

September 2020

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## Software Sector Insights from Employment Data

### Project Backdrop

Value creation in software businesses comes from their human capital. Given the critical importance, Guggenheim Securities software analysts Imtiaz Koujalgi and Ken Wong aimed for a deeper understanding of how well the companies they follow are poised for revenue growth by examining staffing and hiring trends. To do this, we examined employment data compiled by Revelio Labs for a group of software companies listed below. Companies shown in bold font are covered by Guggenheim Securities software analysts. The monthly employment data extended from January 2008 through June 2020.

Employment data, which tracks people in addition to job postings, contains information on the volume of corporate hiring activity, the types of workers hired, the locations where they work, and employee churn rates.

### Software Companies Included in Employment Data Analysis

<b>8x8, Inc.</b>	<b>EGHT</b>	Dropbox, Inc.	DBX	<b>RingCentral Inc.</b>	<b>RNG</b>
<b>Adobe Systems, Inc.</b>	<b>ADBE</b>	Elastic N.V.	ESTC	salesforce.com, inc.	CRM
<b>Altair Engineering Inc.</b>	<b>ALTR</b>	<b>Fortinet Inc.</b>	<b>FTNT</b>	<b>Shopify Inc.</b>	<b>SHOP</b>
<b>Alteryx, Inc.</b>	<b>AYX</b>	GoDaddy Inc.	GDDY	Slack Technologies Inc.	WORK
<b>ANSYS, Inc.</b>	<b>ANSS</b>	<b>Guidewire Software, Inc.</b>	<b>GWRE</b>	<b>Splunk, Inc.</b>	<b>SPLK</b>
Aspen Technology, Inc.	AZPN	<b>HubSpot, Inc.</b>	<b>HUBS</b>	Twilio Inc.	TWLO
Atlassian Corporation	TEAM	<b>Intuit Inc.</b>	<b>INTU</b>	Tyler Technologies, Inc.	TYL
<b>Autodesk, Inc.</b>	<b>ADSK</b>	MongoDB, Inc.	MDB	<b>Veeva Systems, Inc.</b>	<b>VEEV</b>
Box, Inc.	BOX	New Relic, Inc.	NEWR	Vonage Holdings Corp.	VG
<b>Check Point Software Tech.</b>	<b>CHKP</b>	<b>Okta, Inc.</b>	<b>OKTA</b>	<b>Wix.com Ltd.</b>	<b>WIX</b>
Cloudera, Inc.	CLDR	<b>Palo Alto Networks, Inc.</b>	<b>PANW</b>	Workday, Inc.	WDAY
<b>CyberArk Software Ltd.</b>	<b>CYBR</b>	Paycom Software, Inc.	PAYC	<b>Zendesk, Inc.</b>	<b>ZEN</b>
Dassault Systèmes SE	DASTY	Paylocity Holding Corp.	PCTY	<b>Zoom Video Comm.</b>	<b>ZM</b>
Datadog, Inc.	DDOG	<b>Proofpoint, Inc.</b>	<b>PFPT</b>	<b>Zscaler, Inc.</b>	<b>ZS</b>
DocuSign, Inc.	DOCU	<b>PTC Inc.</b>	<b>PTC</b>		

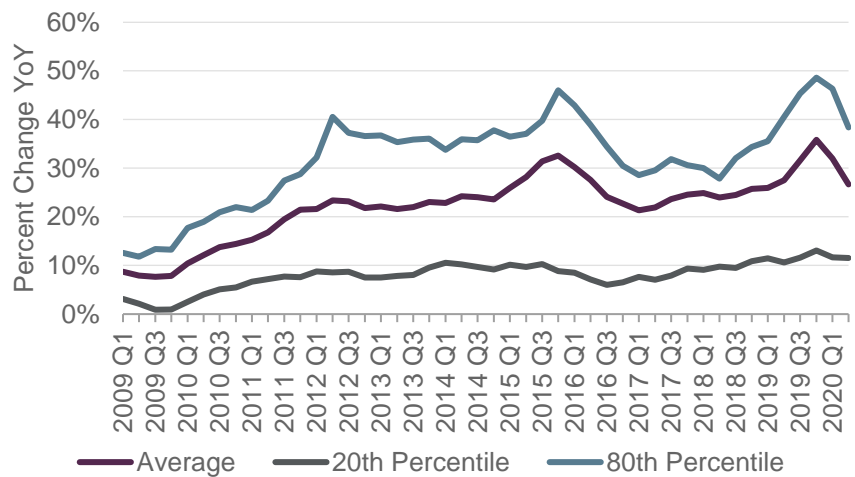
Note: Bolded companies are covered by Guggenheim Securities, LLC. See page 14 of this report for analyst contact information.

## Employment Growth

Revelio Labs' employment dataset provided insights into the current volume of hiring activity and quality of hiring, as the data points to certain types of employee growth being more positively correlated with revenue growth. Revenue growth was 59% correlated with overall employee growth, 70% correlated with growth in sales staff, and 66% correlated with growth in engineers<sup>1</sup>. Employee growth in higher GDP regions was seen as the most positively correlated with revenue growth, as was the hiring of relatively senior employees.

The annual rate of employee growth in Q2 2020 was significantly reduced, bringing the average for the group down to 20% from 26% in Q3 2019.

### Software Group Annual Employment Growth Q1 2009 - Q2 2020



Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

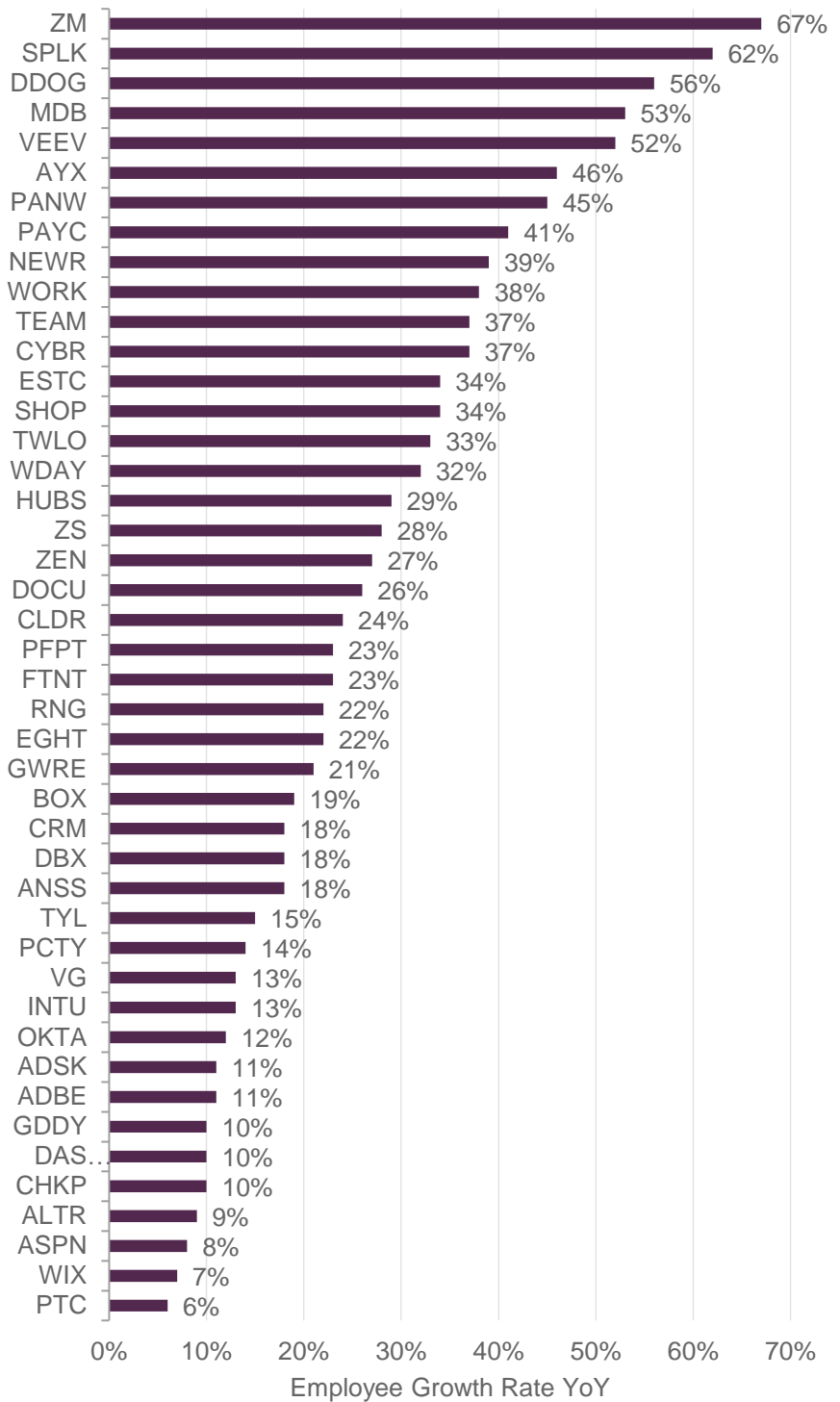
The COVID-19 economic environment has delivered both favorable and unfavorable software product demand shocks. In this environment, it would be reasonable to expect that employment growth is less tied to revenue growth than it was in the economically less turbulent 2010s. In 2020, the software sector has seen a surge in adoption of CaaS; a notable increase in IT security needs; and explosive growth in e-commerce. The employment data shows that, despite the acceleration of many favorable secular trends in the current environment, the rate of hiring among the faster growing sectors (80<sup>th</sup> Percentile in the chart above) was curtailed relatively more.

<sup>1</sup> All correlation figures quoted were calculated using Pearson methodology and have p-values within a 98% confidence interval.

**Employee Growth in Calendar Q2 2020**

- Unsurprisingly, **ZM** led the group with the highest growth rate.
- Companies in the Security and Infrastructure Software space, particularly **SPLK**, **DDOG**, **MDB**, **AYX**, and **PANW** have been some of the fastest growers.
- At the lower end of the growth spectrum are some of the Vertical Software companies including **PTC**, **ASPN**, **ALTR**, and **DASTY**.

**Calendar Q2 2020 Employee Growth YoY**



Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

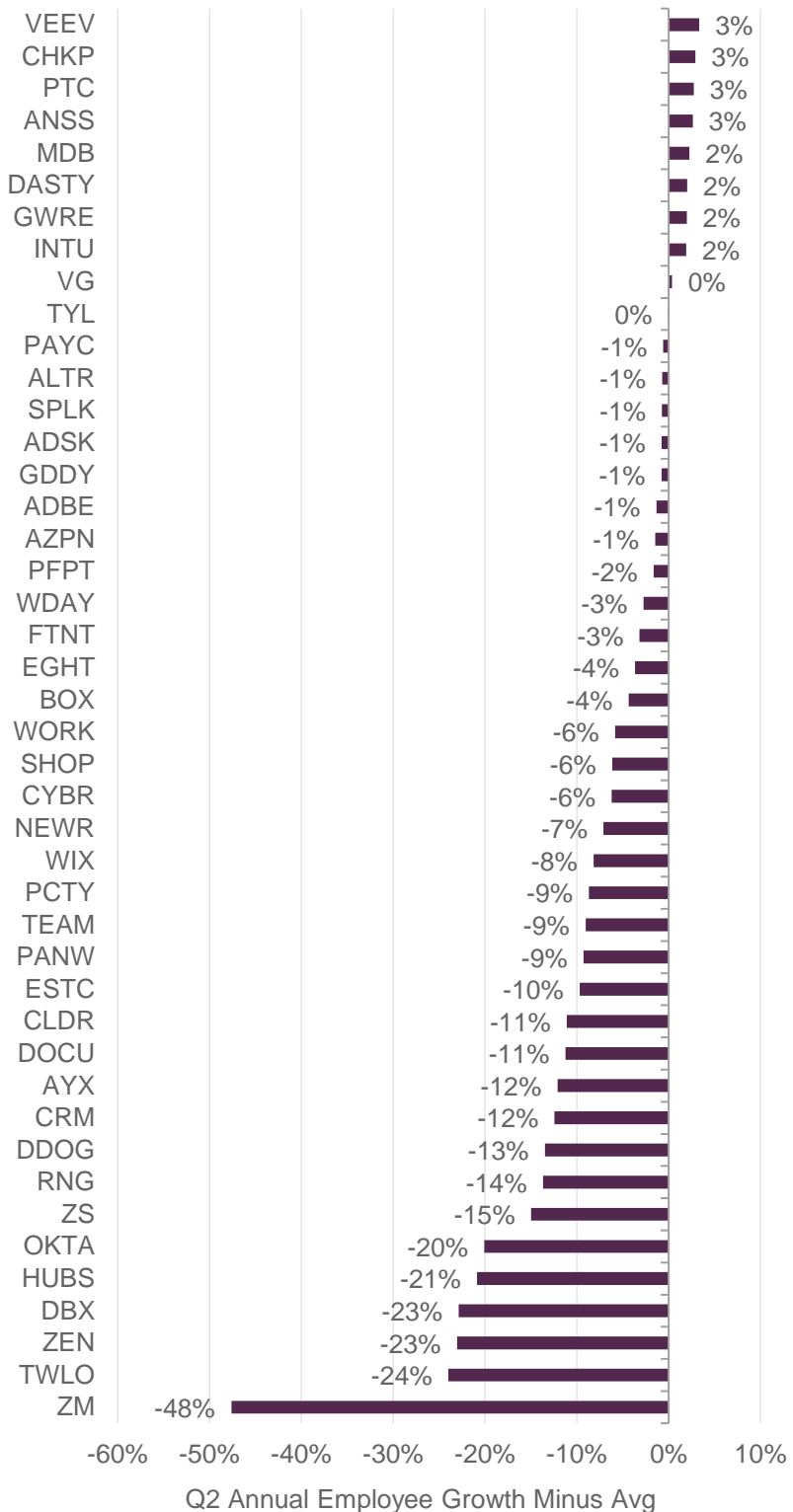
**Employee Growth in Q2 2020 compared to Q1 2020 and Q4 2019**

Most of the faster growing companies strongly reduced their headcount growth rate in the recent quarter, compared to the average of the prior two quarters.

A few notable exceptions were:

- **VEEV**, a Vertical Software company yet one of the fastest growing companies in headcount, slightly increased its 50%+ growth rate from prior quarters. Growth in engineers was particularly strong.
- **MDB**, also slightly increased its growth rate, particularly in sales staff.
- **SPLK** only marginally reduced its headcount growth rate.
- **ANSS** and **GWRE**, two of the faster growing Vertical Software companies with annual headcount growth just under 20% both slightly increased their growth rate in Q2 2020.

**Q2 2020 Employee Growth vs. Average Employee Growth in Prior Two Quarters (Q4 2019 and Q1 2020)**

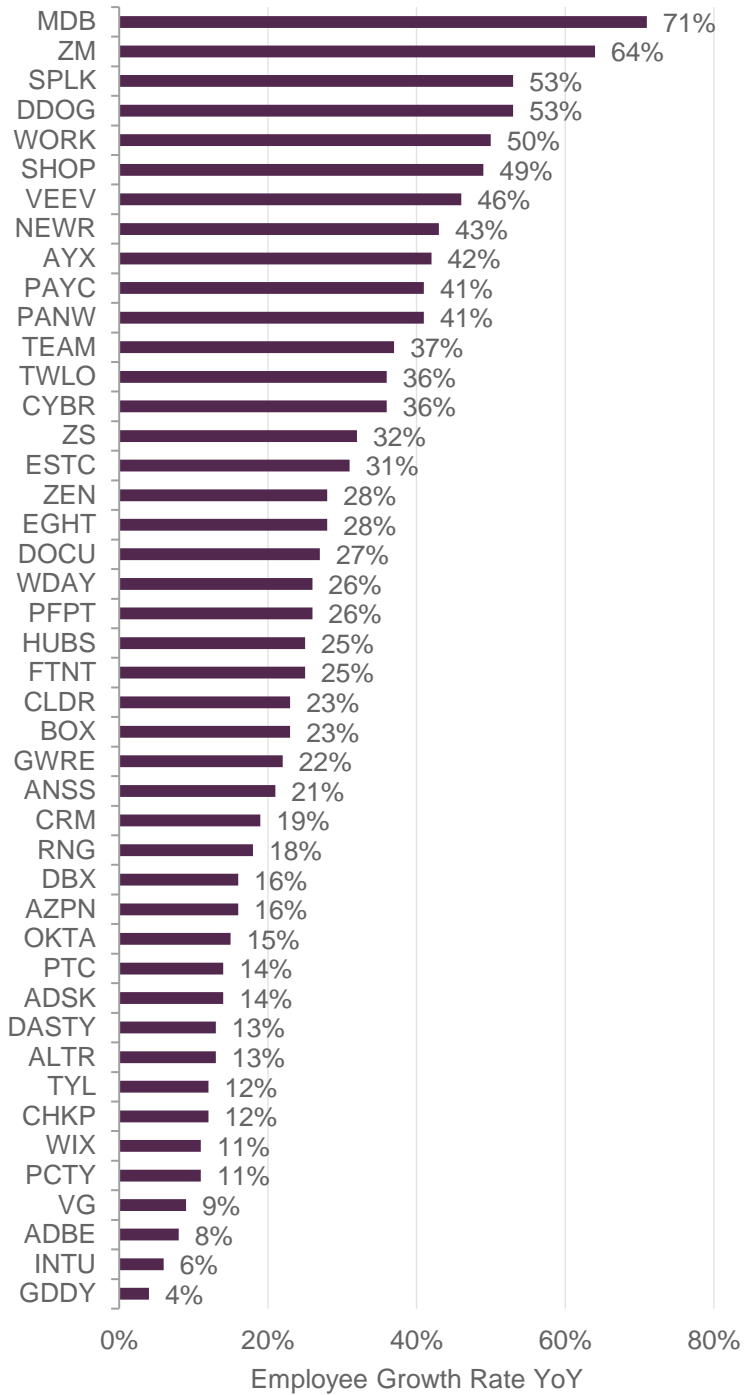


Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

### Employee Growth by Job Category

Sales staff, which for the group averaged approximately 20% of employees in the last quarter, was the job category whose growth was most highly correlated with revenue growth (70%).

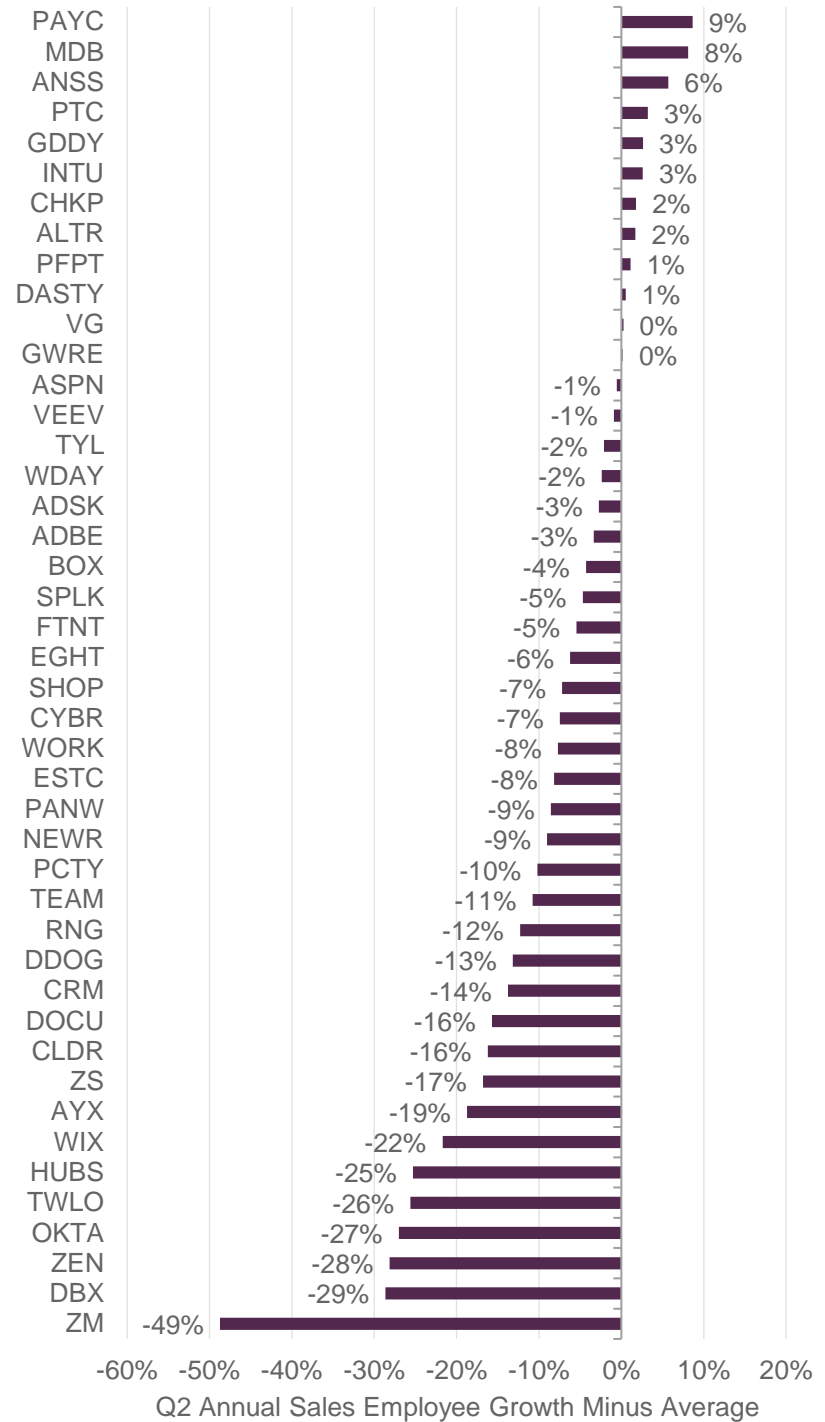
#### Calendar Q2 2020 Growth in Sales Employees YoY



Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

Companies that strongly curtailed employee growth in Q2 also reduced their growth in sales staff. Companies that stand out with relatively larger reductions in sales staff growth rates include **WIX**, **OKTA**, **AYX**, and **DBX**.

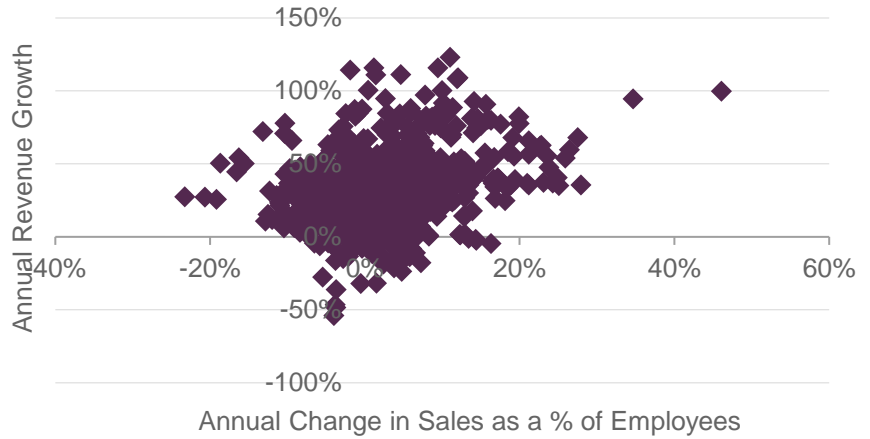
**Q2 2020 Sales Employee Growth vs. Average Sales Employee Growth in Prior Two Quarters (Q4 2019 and Q1 2020)**



Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

Growing sales staff as a percentage of employees was identified as a predictive variable for revenue growth with a 28% correlation. Companies with the highest growth in the percentage of sales employees in Q2 2020 were **MDB** (12%), **SHOP** (11%), and **WORK** (9%).

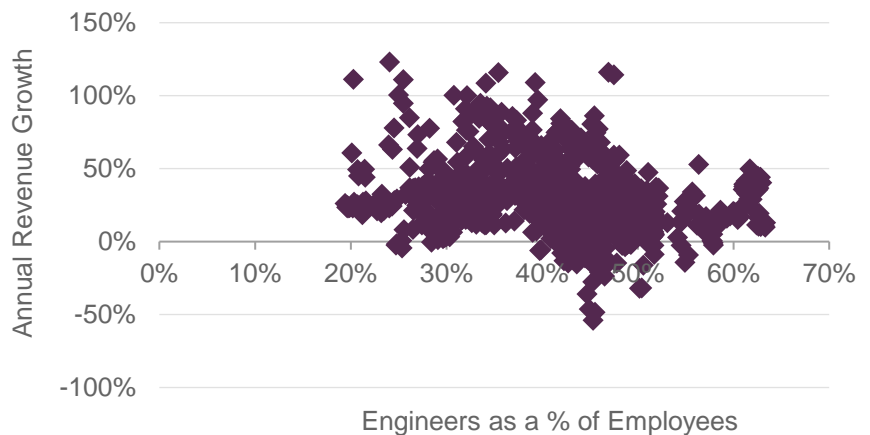
### Revenue Growth vs. Change in Sales as a Percentage of Employees



Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

While hiring of engineers was more highly correlated with revenue growth (66%) than employment hiring generally (59%), growth in the proportion of engineers was not always positive, particularly as engineers became a higher percentage of employees.

### Revenue Growth vs. Engineers as a Percentage of Employees



Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

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In Q2 2020, the rate of hiring of engineers was mostly in line with the pace of employee growth, which makes sense because engineers represented on average roughly 40% of employees. Outliers with particularly strong growth in engineers were **ZM** and **AYX**. Only **MDB** notably reduced its growth rate in engineers relative to employees overall.

### Other Features of Employee Growth

Geography, seniority, and an employee “prestige” score developed by Revelio Labs were all factors that differentiated the level of revenue growth, but all were second in importance to overall employee growth, growth of sales people and growth in engineers. Growth by geographic region and seniority was important while mix was not. Employee growth in higher GDP regions and growth in more senior employees—particularly sales, engineers, and managers—was positively correlated with revenue growth.

Revelio Labs’ prestige score is assigned to employees based on education, schools attended, and previous employers. For the companies analyzed, the average prestige score of workers was 23% correlated with revenue growth. However, unlike geography and seniority, change in prestige was negatively correlated with revenue growth because as companies grew in headcount, prestige scores tended to converge to an average level. More companies with relatively high prestige scores had declining scores as they grew compared to lower scoring companies improving in score as they grew, resulting in a slightly negative correlation between change in prestige and revenue growth.

Companies with high quality employee growth—those whose mix of hiring by geography, seniority, prestige, and job category was a net positive— included **ADBE**, **ADSK**, **DDOG**, **PTC**, **SHOP**, **WIX**, and **ZS**. This means that revenue growth predictions for these companies was higher than it would have been if just the employee growth rate, the sales employee growth rate, and/or the engineer employee growth rate were used to generate an estimate. Companies for which the opposite is true included **VEEV** and **BOX**.

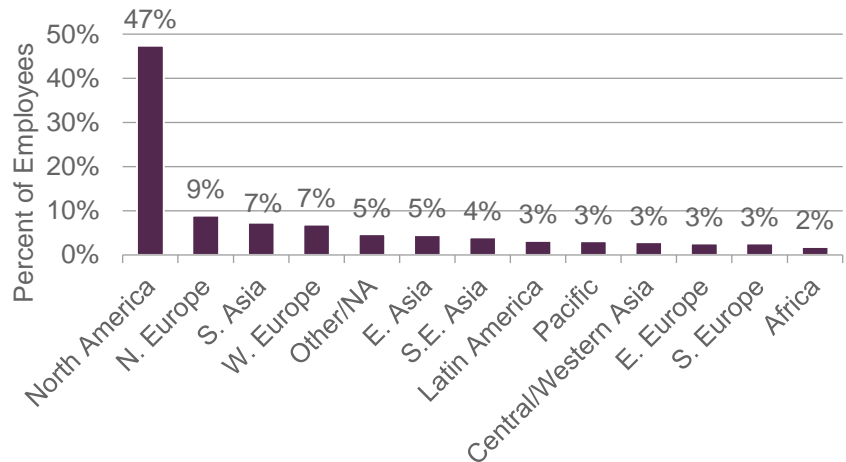


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## Employment by Geographic Region

The aggregate regional breakdown of employees in the recent quarter is shown below.

### Employees by Region - Q2 2020



Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

Employee mix by region was not a differentiating variable with regards to revenue growth. However, growth in employees in economically important regions such as North America, Europe and Eastern Asia did correlate positively with revenue growth. Employee growth in low salary regions did not appear to be an influential factor.

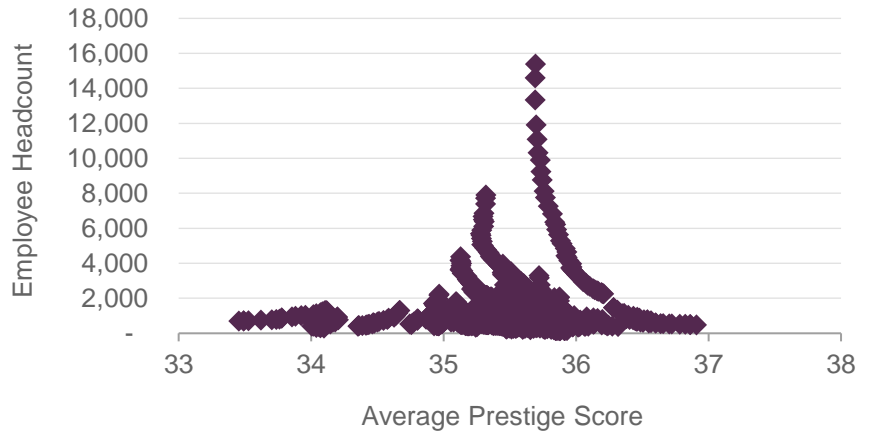
## Employee Seniority

Revelio Labs assigns a seniority category rank of 1 to 4 to each employee. A company's mix of employees by seniority was not correlated with revenue growth but growth in level 3 seniority relative to other levels was 37% correlated with revenue growth and was found to be a significant variable in predictive models. For sales people and engineers, growth in employees ranked 3 and 4 was more highly correlated with revenue growth than those ranked 1 and 2. Growth in management levels 2 and 3, relative to levels 1 and 4, was positively correlated with revenue growth and was also found to be significant in predictive models. Perhaps growth in this level of management goes hand in hand with growth in sales and engineers.

- **SHOP** and **CLDR** increased the percentage of level 3 employees the most, at 8% and 5%, respectively.
- **DDOG**, **MDB**, **HUBS**, **ZS**, and **ESTC** all increased the percentage of mid-level management relative to junior and senior management.

## Employee Prestige Score

### Employee Headcount vs. Average Employee Prestige Score



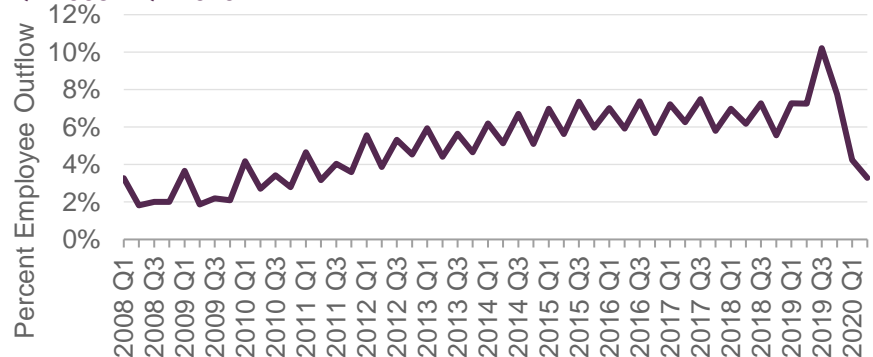
Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

In Q2 2020, **VEEV**, **DBX**, **WORK**, **SHOP**, **HUBS** and **OKTA** scored relatively high in prestige with scores of 35.8 and higher. Scoring at the low end, 34.7 and under, were **PAYC**, **WIX** and **RNG**.

## Employee Churn

Employee churn rates, defined as employee outflow during the quarter as a percentage of average employee count, trended upwards for the software group until 2020. Therefore, churn rates were correlated positively with revenue growth for the period studied.

### Software Group Quarterly Employee Churn Rate Q1 2008 - Q2 2020



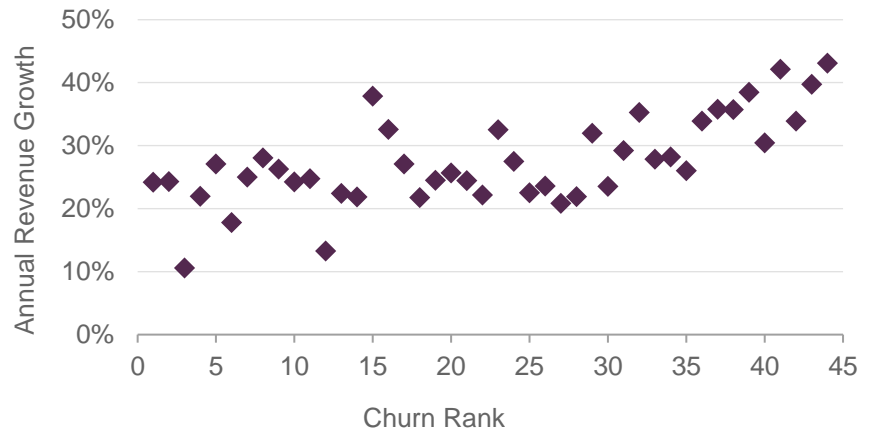
Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

When companies were assigned a numerical rank within the group based on relative churn rate, there was still a positive correlation between high

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rates of employee churn and high revenue growth rates. The average churn rank on a company basis showed that the faster growing companies do have higher churn rates and a handful of fast-growing companies generated the spike in churn rates seen in Q3 2019. This counterintuitive result could be due to the high rates of growth in the software industry and a scarcity of skilled workers in the field.

### Average Annual Revenue Growth by Churn Rank Q1 2009 - Q1 2020



Source: Guggenheim Securities, LLC, Digital Trend Analytics, Revelio Labs.

### Employment Data Analysis

The findings in this report came from exploratory data analysis, examining correlations and trends over time, and from applying machine learning algorithms. Machine learning algorithms quantified the predictive power of the data as well as identified relationships within the data. This dataset tracks 16 geographic regions and 9 job categories, for which there are 4 levels of seniority, and 5 other metrics (count, inflow, outflow, prestige and salary), resulting in 2,880 combinations, or potential data points, for any given quarter. Machine learning was helpful in identifying which of those variables, and which combination of variables, were influential. For example, strong growth in senior sales people in North America accompanied strong revenue growth while growth in junior technicians and marketing staff did not, regardless of region.

For the companies studied, annual revenue growth varied from -50% to +120% with a mean of 27% and standard deviation of 23%. Predictive models built from the employment data frequently showed a 5-7% mean absolute error in back testing using no additional data sources. When the models are applied to Q2 2020 employment data, however, it's evident that the predictions error will be much larger than what was observed in back

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tests even though only a portion of the companies have reported results through June.

No additional data was incorporated into the models to indicate the paradigm shift in business conditions in 2020 as a result of COVID-19. The rationale for this is that the objective was not to build the most accurate model. Rather, the objective was to assess how accurate the employment data could be on its own.

### **Machine Learning Algorithms Employed**

AutoML, or Automated Machine Learning, is a process whereby groups of algorithms are applied to a dataset. Some of the data pre-processing is also handled by the program. This study used [H2O.ai](https://www.h2o.ai), which generated stacked ensembles of machine learning models.

Gradient Boosting Machines (GBM) and Distributed Random Forests (DRF) were the most commonly leveraged algorithms. Both are decision-tree based and therefore allow for the inclusion of highly correlated variables, which is the case with this dataset. Change in headcount by job category and by region were highly correlated, for example, as was employee count and prestige. Both approaches also work well with conditional relationships, the types of interactions that we were seeking to identify in the data.

Decision trees with 5-6 nodes performed the best, indicating a strong interdependence among the variables. The most important variables were employee headcount growth, growth in engineers, growth in sales people, employee growth in North America, growth in senior employees, and company size.

The AutoML approach occasionally generated Deep Learning models that were incorporated into the stacked ensemble. The Deep Learning models tended to put emphasis on a wider range of variables than the GBM and DRF models did. Average prestige score, in particular, was deemed a more important variable in the Deep Learning models than it was in the GBM and DRF models. The Deep Learning models underperformed GBM and DRF models in cross validation.

### **Angles Unexplored**

This analysis did not take a time series approach due to the lack of historical revenue growth data for many of the companies in the group. A time series approach could potentially address questions such as whether hiring of sales people is relatively high or low after a surge of hiring of

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engineers, and whether that signals anything about earnings growth. Lagged variables were included in the analysis but were less predictive than current ones. For example, current quarter year-over-year employee growth was more important than the previous quarter's rate. The accuracy of the predictive models could have been improved by including a variable to differentiate the year and quarter, but it was not necessary to evaluate the relationships in the data and the predictive power of the data was evident without it.

The dataset tagged employees by job roles in addition to job category. Further investigation into the 150 job roles could yield additional insights. Additionally, employee salary estimates were provided by Revelio Labs, but not explored in this analysis.

### **About Revelio Labs**

[Revelio Labs](#), a workforce intelligence company based in New York City, was founded by data scientist Dr. Ben Zweig in 2018. The company leverages the latest advances in AI research methods to create a structured dataset from hundreds of millions of public employment records including resumes, employee profiles, and corporate job postings.

Deriving structure and meaning from the raw text data is a large AI and NLP undertaking with the most difficult challenge being that job positions are extremely numerous and ambiguous. There are approximately 40 million unique job titles in Revelio Labs' raw dataset. The company developed deep NLP models to represent every position mathematically so that they can cluster close positions together into occupational clusters. This becomes the taxonomy of job roles. Revelio Labs developed a set of proprietary clustering algorithms that are specifically tailored to the needs of generating unsupervised taxonomies. Continuing down this road, Revelio Labs built models that can represent high dimensional text into a simple, flexible, and robust set of ontologies representing skills, seniority and educational background.

Revelio Labs' curated dataset provides 10+ years of historical data covering 2.3+ million companies, which are mapped to Ticker, CUSIP, and ISIN/MIC. The dataset covers public and private companies globally with stronger representation in North America, South America, and Europe.

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