Crunched by the Numbers:

THE DIGITAL SKILLS GAP IN THE WORKFORCE

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Capital One

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EXECUTIVE SUMMARY

In the middle-skill job market, the world is increasingly divided between the jobs that demand digital skills and those that don't—and the ones that don't are falling behind.

Much of the debate over technology in the workforce has focused on sophisticated skills, such as writing code. But the more significant impact on the middle-skill job market is in the humbler world of everyday software: spreadsheets and word processing, programs for medical billing and running computerized drill presses. To a large extent, a job seeker without the ability to use this software won't even get in the door.

Middle-skill jobs, roughly defined as those that require more than a high school education but less than a bachelor's degree,[1] comprise 39% of U.S. employment. These jobs matter because they have long sustained a middle-class lifestyle for millions of Americans, and because they're increasingly pressured by changes to the economy. Two-thirds of Americans don't have a college degree, and these jobs represent important career opportunities for them.

A study of job postings by Burning Glass Technologies found that middle-skill jobs that require digital skills are outpacing those that do not in a wide range of ways:

- **Nearly eight in 10 middle-skill jobs require digital skills.** Spreadsheet and word processing proficiencies have become a baseline requirement for the majority of middle-skill opportunities (78%).
- **Digitally intensive middle-skill occupations are growing faster than other middle-skill jobs.** Digitally intensive jobs have grown 2.5 times more rapidly than middle-skill jobs that do not require spreadsheets, word processing, or other digital skills (between 2003 and 2013, 4.7% growth for digitally intensive jobs compared to 1.9% growth for other positions).
- **Digitally intensive middle-skill jobs pay more than middle-skill jobs that do not require a digital component.** Digitally intensive middle-skill occupations offer 18% higher wages on average: $23.76 per hour compared to $20.14 per hour for all other middle-skill jobs.

In fact, as the nation has recovered from the Great Recession, growth for digitally intensive middle-skill jobs has been equivalent to the growth of high-skill positions over the same period (4.8% for digital middle-skills and 4.7% for high-skill positions from 2010 through 2013). Since they are growing more rapidly and pay more than other middle-skill jobs, these jobs offer a promising career path for Americans who lack a bachelor's degree.

By contrast, middle-skill jobs that are not digitally intensive have had the slowest growth of any category, behind even low-skill positions (1.9% for non-digital middle-skill jobs between 2004 and

[1] A specific definition of middle-skills as it pertains to this analysis is in the methodology.

2013, compared to 2.9% for low-skill jobs). These positions, primarily in transportation, construction, and installation/repair, lag in pay, growth, and opportunity.

DEFINING THE TERMS: MIDDLE-SKILLS, DIGITAL SKILLS, AND A LIVING WAGE

The debate over the future of the American workforce tends to express itself in broad sweeps. Middle-skill jobs play an essential role in the economy, but many economists worry they are being squeezed out by the changes wrought by technology and globalization.[2] Many economists worry about "hollowing out" the labor force: losing middle-skill jobs and adding jobs only at the high and low ends of the labor market.

Those trends are abstract to the job seeker scanning job boards or the employer posting an ad. People don't post or apply for jobs based on sweeping social changes; they act based on the skills and options available to them. In this report, we take a more granular approach, attempting to understand the impact of the demand for digital skills on specific occupations.

To conduct our analysis, we went to the source: the skills employers ask for in job postings. Burning Glass scans close to 40,000 job boards, employer sites, and other sources of job postings daily, using artificial intelligence technology to break down these postings into the specific skills and qualifications employers demand.

As we examined these postings, certain clusters of digital skills became apparent**:**

Productivity Software Skills, such as using spreadsheets and word processing programs, are required for the majority of middle-skill jobs. In addition, they often serve as a baseline skill level for more advanced positions. For this report, "productivity software middle-skill occupations" are occupations that require only productivity software skills and no other digital skill group.

Advanced Digital Skills, such as customer relationship management (CRM) software and higher-end computer networking skills, are required in many middle-skill occupations in addition to a baseline of productivity software skills.

Occupationally Specific Digital Skills, such as health technology and computer-controlled machines, are required in specific technical occupations. For many machinist positions, for example, the ability to physically operate machine tools isn't as important as the ability to guide the robots that operate the tools.

The definition of middle-skill jobs has itself become fuzzy, as degree inflation and other trends make the traditional definition (more than a high school diploma, less than a bachelor's degree)

[2] See, for example, the report "Bridge the Gap: Rebuilding America's Middle Skills," produced by the U.S. Competitiveness Project at Harvard Business School, Burning Glass, and Accenture, www.hbs.edu/competitiveness/research/Pages/middle-skills.aspx.

less accurate.[3] For our purposes, we defined middle-skill occupations as those where fewer than 80% of job postings called for a bachelor's degree and that also offer a median hourly wage above that of the national living wage.[4]

THE TRIUMPH OF THE SPREADSHEET: PRODUCTIVITY SOFTWARE

To a remarkable extent, middle-skill jobs have moved from the factory to the office over the last three decades. And office jobs have become defined by productivity software such as spreadsheets and word processing.

Back at the dawn of the computer era, there were those who saw this coming. In fact, for many in the business world, what turned the PC from a toy into a tool was, in the 1980s, the development of spreadsheet programs like Lotus 1-2-3. This enabled workers to track and analyze numbers much more quickly and efficiently.[5]

Since then, spreadsheets have become so central to business and government that spreadsheet errors have become a high-stakes issue.[6] Inaccurate spreadsheets have been implicated in major trading losses[7] and undermined a widely cited academic paper on government finance.[8]

So it is no surprise that 67% of all middle-skill job openings require, at a minimum, proficiency in productivity software such as Microsoft Excel or Microsoft Word, or enterprise resource management software like Oracle or SAP. Chief among these are Office and Administrative Assistant roles, but this also includes positions like Retail Supervisors and Store Managers.

Perhaps more importantly, middle-skill jobs requiring productivity software skills— and no other digital skills—pay 13% more than those that don't ($22.66 per hour for jobs requiring productivity software skills versus $20.14 for non-digitally intensive jobs). In addition, these skills are foundational. More advanced positions require productivity software skills in addition to the extra digital skills needed to advance.

Employers continue to demand other skills that would be helpful in an office environment, such as communications skills, writing, and relationship building. But word processing and spreadsheets are a basic requirement for nearly all office jobs.

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[3] Burning Glass Technologies, "Moving the Goalposts: How Demand for a Bachelor's Degree is Reshaping the Workforce," www.burning-glass.com/research/credentials-gap/.
[4] The living wage calculation is explained further in the methodology.
[5] See, for example, *Harpers*, "A Spreadsheet Way of Thinking," November 1984, https://files.nyu.edu/ap70/public/levyss.htm.
[6] Powell, Stephen G.; Lawson, Barry; Baker, Kenneth R. "Impact of Errors in Operational Spreadsheets," Tuck School of Business, Dartmouth College, http://arxiv.org/abs/0801.0715.
[7] The Baseline Scenario, "The Importance of Excel," Feb. 9, 2013, http://baselinescenario.com/2013/02/09/the-importance-of-excel/.
[8] Economix, *The New York Times*, "With Debt Study's Errors Confirmed, Debate on Conclusion Goes On," April 17, 2013, http://economix.blogs.nytimes.com//2013/04/17/with-debt-studys-errors-confirmed-debate-on-conclusion-goes-on/.

Productivity Software Skills	Top Occupations
• Microsoft Excel • Microsoft Word • Microsoft Outlook • Microsoft PowerPoint • SAP • Oracle	Office / Administrative Assistant
	Retail Supervisor
	Store Manager

Top Baseline Skills for Digitally Intensive Middle-Skill Jobs

Baseline Skills*
Communication Skills
Customer Service
Organizational Skills
Writing
Computer Skills
Problem Solving
Detail-Oriented
Building Effective Relationships
Planning
Multi-Tasking

*Bolded skills represent baseline skills more commonly requested among digitally-intensive middle skill occupations as compared to all middle skill jobs

FROM GENERAL TO SPECIFIC: ADVANCED DIGITAL SKILLS

Advanced digital skills are needed in jobs where there is a direct connection between a specific kind of software and the task at hand. These may or may not be entry-level positions, depending on the occupation, but certainly workers can't even begin a career path in many fields without these skills. A Graphic Designer/Desktop Publisher needs to be familiar with word processing, but also needs to be competent in specific products like Adobe's Photoshop and InDesign. A Sales Representative will need to use spreadsheets, but will probably also need to understand a CRM program like Salesforce or SAP.

Employers pay a premium for this knowledge. Occupations that call for one or more advanced digital skills pay an hourly wage 38% higher on average than non-digital middle-skill occupations ($27.73 vs. $20.14), and 22% more than occupations that call for only productivity software skills. These occupations offer the strongest opportunity for middle-skill job seekers in terms of salary and growth as well as career advancement. In fact, middle-skill occupations requiring CRM software are the highest paying of all the digital middle-skill jobs, with a median hourly wage of $28.90.

Advanced Digital Skills	Top Occupations			Top Skills
Customer Relationship Management	Sales Representative	Sales Manager	Account Manager / Representative	• Salesforce CRM • SAP CRM • Siebel CRM
Computer & Network Support	Computer Support Specialist	Network / Systems Administrator	Network / Systems Support Specialist	• SQL • Linux • Cisco
Digital Media & Design	Graphic Designer / Desktop Publisher	Marketing Coordinator / Assistant	Multimedia Designer	• Adobe Photoshop • Adobe Acrobat • InDesign
Social Media Tools & Search Engine Analysis	Recruiter	Graphic Designer / Desktop Publisher	Search Engine Optimization Specialist	• Social Media Platforms • Blogging • Google Analytics

OPERATING THE EQUIPMENT: OCCUPATIONALLY SPECIFIC DIGITAL SKILLS

Occupationally Specific Digital Skills are focused on technologies commonly used in Health Care, Production, and Manufacturing occupations. Spreadsheets and word processing are less important here, although they are still usually required. Instead, the core skills are specific to the machinery and technology used by each occupation, for example, knowledge of radiology machines by Radiology Technicians.

Occupationally Specific Digital Skills	Top Occupations			Top Skills
Health Care Technology	Registered Nurses	Medical Laboratory Technician	Radiology Technician	• Advanced Cardiac Life Support (ACLS) • Critical Care • Vital Signs Measurement
Health Information Technology	Medical Secretary	Medical Coder	Health Information Technician	• Medical Billing and Coding • Health Information Management • Health Information Exchange (HIE) Technology
Machining Technology	Machinist	Mechanical / Electrical Engineering Technician	CNC Operator	• AutoCAD • Computer Numerical Control (CNC) • Computer Aided Manufacturing (CAM)

ENTIRE OCCUPATIONS HAVE SHIFTED

Overall, it seems clear that middle-skills work has shifted decisively and is now digitally intensive. As noted, nearly eight in 10 middle-skill jobs now require digital skills. Put another way, the percentage of middle-skill jobs in the U.S. workforce has stayed constant (39% of the workforce in 2004, and still 39% in 2013). But the number of those jobs that would be considered digitally intensive has grown 12% over that same time.

It's no surprise that all of the middle-skill occupations in the Computer and Mathematical family require digital skills. But so do those within Office and Administrative Support, Business and Financial Operations, and Management. The Sales and Related, as well as Health Care Practitioners and Technical occupation families, are not far behind with 94% and 88% of opportunities, respectively, demanding digital skills.

Effectively, entire segments of the U.S. economy are off-limits to people who don't have basic digital skills. Even for middle-skill Production jobs, such as machinists, eight in 10 job postings require these skills at some level.

The occupations where digital skills aren't commonly required are concentrated in just a few areas. Hardly any job postings in Transportation and Materials Moving ask for digital skills. Only a small number of jobs in Construction and Extraction (21%) and Installation, Maintenance, and Repair (35%) seek such skills.

MAJOR CITIES: THE DIGITAL DIVIDE WORSENED

To get a sense of how the digital middle-skills dynamic plays out in different parts of the country, we examined the middle-skills job market in five major metropolitan areas: Dallas-Fort Worth; New York; Richmond, Va.; San Francisco; and Washington, D.C.

In these urban areas, the emphasis on digital skills is even higher than in the nation as a whole, with the percentage of digitally intensive middle-skill jobs ranging from 79% in Richmond to 88% in New York and San Francisco. Employers pay more for digital middle-skill jobs in these cities, probably to compensate for the higher cost of living.

But notably, the same pay advantage doesn't happen with non-digital jobs in those cities, such as truckers, mechanics, and welders. That means the digital wage gap is wider. Digital positions in these cities are twice as likely to pay a living wage as non-digital positions.

IMPLICATIONS

It has been clear for some time that technological illiteracy, much less technophobia, is no longer a sustainable option for the modern worker. But this research documents the extent to which entire sectors of the U.S. economy have no place for workers who do not at least have the basic digital skills to undertake tasks like word processing and maintaining spreadsheets. The fact that, in major cities, an even greater share of these occupations now require digital skills—and major cities have long been regarded as bellwethers for trends that ultimately manifest nationwide—suggests that in the future even more workers could be shut out of middle-skill opportunities.

Retail jobs and sales work, for example, are rightly viewed as occupations that demand good communications and other "people skills." They are also areas where workers without a bachelor's degree still have rich opportunities to advance. Yet even entering these fields, much less advancing, has become increasingly difficult without at least some expertise in productivity software and potentially advanced skills as well.

This also suggests that important challenges are being overlooked in the debate over how to invest in education and training. That debate often centers on high-tech industries, sophisticated computer skills (coding, for example), or specialized skill development for particular occupations. To be sure, these more advanced skills also represent important areas for workforce investment, but clearly a focus on the basics—such as widely used productivity applications and social media tools—would pay significant dividends for many workers.[9]

The good news is that many training options already exist in these areas. The challenge may lie in getting these skills the emphasis they deserve, and in letting students and job seekers know what will be valuable to them in the workforce.

METHODOLOGY

Jobs data in this report are drawn from Burning Glass's database of online job postings, which includes nearly 100 million worldwide postings collected since 2007 and other publicly available data sources. Each day, Burning Glass visits close to 40,000 online jobs sites to collect postings. Using advanced text analytics, more than 70 data fields are extracted from each posting including job title, occupation, employer, industry, required skills and credentials, and salary. Postings are then deduplicated and placed in a database for further analysis.

For the purposes of this report, middle-skill jobs are defined as those with less than 80% of job postings calling for a bachelor's degree and with a median hourly wage above the national living wage of $15.

The living wage is based on the Economic Policy Institute's family budget calculator (http://www.epi.org/publication/ib368-basic-family-budgets/). Calculating the living wage is complex, because of the wide range of households. We used two-parent, two-child households as a standard, which produces a median family income needed to provide a living wage of $63,364. Based on this, we identified $15 per hour as a median national living wage.

For median living wages in specific cities, we made the same calculations based on household size and utilizing the MIT Living Wage Calculator (http://livingwage.mit.edu/). The MIT calculator is built using data from the Economic Policy Institute.

All job postings and data were collected nationwide from December 2013 to November 2014.

- Middle-Skill Occupations are defined as those occupations with more than 20% of postings open to sub-baccalaureate job seekers and a median hourly wage above that of the national living wage of $15.

[9] This is not only true for middle-skill workers. See Burning Glass' report on skills that enhance the value of a bachelor's degree in liberal arts at http://burning-glass.com/media/2950/BGTReportLiberalArts.pdf.

- Total postings reflect the number of jobs posted in the nation from December 2013 to November 2014. Source: Burning Glass Technologies.
- Wage data consist of national median hourly wages for workers in each occupation. Source: Bureau of Labor Statistics
- Employment data consist of the national employment for each occupation from 2004 to 2013. Source: Bureau of Labor Statistics

ABOUT BURNING GLASS

Burning Glass's tools and data play a growing role in informing the global conversation on education and the workforce by providing researchers, policy makers, educators, and employers with detailed real-time awareness of skill gaps and labor market demand. Burning Glass's tools let analysts track job market trends and students plan their careers and find jobs.

With headquarters in Boston's historic North End, Burning Glass is proud to serve a client base that spans six continents, including education institutions, government workforce agencies, academic research centers, global recruitment and staffing agencies, major employers, and leading job boards.

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SUPPLEMENTARY TABLES: MIDDLE-SKILL OVERVIEW

Table A: Middle-Skill Overview – Salary and Demand

Middle-Skill Occupations	Postings	Employment (Source: BLS)	2004-2013 Employment Growth (Source: BLS)	2013 Median Hourly Wage (Source: BLS)
Digital	6,273,985	36,689,590	4.7%	$23.76
Non-Digital	1,669,971	13,905,090	1.9%	$20.14

Table B: Middle-Skill Overview – Employment Growth

	Employment Growth		
	2004-2013	**2007-2013**	**2010-2013**
Low Skill	2.9%	-1.3%	5.2%
Non-Digital Middle-Skill	1.9%	-3.6%	4.1%
Digital Middle Skill	**4.7%**	**-0.1%**	**4.8%**
High Skill	13.4%	5.8%	4.7%
Total	3.5%	-1.3	4.3

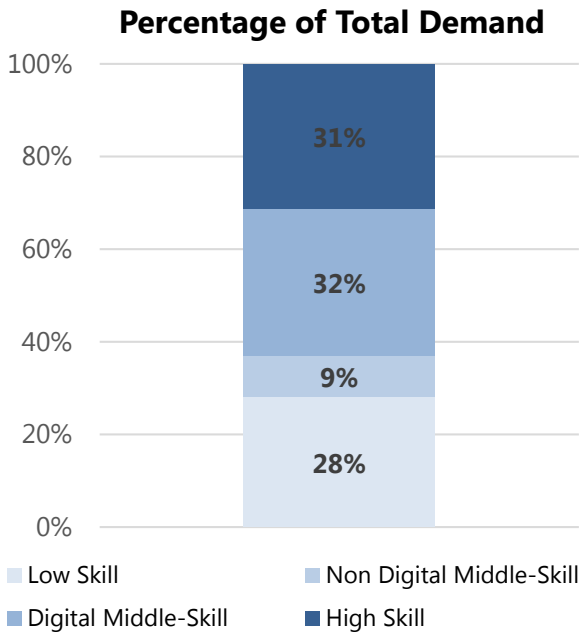
* Non-digital middle-skill occupations were impacted the greatest of all occupation groups during the recession years of 2007-2010, declining 7.4%.

Table C: Middle-Skill Overview – Occupation Family Breakdown

Occupation Family	Middle-Skill Postings	% of Total Postings in Middle-Skill Occupations	Digitally Intensive Middle-Skill Postings	% of Middle Skill Postings in Digitally Intensive Occupations
Health Care Practitioners and Technical	1,310,069	55%	1,157,450	88%
Office and Administrative Support	1,138,971	49%	1,137,935	100%
Sales and Related	1,084,020	51%	1,020,928	94%
Management	825,862	41%	825,862	100%
Transportation and Material Moving	748,328	61%	18,599	2%
Business and Financial Operations	644,695	46%	644,695	100%
Installation, Maintenance, and Repair	600,420	97%	210,476	35%
Computer and Mathematical	538,969	23%	538,969	100%
Production	227,548	46%	181,465	80%
Construction and Extraction	180,093	82%	37,751	21%
All Other	644,981	15%	499,855	77%
Total	**7,943,956**	**41%**	**6,222,207**	**78%**

SUPPLEMENTARY TABLES: DEMAND

Table D: Distribution of Demand



Occupation Group	Demand
High Skill	6,100,433
Digital Middle-Skill	6,273,785
Non Digital Middle Skill	1,669,971
Low Skill	5,498,466
Total	**19,542,855**

Low Skill: Occupations that require less than a bachelor's degree and pay an hourly median wage below the national living wage.

Non-Digital Middle-Skill: Occupations where fewer than 80% of postings call for a bachelor's degree, hourly median wage is above the national living wage and job postings do not call for any digitally intensive skills.

Digital Middle-Skill: Occupations where fewer than 80% of postings call for a bachelor's degree and hourly median wage is above the national living wage. These occupations also call for baseline, health care, machining technology or advanced digital skill sets.

High Skill: Occupations where more than 80% of postings call for a bachelor's degree or higher

Table E: Detailed Distribution of Demand

Occupation Group	Demand	% of Total Demand	2013 Employment (Source: BLS)	2013 Median Wage (Source: BLS)	2004 – 2013 Salary CAGR (Source: BLS)
High Skill	**6,100,433**	**31.2%**	**24,143,010**	**$35.32**	**2.45%**
Digital Middle-Skill	**6,273,785**	**31.8%**	**37,396,550**	**$23.76**	**2.49%**
Advanced Digital Middle-Skill	1,777,612	9.1%	6,088,540	$27.73	2.46%
Health Care Technology	975,550	5.0%	4,606,590	$28.25	2.69%
Health Information Technology	297,381	1.5%	2,708,120	$17.08	3.01%
Machining Technology	179,218	0.9%	1,750,630	$22.04	2.31%
Productivity Software	3,081,366	15.8%	22,213,910	$22.66	2.45%
Non Digital Middle-Skill	**1,669,971**	**8.5%**	**13,966,120**	**$20.14**	**2.26%**
Low Skill	**5,498,466**	**28.1%**	**56,497,720**	**$11.33**	**1.65%**
Total	**19,542,855**	**100%**	**132,003,400**	**$16.87**	**2.01%**

Table F: Skill Cluster Analysis

Digital Skill Cluster	Postings	% of all Middle-Skill Demand	2004 – 2013 Employment Growth (Source: BLS)	2013 Median Wage (Source: BLS)			
Non-Digital Middle-Skill	1,669,971	21%	1.9%	$20.14	**Top Occupations by Skill Cluster**		
Digital Middle-Skill	**6,273,785**	**79%**	**4.7%**	**$23.76**			
Productivity Software	3,081,366	39%	5.2%	$22.66	Office / Administrative Assistant	Retail Supervisor	Store Manager
Health Care Technology	975,550	12%	18.2%	$28.25	Registered Nurse	Medical Laboratory Technician	Radiology Technician
Customer Relationship Management	974,173	12%	16.20%	$28.90	Sales Representative	Sales Manager	Account Representative
Computer & Network Support	499,588	6%	34.6%	$28.84	Computer Support Specialist	Network / Systems Administrator	Network Support Specialist
Social Media &	326,547	4%	9.4%	$25.74	Recruiter	Graphic Designer /	SEO Specialist

Search Engine					Desktop Publisher		
Health Information Technology	260,039	3%	17.0%	$17.08	Medical Secretary	Medical Coder	Health Information Technician
Machining Technology	179,218	2%	-5.9%	$22.04	Machinist	Electrical Engineering Technician	Mechanical / Electrical Drafter
Digital Media & Design	132,692	2%	25.5%	$26.06	Graphic Designer	Marketing Coordinator	Multimedia Designer