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Promising Practice Article

Skillshed Analysis as a Tool to Inform Workforce Training Programs: The Case of Amazon HQ2

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Abstract: This promising practice article briefly describes skillshed analysis as a tool community colleges and universities can utilize to inform workforce training and curriculum development to meet emerging workforce needs for displaced workers or those in declining occupations. As an example, the skillshed analysis is applied to the Columbus, Ohio MSA and used to identify the declining occupations and existing skillset of those workers. This skillset is then compared to emergent computer occupations that were demanded by Amazon's HQ2 RFP. If Columbus had been selected for the Amazon HQ2 facility, this analysis would support the identification and retraining needs of displaced workers and match those training needs to the employment opportunities presented by HQ2. The training gaps demonstrate areas where community colleges and universities might focus their respective workforce training efforts.

Keywords: Skillshed, Amazon, workforce training, university economic development

I. Introduction

This promising practice piece briefly introduces skillshed analysis, a methodology for assessing the occupational skills of a workforce. It then uses the Columbus, Ohio MSA as a case study, where skillshed analysis is applied to match the needs of Amazon HQ2 (hypothetically locating in the region) to the skillset of employees in declining occupations. Lastly, it describes how skillshed analysis might be applied within the context of higher education, especially community colleges, to inform decisions about workforce training and associated curriculum development.

II. What is Skillshed Analysis?

The states of Iowa, Nebraska, Missouri, and Indiana and the city of Peoria, Illinois produced a guide on conducting skillshed analysis across regions. In this guide, they define a skillshed as "the geographic area from which a region pulls its workforce and the skills, education, and experience that the workforce possesses" (Iowa Workforce Development, 2010: 1). Other practitioners have noted that a skillshed's geographic area does not necessarily conform to geographic boundaries (city, county, or even state lines), but should reflect a footprint recognizable to firms, employees, and workforce development organizations (Scott and Kotlyar, 2013). The goal of a skillshed is to assess the

supply and demand for workforce in a region and identify the skills gap (and thereby the training needs) of the existing workforce (Scott and Kotlyar, 2013). As such, a skillshed analysis is particularly beneficial to transitioning economies or those economies experiencing an exogenous shock such a plant closure or new plant opening that may disrupt the labor force.

In practice, conducting a skillshed analysis has taken two forms. Some studies have utilized a survey approach. In a survey approach, workers are surveyed (the supply side survey) to determine the supply of available workers and their skillsets and task activities. A complementary demand-side survey is also used for employers. This survey measures the skillset, education, and training requirements of the workforce from the perspective of employers. The gap between the skillsets supplied and demanded inform training needs.

Survey-based skillsheds have the advantage of providing information at the skillshed level, which is typically otherwise not publicly available. Yet, survey-based skillshed analyses are costly to administer and suffer the limitation of being based on individual perception of the labor market. Such an approach would likely suffer from poor response rates as well.

Conducting a skillshed based on publicly available data (or data estimates from these sources) present an alternative approach, which is used in this paper. Skillshed analyses using this approach have been used to assess the transition of coal economy workers to emerging occupations (Jolley, Khalaf, Michaud, and Sandler 2019). Using publicly available data avoids the large-scale survey data collection and administration costs. Data suppression of employment distribution by occupation at the county level in the U.S. may limit this approach. Several strategies can be employed to overcome data suppression. Data suppression strategies include using the midpoint by size class (LaFayette, 2015) or gathering firm level information through LexisNexis or similar software (Michaud and Jolley, 2017). Scholars have suggested that proprietary databases such as LexisNexis can be used to overcome data suppression (Michaud and Jolley, 2017) and private firms such as EMSI, IMPLAN, and others provide modeling software and data for a fee to estimate suppressed data. The intent here is not to explain the complexities of 'how to' estimate employment or establishments where data suppression occurs, but rather to acknowledge that approaches exist to support these estimations to complete the skillshed analysis.

Once declining occupations and emergent occupations are identified, the U.S. Department of Labor's O*NET database can be used to determine skills required to perform a job. All occupations are classified following a federal statistical standard (Standard Occupational Classification system). O*NET breaks down each one of those standardized occupations into its components in terms of capacities (e.g. critical thinking) and knowledge (e.g. mathematics), as well as relevant work activities (e.g. analyzing data). The O*NET database assigns a numeric value to each knowledge area, capacity, or work activity associated with an occupation. Using those numeric values, we can compare skills required by emergent occupations to the skills available within declining occupations.

For example, a sewing machine operator needs some high school level math classes (mathematics variable level = 1.84) while a computer system analyst needs at least associate degree level math classes (mathematics variable level = 3.84). Therefore, a sewing machine operator transitioning into a computer system analyst occupation would need to obtain more formal education in mathematics.

To calculate the difference in level values across all the skills required within an occupation, we use a mathematical equation (squared Euclidean distance) that aggregates the information and produces one measure or number called a dissimilarity measure. The squared Euclidean distance between occupation X ($x_1, x_2 \ldots x_n$) and occupation Z ($z_1, z_2 \ldots z_n$) is calculated as follows:

$$d(X,Z) = \sum_{i=1}^{n} (x_i - z_i)^2$$

Where $x_1, x_2 \ldots x_n$, and $z_1, z_2 \ldots z_n$, represent the numeric values assigned by O*NET for the skills needed to perform the respective occupations. The distance increases when skills to perform two distinct occupations diverge in values. Consequently, this distance measure indicates how close a match is between two occupations: the lower the number, the easier the transition. Using 110 variables describing occupations' work activities, required capacities, knowledge levels, and job zones, we compare emergent occupations to declining occupations.

III. Amazon HQ2 Example

To illustrate the application of a skillshed analysis, this paper considered the hypothetical siting of Amazon HQ2 in the Columbus, Ohio MSA. Amazon HQ2 was projected to bring 50,000 jobs with an average annual salary of $100,000. The major hiring categories include executive/management, engineering (preference for

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software development), legal, accounting, and administrative positions (Amazon HQ2 RFP, 2017). To compare the training needs of the Columbus, Ohio MSA, we identify 117 declining occupations out of 456 occupations in the region with 100 or more workers, using 2017 data from the Ohio Department of Job and Family Services.

Table 1 provides an example of transitions that are relatively easy. The top row contains emergent computer occupations that we expect will be in demand by Amazon's HQ2 along with the corresponding average hourly wage rate. The vertical column contains occupations (e.g. computer programmers, prepress technicians and workers, etc.) in declining occupations and their corresponding median hourly wage rate. Where the two occupations intersect contains the difference in the hourly wage rate and a corresponding color outlining the skills match. Dark green indicates that relatively easy transition can occur, lighter green indicates some retraining/education may be required, and yellow indicates even more training is required. For example, photographic process workers and processing machine operators earn $12/hr. If a worker in this occupation transitioned to a computer systems analyst position, then s/he would earn $41/hr or a difference of +$28hr (note: sums are rounded to even dollars) as indicated in the table. The yellow indicates that additional educational attainment, such as a formal degree (associates or bachelors), certification, and/or formal training, is required for this transition. Alternatively, this occupation could transition to a computer user support specialist (average hourly wage $21) and earn +$9/hr. The dark green indicates little upskilling or additional educational attainment is required.

Table 1. Skillshed Applications with Easy Transitions.

		Computer Systems Analysts	Software Developers, Applications	Software Developers, Systems Software	Web Developers	Database Administrators	Network and Comp. Systems architects and Admins	Computer Network Architects	Computer User Support Specialists	Computer Network Support Specialists
		$41	$44	$52	$36	$43	$34	$49	$21	$32
Computer Programmers	$36	$5	$8	$16	$0	$7	-$2	$13	-$15	-$4
Computer Operators	$18	$23	$26	$34	$18	$25	$16	$31	$3	$14
Telecomm. Equip. Install/Repair, ex. Line Install	$25	$15	$19	$27	$11	$18	$9	$24	-$4	$7
Prepress Technicians and Workers	$20	$21	$24	$32	$16	$23	$14	$29	$2	$13
Photographic Process Workers and Processing Machine Operators	$12	$28	$31	$40	$24	$31	$21	$37	$9	$20

Table 2 provides similar comparison of occupations where significant educational attainment and retraining is required. In this example, the declining occupations in the Columbus MSA include sewing machine operators, cashiers, postal service mail carriers, etc. Here, the increase in wage rates from shifting to the new Amazon HQ2 occupations are greater on average, but the presence of orange to dark red colors demonstrate significant education attainment (likely moving from a GED or high school diploma to associate or bachelor's degree) is required.

Table 2. Skillshed Applications with Challenging Transitions.

		Computer Systems Analysts $41	Software Developers, Applications $44	Software Developers, Systems Software $52	Web Developers $36	Database Administrators $43	Network and Comp. Systems architects and Admins $34	Computer Network Architects $49	Computer User Support Specialists $21	Computer Network Support Specialists $32
Sewing Machine Operators	$14	$27	$30	$38	$22	$30	$20	$36	$8	$19
Postal Service Mail Sorters/Proc/Proc Mach. Op.	$28	$12	$16	$24	$8	$15	$6	$21	-$7	$4
Cashiers	$9	$31	$34	$43	$27	$34	$24	$40	$12	$23
Farmworkers/Laborers, Crop/Nursery/Greenhse	$13	$28	$31	$39	$23	$30	$21	$36	$9	$20
Postal Service Mail Carriers	$28	$12	$15	$24	$8	$15	$5	$21	-$7	$4

By providing a color-coded indicator for the level of difficulty associated with an occupational transition and wage differentials, it becomes evident which transitions make financial sense and the extent of needed skills acquisition and improvement. Additionally, practitioners can utilize the data to identify the lacking skills and design programs or start initiatives to facilitate transitions from declining to emergent occupations.

IV. Higher Education Applications of the Skillshed Analysis

Many colleges, especially community colleges, serve a workforce development role as part of their educational mission. Kasper (2003) acknowledged the changing role of community colleges in offering vocational training programs, especially in rural places where thin markets exist, and educational opportunities are sparse. Callan (2001) cited vocational and occupational training as one of three primary mission of the 1,036 public community colleges that serve 5.3 million students. Community colleges also play a role in workforce intermediation providing job training to disadvantaged populations (e.g. Lowe, 2010; Lowe, Goldstein and Donegan, 2011). More broadly, policymakers and others have raised concerns about the "the lack of alignment between college graduate skills and labor-market demand" (Johnstone and Soares, 2014: 12). Skillshed analyses is a promising practice to identify this labor-market demand and use the workforce development and vocational training mission of community colleges to provide customized training.

For example, we examine the training needs of a transition from a photographic process worker to computer system analyst, which is associated with a significant increase in pay. While the computer system analyst position requires slightly more knowledge of computer and electronics (knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software), it requires significant upskilling in terms of abilities (operation analysis and programming) and work activities (analyzing, processing, and interpreting information). Having identified these gaps using a deeper dive into the O*NET data (which underlies the tables above), higher education institutions can offer the appropriate classes to displaced workers (e.g. programming classes). Funding for such programs may be secured through a variety of federal grants that aim to match employers with skilled workers. The United States Department of Labor's Employment and Training Administration lists a series of grants that were awarded in recent years to

assists states and other eligible applicants respond to large, unexpected events causing significant job losses.[1]

V. Summary

In summary, a skillshed analysis applied to the workforce suffering from an industry closure would identify the skills gaps of the existing workforce to better determine curriculum or training needs to speed these individuals to reemployment. In the example provided in this paper, identifying the training gaps of those working in declining industries better prepares higher education institutions to deliver certificate or vocational training programs to ensure these individuals are prepared for these employment opportunities. Skillshed analysis is a promising practice worth considering to position higher education institution to better serve these training needs.

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