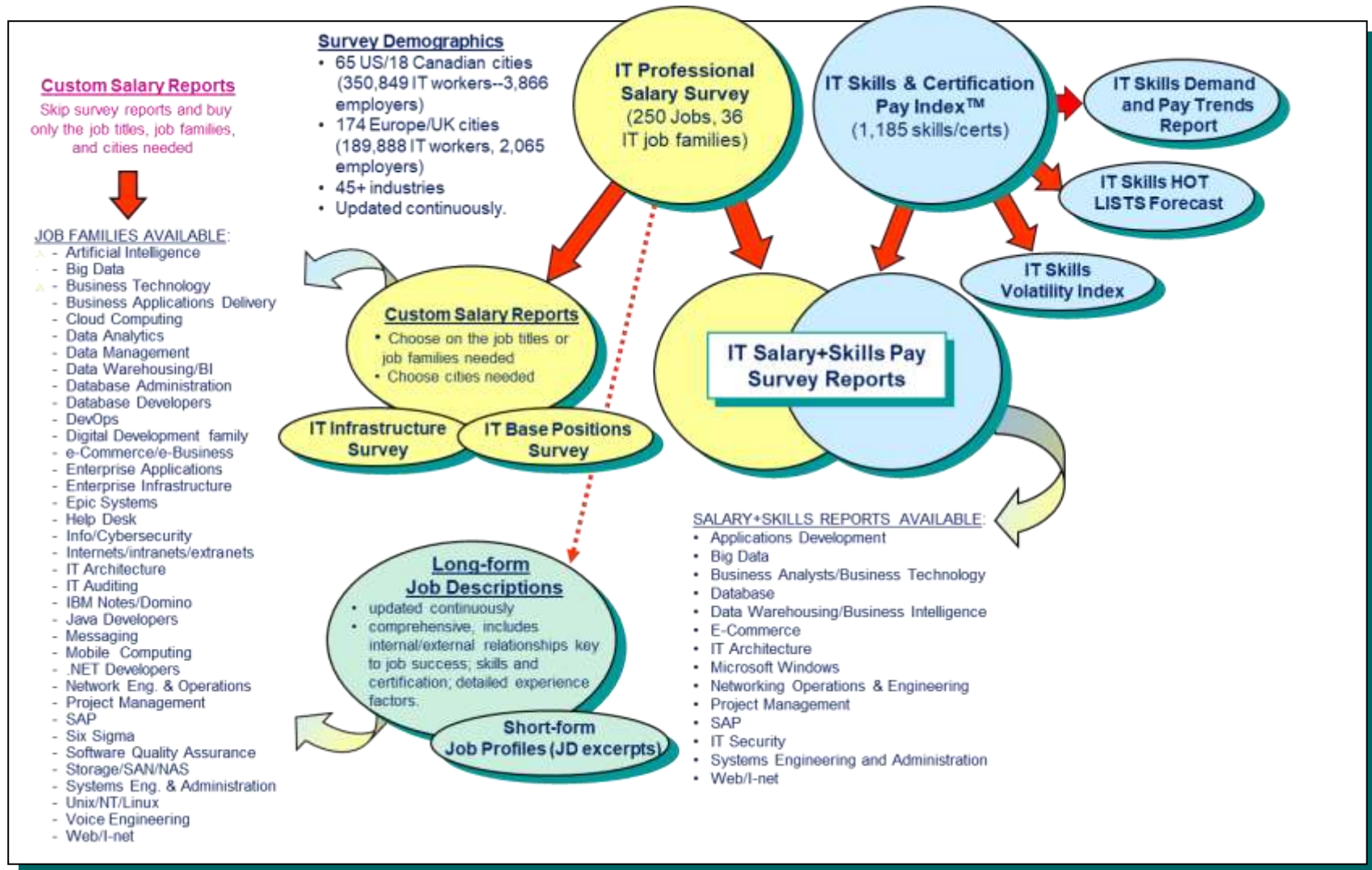
ABOUT FOOTE PARTNERS

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

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

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

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

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