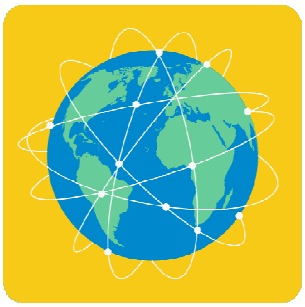
National Center for Supply Chain
Technology Education

How to Obtain Labor Market Information on Supply Chain Technology Industries and Occupations

Guide for Education Practitioners



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National Center for Supply Chain Technology Education

The distribution centers of tomorrow require highly trained supply chain technicians to install, operate, support, upgrade or maintain the software, hardware, automated equipment and systems that support the supply chain. The **National Center for Supply Chain Technology Education** is working towards facilitating real time alignment between community college programs and industry needs. Once achieved, supply chain technicians will be prepared with portable (stackable) certifications and poised for successful careers. Small businesses will be able to adopt emerging technologies and companies with multiple locations will receive consistently trained technicians across state lines. The speed and accuracy of goods movement will increase, while producing a more efficient process. As a result of this important work, the use of technology will expand. Workers' skills will be enhanced and the efficiency of our nation's supply chain will improve.

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Introduction

In a field where business success hinges on competiveness and efficiency, Supply Chain Technicians play an important role in the smooth functioning of warehouses and distribution centers. These technicians oversee a variety of software and equipment related to mechanical, applied electronics, manufacturing, automated systems, and information technology.

The National Center for Supply Chain Technology Education (NCSCTE) was established to help meet industry's need for highly skilled supply chain technicians. There are currently too few trained workers to meet the demand for technicians with the skills to keep the modern supply chain humming. As a result, the Center's goal is to increase the number of qualified Supply Chain Technicians to meet the growing national need across the private and public supply chains.

Because of the emergent nature of this work, measuring the demand for skilled Supply Chain Technicians presents a challenge to educational institutions that are trying to understand the need for training in their respective geographic areas. In 2013, the NCSCTE and the California Centers of Excellence conducted a nationwide research study to gather labor market information and analyze trends related to Supply Chain Technology. For the purpose of the study, 625 businesses with warehouses or distribution centers were surveyed nationwide and a report summarizing the findings was published in May 2013[1]. This study was the first of its kind to measure the size and importance of industries and employment related to supply chain technology, project employment for Supply Chain Technicians, and understand the skills and education levels that employers find most valuable.

The NCSCTE has developed this Guide to help educational institutions across the nation obtain labor market information on supply chain technology for their area in order to inform the development of skills-based educational pathways and new curricula. The Guide provides helpful tips on how to scope and look for data and profiles both public and private data sources available to colleges.

Potential uses of the guide include the identification of supply chain technology employers for partnership development, the demonstration/assessment of the regional occupational need for starting a program or training in supply chain technology, the evaluation of existing curricula against employer demands for skills and knowledge, and the securing of employer support for grant applications, and others.

[1] http://www.supplychainteched.org/industrysurvey.html

Understanding LMI Categories

The term Labor Market Information, or LMI, refers to a variety of information associated with the supply and demand for workers. This includes information on labor force, employment, unemployment, industries, occupations, skills, and wages.

All employment related information is classified by industry and/or occupation.

Industries

Industry jobs show an area's monthly employment by type of business activity. The North American Industry Classification System (NAICS) defines an industry as a cluster of establishments utilizing the same production process or the same type of work involved in creating the final product. Each establishment is classified to an industry according to the primary business activity taking place.

There are 20 top-level industries under NAICS called sectors such as agriculture, construction, manufacturing, etc. These sectors are broken down into more detailed industry categories. Examples include the automotive industry, health care, and retail trade. More detailed industries within these broad categories would include motor vehicle engine manufacturers, hospitals, and electronic and appliance stores.

Industry employment is a measure of full-time and part-time workers (including employees on paid vacation or paid sick leave) who work or receive compensation from establishments within the same industry code(s).

To learn more about NAICS codes, visit https://www.census.gov/eos/www/naics/.

Occupations

The Standard Occupational Classification (SOC) system is used to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. All workers are classified into one of 840 detailed occupations according to their occupational definition. To facilitate classification, detailed occupations (6-digit SOC level) with similar job duties, and in some cases skills, education, and/or training, are grouped together.

The SOC system is not static. As some new job titles become more pervasive in the labor market and the others become obsolete, the U.S. Bureau of Labor Statistics revises the occupational codes to account for such dynamics.

Occupational employment is a measure of the number of employees in a given occupation. Occupational employment is measured across industries.

Estimates of occupational employment by industry, that is, the number of employees in a given occupation in a given industry, are called ***staffing patterns***.

To learn more about SOC codes, visit http://www.bls.gov/soc/.

Defining Supply Chain Technology

Before obtaining labor market data on supply chain technology, it is necessary to define the industries using NAICS codes and occupations using SOC codes.

Industry Definition

Considering that warehousing and goods movement activities often occur in businesses classified under industries other than transportation and warehouses (for example, retail), defining exact NAICS codes can be challenging. However, previous research conducted on this topic can provide a useful model to follow.

Table 1 below provides the estimated percentage of establishments within each sector that have warehousing and distribution activities. The data was collected by the Centers of Excellence and the NCSCTE through a nationwide survey of employers. Nine sectors (2-digit NAICS codes) and specific industries within them (3-, 4-, and 6-digit NAICS codes) were identified as relevant. They include manufacturing, wholesale trade, retail, transportation and warehousing, agriculture, and other sectors. Only a portion of establishments in each industry identified has supply chain activities. The data was collected **only** for businesses with 50 or more employees.

Table 1 – Estimated Percentage of Establishments with 50 or More Employees Engaged in Supply Chain Activities by Industry

NAICS Code & Industry Description	% of businesses with supply chain activities *(rounded)*
81 Other Services (except Public Administration) 811 Repair and Maintenance	60%
48-49 Transportation and Warehousing 481 Air Transportation 482 Rail Transportation 484 Truck Transportation 493 Warehousing and Storage	50%
31-33 Manufacturing *(all detailed industries included)*	45%
42 Wholesale Trade *(all detailed industries included)*	45%
62 Health Care and Social Services 622 Hospitals	25%
11 Agriculture and Forestry 111 Crop Production 112 Animal Production 115 Support Activities for Ag. and Forestry	20%
54 Professional, Scientific, and Technical Services 541614 Process, Physical Distribution,& Logistics Consulting Services	20%
72 Accommodation and Food Services 7211 Accommodation	20%
44-45 Retail Trade *(all detailed industries included)*	10%

Source: National Center for Supply Chain Technology, 2013 (http://www.supplychainteched.org/industrysurvey.html)

In October 2013, the North Carolina Center for Global Logistics estimated supply chain employment as a share of each sector employment.[2] Table 2 provides the list of sectors and attributed supply chain employment. According to the authors, "the percentage is a reflection of the composition of the work conducted in each sector and the role of workers who are involved in supply-chain activities."

Table 2 - Estimated Percentage of Employment Related to Supply Chain by Industry Sector

Industry Sector	Supply-Chain Employment %
48-49 Transportation and Warehousing	100%
42 Wholesale Trade	15%
44-45 Retail Trade	10%
31-33 Manufacturing	10%
23 Construction	10%
22 Utilities	10%
21 Mining	10%
11 Agriculture, Forestry, Fishing & Hunting	5%
62 Health Care and Social Services	2%
72 Accommodation and Food Services	2%
56 Administrative and Waste Services	2%
92 Public Administration	1%
61 Educational Services	1%

Source: North Carolina Center for Global Logistics, 2013. www.nccgl.com

Occupation Definition

Available lists of SOC code occupations related to supply chain technology published by federal agencies are usually rather broad. They combine all job titles in transportation and warehousing, from truck drivers to travel agents. Many of these job titles are not relevant to supply chain or logistics. To get a more precise lists of logistics occupations, the Georgia Center of Innovation for Logistics grouped together selected SOC codes into six sub-categories to represent the freight-related logistics jobs.[3] These six sub-categories include Logistics Operations, Industrial Engineering, Warehouse & Distribution Labor, Trucking, Freight Rail, and Air Cargo Supervisors (Table 3). According to the Georgia Center of Innovation for Logistics, "these six sub-categories can be utilized to create a comparable baseline illustrating projected future activity in the logistics industry across states, regions and sectors over time."

[2] North Carolina Center for Global Logistics. An Estimate of Supply-Chain Employment in North Carolina (2013). www.nccgl.com

[3] The Georgia Center of Innovation for Logistics. The Logistics of Education and Education of Logistics: Exploring the Supply and Demand of Logistics Workforce. (2012) www.georgialogistics.com

Table 3 – Occupations Related to Logistics Industry

Sub-Category	SOC	SOC Title
Logistics Operations & Management	13-1081	Logisticians
	11-3071	Transportation, Storage, and Distribution Managers
	43-5011	Cargo/Freight Agent
Industrial Engineering	17-2112	Industrial Engineers
	11-3051	Industrial Production Managers
	17-3026	Industrial Engineering Technicians
Warehouse & Distribution Labor	43-5071	Shipping and Traffic Clerks
	53-1021	First-Line Supervisors of Helpers, Laborers, & Material Movers, Hand
	53-7062	Laborers and freight, Stock and material Movers, Hand
	53-6051	Freight and Cargo Inspectors
	53-7121	Tank car, Truck and Ship Loaders
Trucking	53-7051	Industrial Truck and Tractor Operators
	53-3032	Heavy and Tractor-Trailer Truck Drivers
	53-3033	Light Truck or Deliver Services Drivers
Freight Rail	53-4011	Locomotive Engineers
	53-4013	Rail Yard Engineers, Operators and Hostlers
	53-4031	Railroad Conductors and Yardmasters
Air Cargo Supervisors	53-1011	Air Cargo Handling Supervisors

Source: The Georgia Center of Innovation for Logistics. www.GeorgiaLogistics.com

Useful Tip: For the purposes of identifying job titles that are relevant to supply chain technology, two sub-categories of SOC codes from Table 3 should be considered – ***Industrial Engineering*** and ***Warehouse & Distribution Labor***.

Supply Chain Technicians

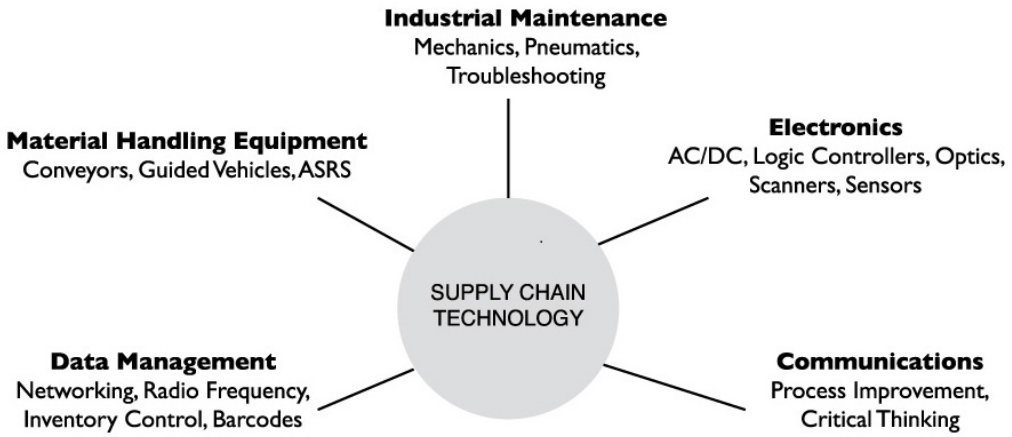
Supply Chain Technician is an emergent occupation that does not currently exist in SOC system. The industry leadership team for the National Center for SCTE defines the job of a Supply Chain Technician as, "a person who installs, operates, supports, upgrades or maintains the software, hardware, automated equipment and systems that support the supply chain."[4]

Supply Chain Technicians play an important role in ensuring that efficiency and competitiveness is achieved through the smooth and prompt distribution of goods. They are on the front end of maintaining and managing the technological innovations that are being adopted by warehouses and distribution centers throughout the nation. Examples of new technologies being adopted by logistics firms include autonomous material handling equipment, Bluetooth connectivity, speech recognition

[4] Young, N. *How Does Supply Chain Management Differ from Supply Chain Technology?* (2013) Published by the National Center for Supply Chain Technology Education.

software, digital imaging, portable printing, and two-dimensional bar coding.[5] According to the National Center for SCTE, this occupation may also specialize in software systems that handle complex business variables, such as Business Intelligence systems and Enterprise Resource Planning solutions, which integrate areas including finance, operations, sourcing, and logistics into platforms to share real-time information.[6]

The responsibilities of Supply Chain Technicians encompass a broad spectrum of activities. These technicians handle the support, maintenance, and operation of software, hardware and material handling equipment. They also support the installation and upgrade of those same systems. Five areas of expertise identified for Supply Chain Technicians include the following:[7]



Some of the related job titles that employers use to describe Supply Chain Technicians include:

- Warehouse Technician (Levels I, II, and III)
- Industrial Maintenance Technician
- Supply Chain Assistant
- Operations Maintenance Technician
- Warehouse Management Systems (WMS) Analyst
- Material Planner
- Material Handler
- Materials Coordinator
- Electro-Mechanical Technician
- Warehouse Associate/Warehouse Operations Associate

Useful Tip: Even though there are no exact matches between the Supply Chain Technician occupation and existing SOC occupations, the ***following SOC codes*** could be utilized for obtaining LMI for this occupation:

[5] Intermec Technologies Corporation. *Top 10 Supply Chain Technology Trends (White Paper)*. (2011)
[6] Moguel, R. *The Technology Supporting the Supply Chain.* (2013) Published by the National Center for Supply Chain Technology Education.
[7] National Center for Supply Chain Technology Education www.supplychainteched.org

17-3023	Electrical and Electronic Engineering Technicians
17-3024	Electro-Mechanical Technicians
17-3026	Industrial Engineering Technicians
17-3027	Mechanical Engineering Technicians
43-5071	Shipping and Traffic Clerks
49-9041	Industrial Machinery Mechanics
49-9043	Maintenance Workers, Machinery
49-9071	Maintenance and Repair Workers, General
53-6051	Freight and Cargo Inspectors

Obtaining LMI Data Using Existing Sources

After the lists of NAICS codes and SOC codes related to supply chain technology have been identified, it is possible to obtain the labor market data using existing public and private sources of information. This section of the guide provides an overview of the data elements to describe the labor market and the main sources where these data elements can be found.

Key Data Elements to Look For

The following data elements are helpful when analyzing industry trends:

- ***NAICS Code Number:*** the North American Industry Classification System unique numerical identifier for each industry (2-, 3-, 4,-, 5-, or 6-digit)
- ***Industry Description:*** a descriptive title that corresponds to the NAICS code
- ***Current Employment:*** full-time and part-time workers (including employees on paid vacation or paid sick leave) who work or receive compensation from establishments
- ***Future Employment:*** the projected number of full-time and part-time workers (including employees on paid vacation or paid sick leave) who are expected to work or receive compensation from establishments in a future year
- ***Absolute Employment Change:*** number of new jobs or job losses projected in each industry, calculated as the difference between Future Employment and Current Employment
- ***Projected Growth:*** percentage change in employment projected in the industry
- ***Industry Earnings:*** average annual wages, salaries, and proprietor earnings paid by industry establishments per worker
- ***Number of Establishments:*** the estimated number of firms that identifies with each industry code

The following data elements are helpful when analyzing occupational trends:

- ***SOC Code Number:*** the Standard Occupational Classification (SOC) system's unique, six-digit numerical identifier for each occupation
- ***Occupation Title:*** a descriptive title that corresponds to the SOC code
- ***Current Employment:*** the estimated total occupational employment
- ***Future Employment:*** the projected total occupational employment

- ***Absolute Employment Change:*** number of new jobs or job losses projected in each occupational category, calculated as the difference between Future Employment and Current Employment
- ***Projected Growth:*** percentage change in employment projected in each occupational category
- ***Projected Annual Openings:*** number of new jobs and replacement jobs projected in each occupational category. Replacement jobs are the job openings due to workers leaving the workforce (e.g. retirements or upward mobility).
- ***Median Hourly Wages:*** the estimated 50th percentile (the middle point) of the distribution of wages based on data collected from employers for each occupational title in all industries
- ***Mean Hourly Wages:*** the estimated total hourly wages of an occupation divided by its estimated employment, i.e., the average hourly wage
- ***Typical Education Requirement:*** the typical level of education that most workers need to enter the occupation. Occupations are assigned one of the eight education levels, ranging from *Doctoral or professional degree* to *Less than high school*. [8]
- ***Work experience in a related occupation:*** work experience that is commonly considered necessary by employers, or is a commonly accepted substitute for other, more formal types of training or education. Occupations are assigned one of the three categories that deal with length of time spent gaining related work experience: *Five years or more; Less than 5 years*; and *None*.[9]

Public Data Sources

There are a number of publicly available data sources that provide access to labor market data on national, state, and local levels.

Federal Sources

Bureau of Labor Statistics

www.bls.gov

The U.S. Bureau of Labor Statistics (BLS) collects data on employment and earnings of U.S. workers and produces a variety of data at the national, state, and local level regarding labor market conditions. Through a semi-annual survey of establishments, BLS collects detailed occupational and wage information by industry and area. Every two years employment projections by occupation and industry are released (2012-2022 projections are most current). Much of this information is produced in cooperation with states.

Two web-based tools provide users with readily accessible information on employment and wages by occupation and by geographic area:

- **Industry-level:** *Quarterly Census of Employment and Wages (QCEW) database searches* provide tables on number of establishments, total employment, and average wages for selected NAICS codes. The data are available for the nation, states, and local/metropolitan statistical areas (MSAs). Multi-screen data search is found at: http://www.bls.gov/cew/data.htm

[8] http://www.bls.gov/emp/ep_definitions_edtrain.pdf
[9] Ibid.

Useful Tip: In order to obtain the data for supply chain industries, NAICS codes listed on pages 6 and 7 can be selected when prompted on the industries selection page. You will also need to specify the state or the local area that you are interested in. For types of data, select number of establishments, total employment, and average annual wages.

- **Occupation-level (1):** The *Overview of Wage Data by Area and Occupation* includes detailed wage data that can be reviewed by occupation and geographic area. It allows users to select a region or state, find a robust list of occupations, and gather information about employment rates and median wages in the region for each occupation. This resource is available at http://www.bls.gov/bls/blswage.htm.

  Useful Tip: In order to obtain the data for supply chain related occupations, you can use either SOC codes listed on pages 7 & 8 for a broader logistics employment or SOC codes on page 9 for a more focused look at supply chain technicians. The tool will provide the data for all occupations in your area. You will then need to extract the occupations you are interested in and build your own table.

- **Occupation-level (2):** *The Occupational Outlook Handbook* (OOH) is a web-based tool that provides comprehensive information about hundreds of occupations, including national projected growth (2012-2022), total number of jobs, and median income. This tool is available at http://www.bls.gov/ooh/.

  Useful Tip: This tool can be used to understand supply chain related occupations defined by SOC codes. It only returns national data.

Occupational Information Network (O*Net)

www.onetonline.org

Occupational Information Network (O*Net) of the U.S. Department of Labor is a centralized database for information about what workers do, and how they do it. This website delivers detailed information about occupational skills, working conditions, and other related information. O*Net also draws from several sources – including the Department of Labor & Economic Growth and the U.S. Bureau of Labor Statistics, to match skills information on jobs with detailed labor market information.

O*Net also provides information on new and emerging occupations that don't have an SOC code yet. The system assigns these occupations a unique 8-digit identifier which makes it a "sub-occupation" of a related 6-digit SOC code. However, data on employment and wages are not collected for such occupations.

Useful Tip: Through the O*Net website, you can:

- Use the *Occupation Quick Search* tool to browse occupations relevant to supply chain technology using occupational titles on page 9 of this Guide.

- Identify the required skills for supply chain occupations, or – inversely – search what occupations can perform a particular skill set (that you identified as relevant to supply chain technology).

State Sources

Employment development agencies of most states prepare state and sub-state employment projections. In many cases, they create more detailed data than what is available through federal sources. They also have web-based tools that allow multiple data searches. The following table lists the top states with the most supply chain employment based on the data reported by the NCSCTE in 2013 and provides the names of their labor market information agencies and the links to their online data tools.

Table 4 – State Data Sources for LMI in Top 10 States with Most Supply Chain Employment

California	Employment Development Department Labor Market Information Division (EDD LMID) http://www.labormarketinfo.edd.ca.gov/
Texas	The Labor Market & Career Information Department (LMCI) of the Texas Workforce Commission http://www.tracer2.com/
Florida	Florida Department of Economic Opportunity Bureau of Labor Market Statistics http://www.floridajobs.org/labor-market-information
New York	New York State Department of Labor http://labor.ny.gov/stats/index.shtm
Illinois	Illinois Department of Employment Security (IDES) http://www.ides.illinois.gov/Pages/Data_Statistics.aspx
Pennsylvania	Pennsylvania Department of Labor & Industry Center for Workforce Information and Analysis http://www.paworkstats.state.pa.us/portal/server.pt/community/home/19890
Ohio	Ohio Department of Job and Family Services http://ohiolmi.com/
Michigan	Michigan Department of Technology, Management, & Budget http://www.milmi.org/
North Carolina	North Carolina Department of Commerce http://www.nccommerce.com/research-publications/industry-economy/workforce-analyses
Georgia	Georgia Department of Labor Workforce Statistics & Economic Research https://explorer.dol.state.ga.us/vosnet/Default.aspx

For the states not listed in Table 4, use http://www.projectionscentral.com/Projections/ProjectionSites

Useful Tip (1): In order to retrieve data for supply chain technology using state sources, you will need to navigate to your state's labor market information website and, if the tool allows it, specify relevant NAICS codes and SOC codes as well as your local area(s).

Useful Tip (2): You can also contact your state agency, identify who the LMI representative is in your state and/or local area and email them the NAICS and SOC codes that you are interested in. You can send them a list of data metrics from pages 10 and 11 of this Guide.

Regional/Local Sources

There are many organizations and agencies on regional and local levels that collect and analyze labor market data. Some agencies conduct their own research on certain sectors. Many have published data and/or reports on logistics/supply chain.

Regional and local agencies that may collect and analyze labor market data include:

- Economic development corporations/agencies
- Workforce development agencies
- Associations of governments
- Industry groups/associations
- Chambers of commerce

Useful Tip: Identify which regional/local agencies are in your area and reach out to them to see if they have any research already completed on supply chain or logistics. If they don't, ask if they have capacity or resources to help with the research you are doing.

Private Data Sources

Public data sources could be cumbersome to navigate and obtain data from. Some state agencies do not provide local area projections. There are a number of proprietary labor market data providers that offer data-based tools and customized services. These tools are user friendly and provide more detail, but require a paid subscription or a service fee.

Some private data providers include:

- Economic Modeling Specialists Intl. (EMSI) www.economicmodeling.com
- Regional Economic Models, Inc. www.remi.com
- Claritas www.claritas.com
- Burning Glass www.burning-glass.com
- Monster www.monster.com
- Wanted Analytics www.wantedanalytics.com
- InfoGroup aka InfoUSA www.referenceusa.com

Some of the private sources are explained below.

EMSI

Economic Modeling Specialists Intl. (EMSI) regularly combines data from federal, state, and private sources in a database from which it pulls information relevant to local labor markets. Depending on subscription level, EMSI provides data for states, counties, and zip codes. It allows for the creation of customized regions using these standard levels of geography. However, zip-code level data should be used with caution as the accuracy has not been confirmed. Among other tools, EMSI has developed data analytic systems based on local labor market information and software colleges can use to provide

students with customized regional wage information, including number of projected jobs, employment trends by occupation, and job postings.

Useful Tip: You can inquire if your educational institution or any other workforce/economic development agencies in your state/area have purchased a subscription to EMSI Analyst. If such access is available, you can request labor market information for supply chain industries and occupations in your state or area. You will need to specify the geographic area you are interested in, the SOC codes and/or NAICS codes, the time period for projections (e.g. 2014-2017) and the data elements you are looking for.

Data tables that we recommend running in EMSI Analyst are:

1) Industry Employment (using NAICS codes recommended in this Guide; pages 6-7)
2) Occupational Employment (using SOC codes recommended in this Guide; pages 8-9)
3) Staffing Patterns Employment (using both NAICS codes and SOC codes)

If access is not available, you can contact EMSI directly to request a one-time report for a fee. You will need to specify the geographic area you are interested in, the SOC codes and/or NAICS codes, and the data elements you are looking for.

Real-time LMI Data Providers

Burning Glass, Wanted Analytics, and Monster.com are providers of what is sometimes referred to as "real-time LMI." These companies sell aggregated information on the number of job postings within a given geographic area by occupation and industry, the foundational and specialized skills employers are looking for, and the credentials and certifications they are seeking. The data are generated from techniques that capture nearly all job postings on the internet. In addition to searches by standard categories such as occupations, industries, etc., these tools allow for keyword searches that are helpful when analyzing new and emerging occupations. However, real-time data like these should be treated with caution because they can overstate openings when one job is posted in multiple places or remains posted after the job has been filled.[10]

Useful Tip: Real-time data can be particularly helpful for you to understand what supply chain related jobs employers are posting in your area, and what skills, education levels, and certifications they are looking for. You can inquire if any public or private entities in your area have purchased a subscription to one of these tools. If such access is available or if you contact a real-time data provider directly, you can request job postings data for supply chain industries and occupations in your state or area. You will need to specify the geographic area, industries (NAICS codes), and/or occupations (SOC codes), and the time period of job postings (e.g. last 3 months, last 12 months, all of 2013, etc.). Instead of searches by industries and/or occupations, you might also want to request searches using keywords. For a list of sample job titles related to Supply Chain Technicians, see page 9 of this Guide.

InfoGroup's ReferenceUSA

[10] The Aspen Institute, College Excellence Program. A Guide for Using Labor Market Data to Improve Student Success. (2013) www.aspeninstitute.org

InfoGroup's ReferenceUSA is a subscription-based online tool that provides company listings and information. The business data are pulled from a variety of sources. Data points for each business record may include location information, contact information, industry profile (NAICS code), and business demographics such as number of employees, sales volume, etc. This data tool is useful for identifying specific employers in an industry within a geographic area.

Useful Tip: If subscription to ReferenceUSA (or any other business database tool) is available, you may use the list of NAICS codes provided in this Guide to request the listing of employers relevant to supply chain technology. Local Chambers of Commerce and economic development entities might have their own listings of firms.

Interpreting LMI Tables

Table 5 represents an example of the industry level employment data extracted using the EMSI Analyst tool. The data in this example are for the Inland Empire region of California that consists of Riverside and San Bernardino counties. Employment numbers represent all **current** (2013) and **projected** (2018) industry jobs for twelve sectors with relevance to supply chain, as well as 5-year **Change** – the difference between future and current employment, and **average wages** per worker. Note that similar numbers can be obtained from public sources described in sections above.

Table 5 – EMSI Projected Sector Employment Data for Riverside and San Bernardino Counties, California

NAICS Code	Description	2013 Jobs	2018 Jobs	Change	2014 Avg. Wages
11	Agriculture, Forestry, Fishing and Hunting	16,000	13,475	-2,525	$30,647
21	Mining, Quarrying, and Oil and Gas Extraction	1,227	1,153	-74	$83,126
22	Utilities	5,642	5,449	-193	$119,853
23	Construction	98,979	101,662	2,683	$47,416
31-33	Manufacturing	89,985	84,659	-5,326	$59,644
42	Wholesale Trade	57,387	66,217	8,830	$59,329
44-45	Retail Trade	175,403	193,478	18,075	$33,825
48-49	Transportation and Warehousing	77,614	91,789	14,175	$51,199
56	Administrative and Support and Waste Management and Remediation Services	107,254	127,330	20,076	$29,247
61	Educational Services (Private)	21,978	25,078	3,100	$34,383
62	Health Care and Social Assistance	171,458	200,442	28,984	$48,967
72	Accommodation and Food Services	120,907	140,957	20,050	$19,963
	Total	**943,834**	**1,051,690**	**107,856**	**$41,521**

Source: QCEW Employees, Non-QCEW Employees & Self-Employed - EMSI 2014.2 Class of Worker. Provided by Regional Center of Excellence, California Community Colleges.
Note: Information for NAICS 92 is not provided by EMSI

While the numbers above help one understand the overall size of each sector, they are not specific to supply chain employment. Table 6 demonstrates how the data in Table 5 and Table 2 can be utilized to arrive at estimated supply chain industry jobs. The total jobs for each sector are multiplied by a percentage of supply chain employment in that sector. Shaded data cells represent the current supply chain industry jobs, the projected supply chain industry jobs in the future, and the 5-year growth or decline in supply chain industry employment. In this example, the region is expected to add over 18,000 new jobs related to supply chain across twelve industry sectors.

Table 6 – Calculated Supply Chain Industry Employment in Riverside and San Bernardino Counties, California

NAICS Code	Description	Supply Chain %[11]	2013 Jobs		2018 Jobs		Change	
			All	Supply Chain	All	Supply Chain	All	Supply Chain
11	Agriculture, Forestry, Fishing & Hunting	2%	16,000	320	13,475	270	-2,525	-51
21	Mining, Quarrying, and Oil	10%	1,227	123	1,153	115	-74	-7
22	Utilities	10%	5,642	564	5,449	545	-193	-19
23	Construction	10%	98,979	9,898	101,662	10,166	2,683	268
31-33	Manufacturing	10%	89,985	8,999	84,659	8,466	-5,326	-533
42	Wholesale Trade	15%	57,387	8,608	66,217	9,933	8,830	1,325
44-45	Retail Trade	10%	175,403	17,540	193,478	19,348	18,075	1,808
48-49	Transportation and Warehousing	100%	77,614	77,614	91,789	91,789	14,175	14,175
56	Administrative & Support and Waste Mgt. and Remediation Srvs.	2%	107,254	2,145	127,330	2,547	20,076	402
61	Educational Services (Private)	1%	21,978	220	25,078	251	3,100	31
62	Health Care and Social Assistance	2%	171,458	3,429	200,442	4,009	28,984	580
72	Accommodation & Food Services	2%	120,907	2,418	140,957	2,819	20,050	401
	Total		**943,834**	**131,878**	**1,051,690**	**150,257**	**107,856**	**18,379**

Source: QCEW Employees, Non-QCEW Employees & Self-Employed - EMSI 2014.2 Class of Worker. Provided by Regional Center of Excellence, California Community Colleges.

Occupational Employment

An example of regional occupational data is provided in Table 7. The data were extracted using EMSI Analyst. However, similar data can be found in public sources. The table demonstrates employment projections for the nine supply chain technology related occupations with SOC codes (see the list on page 9 of this Guide). The numbers in Table 7 represent employment across industries and are not limited to any specific sector. The following information is contained in the table: current number of

[11] North Carolina Center for Global Logistics. An Estimate of Supply-Chain Employment in North Carolina (2013). www.nccgl.com

people employed in each occupational code (2013 Jobs), projected number of people employed in each occupation in 2018 (2018 Jobs), net 5-year job growth or decline in absolute numbers (Change), relative 5-year job growth or decline (% Change), absolute number of new and replacement jobs in the next 5 years (Openings), annual number of new and replacement jobs (Annual Openings), median hourly wages of people who currently work in these occupations, and average/mean hourly wages.

Table 7 – EMSI Projected Occupational Employment Data for Riverside and San Bernardino Counties, California

SOC	Description	2013 Jobs	2018 Jobs	Change	% Change	Openings	Annual Openings	Median Hourly Earnings	Avg. Hourly Earnings
17-3023	Electrical and Electronics Engineering Technicians	1,047	1,063	16	2%	128	26	$30.52	$30.45
17-3024	Electro-Mechanical Technicians	31	36	5	16%	<10	--	$25.07	$25.13
17-3026	Industrial Engineering Technicians	297	295	(2)	1%)	34	7	$23.61	$24.52
17-3027	Mechanical Engineering Technicians	185	194	9	5%	30	6	$22.86	$22.67
43-5071	Shipping, Receiving, & Traffic Clerks	9,291	10,077	786	8%	2,084	417	$13.91	$14.67
49-9041	Industrial Machinery Mechanics	2,008	2,215	207	10%	524	105	$24.04	$24.29
49-9043	Maintenance Workers, Machinery	965	1,001	36	4%	98	20	$20.04	$20.88
49-9071	Maintenance and Repair Workers, General	11,845	12,677	832	7%	2,068	414	$17.88	$18.67
53-6051	Transportation Inspectors	193	206	13	7%	52	10	$26.35	$28.55
	Total	**25,863**	**27,764**	**1,901**	**7%**	**5,026**	**1,005**	**$17.70**	**$18.41**

Source: QCEW Employees, Non-QCEW Employees & Self-Employed - EMSI 2014.2 Class of Worker. Provided by Regional Center of Excellence, California Community Colleges.

In this example, there are currently over 25,800 people employed in the nine occupations related to supply chain technology in the region. In the next five years, these occupations are expected to grow by 7% and add nearly 2,000 new jobs. Together with the openings created due to various labor market separation factors (such as retirements), there could be as high as 5,000 job openings for these occupations in the next five years. Based on the LMI data, the majority of the job openings are projected for Shipping, Receiving, and Traffic Clerks and Maintenance and Repair Workers, General.

Obtaining LMI Using Employer Survey

As demonstrated in the previous section, there are a variety of sources from which to obtain LMI data. However, the main limitation of the existing LMI sources is that most of them rely on existing industry and occupational classifications. The jobs that are emerging or new cannot always be captured by existing SOC codes. That is why it sometimes becomes necessary to collect labor market data from employers directly using some type of a survey.

Employer surveys are online or phone surveys of firms that usually focus on a specific industry/ies and occupations. Employer surveys that are properly executed and receive an adequate number of responses allow for estimating employment and understanding employer workforce needs in more detail.

Employer surveys usually help obtain the following information:

- Current and projected overall company employment
- Current and projected employment for occupations
- Turnover/replacement rates
- Hiring challenges
- Education and training preferences
- Skills and knowledge preferences
- Other (awareness of existing education programs, industry trends, etc.)

Employer surveys as a labor market data source have a number of benefits and limitations. Table 8 lists the most common ones.

Table 8 – Benefits and Limitations of Employer Surveys

Benefits	Limitations
1) Surveys can be customized to the research questions an educational institution has. While public sources of data only provide some data points, employer surveys can fill in the gaps. 2) Surveys can be used for understanding emerging occupations and industries. 3) Surveys are great for collecting qualitative data (skill mismatch, education preferences, training practices, etc.). 4) Surveys can also be used as a marketing tool -- questions can be added to seek commitment from respondents to proposed activities (such as follow-up conversations, internships, etc.).	1) Phone and sometimes even online surveys require a significant budget to pay for employer database and call center services. 2) Preparation, data collection, and analysis require time (usually several months). 3) Even though it is possible to conduct the survey in-house, it is recommended to have experienced researchers on the team to ensure survey quality. 4) If the number of employers in a geographic area that meet criteria to take a survey is limited, getting a representative sample can be challenging (sometimes impossible). 5) To be effective, surveys should be relatively short.

In 2013, the NCSCTE collected workforce data from supply chain technology employers and vendors through a nation-wide employer survey. The purpose of the survey was to understand employer needs related to supply chain technicians (i.e. staff who install, operate, support, upgrade or maintain the software, hardware or material handling equipment) as well as job functions, in-demand skills, and education requirements for these employees.

Below is a step-by-step guide on how to conduct a similar survey in your geographic area.

Step 1: Define research objectives

Research objectives are broad data and information rubrics that one is aiming to obtain through the survey research. Research objectives can be developed by starting with a list of questions that stakeholders conducting the study are hoping to answer.

Sample objectives for a workforce study on supply chain technology:

- Understand the composition of the industry sectors related to supply chain technology, their size, and regional concentration.
- Quantify and qualify technician-level jobs in these sectors within main regions of concentration.
- Project current and future employment for state/region/local area.
- Identify main skill clusters and educational requirements in demand.
- Understand employer needs for training in supply chain technologies.

Step 2: Define universe and sampling plan

After research objectives are formulated, it is necessary to determine which employers will be targeted to participate in the study. This step involves the following sequences of activities:

1. **IDENTIFY UNIVERSE:** For employer surveys, ***universe*** is defined as all potential employers in the industries and other characteristics relevant to the study. In some cases, employers across all 20 sectors are targeted. For the supply chain technology study conducted in 2013, the following employers were targeted:
    - Industry: Employers in the NAICS codes listed in Table 1 of this Guide
    - Size: Employers with 50 employees or more
    - Relevant Activity: Employers that have or operate a warehouse/distribution center

2. **OBTAIN DATABASE**: When parameters for the universe are determined, you will need to obtain an employer database that meets these parameters as closely as possible and contains contact information (phone and/or email). It is not always possible to find a list of employers that meet all the criteria. For example, for the NCSCTE's study in 2013, it was not possible to find a database of firms with known warehouse activities. Only two criteria (NAICS codes and size) were utilized. The employers were then screened during the interviewing process – those that met the criteria qualified to take the survey while those that did not meet the criteria were not offered a survey.

Possible Database Sources/Vendors: InfoUSA, Dun&Bradstreet/Hoovers, Chambers of Commerce, state LMI offices, others.

3. **UNDERSTAND UNIVERSE:** After the database is obtained, the preliminary analysis of the universe can be conducted. You can analyze the universe of firms by demographic characteristics available in the database. At the very least, filter the list and create summaries of the number of firms by industry code and employment size. This analysis will give you an understanding of the composition of your universe – the most common industries that they work in and whether or not these are large corporations or small businesses. If the geographic scope of your database is rather wide, you can also summarize the data for sub-regions (for example, counties) to determine if any regional concentration of firms exists.

4. **DEFINE SAMPLING TARGETS:** In simple terms, defining sampling targets is determining what employers you are going to target with a survey and how many. The ***number of responses*** you want to obtain will depend on the number of firms in your universe and your estimate of those that would qualify to take a survey (if you have additional screeners). For example, if you do not know whether or not the firms in your sample have warehousing operations, but know that about 30% of firms (the average incidence rate for the 2013 NCSCTE study) have such activities, you would realistically estimate that your actual universe is 30% of the number of firms in the database. Then you would also need to factor in a realistic response rate. Depending on the complexity of the survey, response rates for any survey range from 10% to 30%. The example below demonstrates your calculation:

   Number of firms in universe (population): 5,000
   Average incidence of warehousing activities: 30%
   Conservative response rate expected: 10%
   *Number of targeted responses (sample size): 5,000*30%*10% =* ***150***

   In terms of statistical sampling, determining the right sample size is a slightly more complex process. In practice, the absolute minimum size of a sample should be 30. In order to achieve any acceptable level of confidence with the data, your sample size should range from about 260 to 640 (90% to 99% level of confidence). However, when you are working with a limited number of companies in your universe (as in example above), lower levels of confidence could be tolerated. For more information about level of confidence, other sampling measures and for an online sample size calculator, visit the following free resource: www.raosoft.com/samplesize.html. If you have a large enough universe, you could also establish additional sample targets for sub-groups of companies, for example, you might want a proportional representation of small, medium, and large businesses; firms located in different sub-regions; or firms in specific sectors.

Step 3: Develop survey instrument

Crafting an effective survey instrument or questionnaire can be challenging. There are many principles involved in building questions and developing a survey flow. Appendix B outlines many of these principles for mail and online survey instruments.

This Guide provides you with the template questionnaire that the NCSCTE utilized in the national survey on supply chain technology (Appendix A). This questionnaire can be adapted and utilized. You can add or delete questions depending on your specific needs.

The template instrument includes questions related to the occupation of Supply Chain Technician. In the tool, Supply Chain Technicians are also referred to as support/repair/maintenance technicians as employers use different job titles to describe supply chain technology workers. The questionnaire asks for information concerning employer involvement with supply chain technologies, as well as their employment levels of Supply Chain Technicians, future hiring expectations, job functions, in-demand skills, and education requirements for hiring. The survey instrument also includes appropriate screener questions in order to determine whether the respondent qualifies for the survey and to capture general information about each respondent (industry, company size, etc.). The questionnaire was adapted for both online and phone data collection.

Useful Tip: Prior to data collection, it is recommended that the questionnaire be reviewed by researchers as well as pre-tested by subject matter experts to ensure the most effective wording of the questions. In order to factor out survey fatigue and mitigate order biases, answer options in some questions should be presented to the respondents in a random order.

Step 4: Collect data

Web and phone recruitment are common strategies to drive potential employer respondents to the survey and to collect data.

- **PHONE RECRUITMENT:** Phone recruitment involves either a call center or in-house interviewers reaching out to the employers from your database in accordance with the specifications of the sampling plan. Each potential respondent is screened for qualification criteria prior to being offered a phone survey. On average, a phone interview for the NCSCTE survey on supply chain technology lasted from 10 to 15 minutes. Phone recruitment that is outsourced to a call center can be very effective in obtaining a good number of completed surveys in a short period of time, but it can be costly.
- **ONLINE CAMPAIGN:** In addition to phone interviews, an online survey tool can be developed to obtain additional responses from employers. Appropriate screeners are necessary to ensure that an employer meets the sampling criteria to participate in the survey. In its nationwide survey, the NCSCTE and its partners disseminated the link to the web questionnaire throughout their network of supply chain professionals. An online survey is a very cost-effective instrument when you have a strong database of employer email addresses or connections with employer groups that are willing to forward the survey link on your behalf. To set up an online survey, the following instruments are available: (1) SurveyMonkey, and (2) Qualtrics. Both require a fee to

subscribe. While SurveyMonkey is a more cost effective tool, Qualtrics provides better overall functionality and output of results. You can also outsource the online survey instrument to a vendor.

Step 5: Analyze results

Analyzing employer survey results involves connecting the data received from employers to the research objectives determined in Step 1. The output of the results could be a simple report of the top-level statistics for each question (easily extracted from an online tool, such as Qualtrics) or a more involved analysis of the data similar to the report produced by the NCSCTE on the nationwide survey.

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Appendix A – Supply Chain Technician Employer Survey: Phone Questionnaire

Introduction:

INTRO1

Hello, my name is _____ calling on behalf of the [COLLEGE X]. I am not selling anything. [COLLEGE X] is interested to start a program to train supply chain technicians. We are conducting this study that will help us understand employer needs related to supply chain technology as well as job functions, skills and education requirements.

May I please speak with _____ or a person knowledgeable about your workforce needs?

[ONCE CORRECT PERSON IS ON THE PHONE RE-INTRODUCE]

[IF ASKED HOW LONG SURVEY WILL TAKE SAY "The survey should take about 10 minutes to complete."

Firm Information:

1a. In relation to material handling technology, for example, automated conveyer systems or GPS tracking devices, which of the following would best describe your firm? [READ LIST. SELECT ONE RESPONSE]

1 A user of material handling technology and equipment
2 A supplier or installer of material handling technology and equipment [TERMINATE]
3 None of the above [TERMINATE]

1b. Are you knowledgeable about the employment and workforce needs of your firm's distribution center?

1 Yes [SKIP TO INTRO2]
2 No [TERMINATE]

1c. May I please speak with someone in your company who is knowledgeable about the employment and workforce needs of your firm's distribution center?

1 Yes – RESPONDENT AVAILABLE [GO BACK TO INTRODUCTION]
2 Yes but not at the moment [SCHEDULE CALLBACK AND BEGIN AT INTRODUCTION]
2 No/Refused [TERMINATE]

INTRO2

Just some quick background information before we begin.

A supply chain technician is a person who installs, operates, supports upgrades or maintains the software, hardware or material handling equipment which supports the supply chain.

The information you provide will be utilized to develop skills-based educational pathways, build new curricula, guide professional development for faculty, and develop the high skilled employees your firm will need in the future. Your input into this study is valuable and appreciated.

Please note that all survey data will be aggregated. Individual responses will not be published.

2. What is the name of your company? _____

3a. In what state is your firm's distribution center located? If your company has multiple distribution centers, please specify the location of the one that you work at or work with most.

State:_____ [SHOW ALPHA LIST OF STATES]

3b. What is the zip code where this distribution center is located?

Zip:_____ [SKIP TO 3d]
9 Don't know [ASK 3C]

3c. In what city is this distribution center is located?

City:_____

3d. How many permanent employees work at your firm at your location, including full-time and part-time staff? [DO NOT READ LIST. RECORD RESPONSE BELOW.]

1	1-19 **TERMINATE**	6	500-999
2	20-49 **TERMINATE**	7	1,000-4,999
3	50-99	8	5,000-9,999
4	100-249	9	10,000+
5	250-499		

4. Which of the following best describes your company's industry? [READ LIST. SELECT ONE RESPONSE.]

1	Agriculture	7	Healthcare
2	Manufacturing	8	Transportation and Warehousing
3	Retail (grocery)	9	Professional Services/Consulting
4	Retail (non-grocery)	10	Automotive
5	Wholesale Trade	11	Other (specify):
6	Hospitality		_____

5. Is your firm currently responsible for any of the following? Please say "yes" or "no" to each of the following: [READ LIST, SELECT ALL THAT APPLY.]

1	Manufacturing	6	Packaging
2	Distribution	7	Freight Transport by truck
3	Freight Transport by air	8	Specialized Consulting Services
4	Freight Transport by rail		(e.g. 3PL)
5	Importing and Exporting	9	Other (specify):
			_____

Workforce and Training:

6. Which of the following material handling or supply chain technologies or equipment does your firm currently use or plan to use? Does your firm currently or plan to use…[READ LIST – SELECT ALL THAT APPLY]

1 Warehouse Management System
2 Warehouse Control System
3 Transportation Management System
4 Inventory Management System
5 Enterprise Resource Planning (ERP)/Manufacturing Resource Planning (MRP) software
6 Radio Frequency (RF) components like RF on forklift for picking, pick-to-light, pick-to-voice
7 Conveyor Belts
8 Bar codes
9 Electronic Data Interchange (EDI)
10 Automated warehouse components like conveyors, sensors, AS/RS, AGVs robots
11 Labor Management Systems
12 Other (specify): _____
13 [DO NOT READ] None of these

6a. For the technologies that you just mentioned your firm currently uses or plans to use, who is **maintaining and supporting** them? Please say "yes" or "no" to each of the following: [READ LIST. SELECT ALL THAT APPLY.]

1 In-house staff/employees
2 External (vendor) staff
3 External (third party) staff
4 Other (specify): _____

7. How many supply chain technicians – technicians who install, operate, support or maintain the software, hardware or material handling equipment – do you **currently** have on staff at your location?

_____

8a. Thinking about supply technicians, two years from now do you think you'll have MORE or FEWER supply chain technicians than you currently have on staff?

1 More
2 Fewer
3 [DO NOT READ] About the same [SKIP TO Q9]

8b. How many (insert response from Q8a) supply chain technicians are you planning to have on staff at your location **two years from now**?

[DISPLAY IF Q8A=MORE] More_____
[DISPLAY IF Q8A=LESS] Less_____

9. What is the minimum level of education required for your **entry level** employees who install, support, or maintain supply chain technologies? [READ LIST]

1 High school diploma or equivalent
2 Postsecondary certificate from a community college or private technical college
3 Associate/2-year degree
4 Bachelor's degree
5 Graduate-level degree

10. Which of the following industry certifications does your firm find important for your technicians who install, support, or maintain supply chain technologies? Please say "yes" or "no" to each of the following: [READ LIST, SELECT ALL THAT APPLY]

1 **Manufacturing Skill Standards Certification (MSSC)** – Certified Logistics Assistant/Technician
2 **Association for Operations Management (APICS)** – Certified in Production and Inventory Management/Certified Supply Chain Professional
3 **National Institute for Metalworking Skills (NIMS)** – Industrial Maintenance and Mechatronics Technicians
4 **The Association for Packaging and Processing Technologies (PMMI)** – Mechatronics Certificate
5 **Occupational Safety and Health (OSHA)** Certification
6 **Forklift Certification**
7 Other (specify): _____
8. None of the above

11. For each of the following functional areas of Supply Chain Technicians, please indicate how important you feel each job function will be for your organization over the next two years. Please indicate if each is extremely important, moderately important, slightly important or not important. The first area is…

Extremely important (1) Somewhat important (2) Not very important (3) Not at all Important (4) DK/NA (5)

[RANDOMIZE LIST]

A. **Operate Equipment**: Operate material handling equipment to unload, move and retrieve products in a warehouse.

B. **Maintain Equipment**: Perform corrective and preventative maintenance of the material handling equipment and the necessary systems to manage, schedule and record this activity.

C. **Direct Maintenance**: Coordinate projects related to installation, maintenance and repair work including planning, scheduling work and equipment.

D. **Maintain Systems**: Use warehouse management system; implement, evaluate and test the changes to the WMS; and update configuration of the WMS to achieve production accuracies and efficiencies

11a. Are there any other important functions I did not mention?

1 Yes (specify): _____
2 No

12. Lastly, please describe the type of training your firm would find useful for your technicians who install, support, and maintain material handling equipment and technologies?_____
_____

Additional Information:

Thank you for taking the time to answer our questions.

13. In case it is necessary to confirm your responses, may I please have your contact information? Note that this information will only be used for research purposes and your individual responses will not be published, unless you give us explicit permission to do so.

1 Your name:_____
2 Your position or job title:_____
3 The name of organization:_____
4 The address of organization:_____
5 Your email address:_____
6 Your phone number:_____

14. May we contact you for further information about your organization and your training needs?
1 Yes
2 No

Closing:

15. Are you interested in receiving a report on the findings of the research?
1 Yes
2 No

16. Any additional comments or thoughts that you would like to share with us?
1 Yes (SPECIFY) _____
2 No

Thank you very much for your time! Your input is very valuable! Have a great day.

Appendix B – Don Dillman's* Guiding Principles for Mail and Internet Surveys

Dillman, D., Smyth, J. & Christian, L. *Internet, Mail, and Mixed-Mode Surveys: The Tailored Design Method* (2009). New York: Wiley.

Mail and Internet Surveys

1. Write each question in a way that minimizes the need to reread portions in order to comprehend the response task.

2. Place instructions exactly where the information is needed and not at the beginning of the questionnaire.

3. Place items with the same response categories into an item-in-a-series format, but do it carefully.

4. Ask one question at a time.

5. Minimize the use of matrices.

6. Begin asking questions in the upper left quadrant; place any information not needed by the respondent into the lower left quadrant.

7. Use the largest and/or brightest symbols to identify the starting point on each page.

8. Identify the beginning of each succeeding question in a consistent way.

9. Number the questions consecutively and simply, from beginning to end.

10. A consistent figure/ground format encourages the reading of all words. The use of reverse print should be limited to section headings and/or question numbers.

11. Place more blank spaces between the questions than between subcomponents of the questions.

12. Use dark print for questions and light print for answer choices.

13. If special instructions are essential, write them as a part of the question statement.

14. Optional or occasionally needed instructions should be separated from the question statement by font or symbol instructions.

Internet Surveys

1. Recognize that web surveys are subject to the same sources of error as other surveys.

2. Develop a satisfactory identification system for respondents to control coverage error and assure survey credibility.

3. Design web surveys for those with older browsers and poorer communication rather than those with state of the art access.

4. Define desired response path by placing information in the order the respondent should process it.

5. To the greatest extent practical, place needed definitions, explanations, and instructions in the response path exactly where needed by the respondent.

6. Use graphical language to guide respondents through the desired response path.

7. Anticipate the potential mode effects that flow from these sources: no interviewer, respondent control, visual processing of information.

8. Avoid visual composition that runs counter to the designer's measurement intentions.

9. Avoid construction techniques that require multiple steps to answer items that require only one step in other survey modes.

10. When respondents need to prepare information before answering, provide a printable version of the questionnaire as an email attachment.

11. Keep the questionnaire short on voluntary surveys.

12. Design an introductory page and first questions so that they are relevant, fast, and easy.

13. Use a conventional formula similar to those normally used on paper self-administered questionnaires, e.g. numbered items, left justification, vertical response choices.

14. Avoid differences in the visual appearance of questions that result from different screen configurations, operating systems, browsers, partial screen displays, and wrap-around text.

15. Don't require respondents to reconfigure computers, switch browsers, or download software in order to complete the survey.

16. Provide instruction commensurate with population need. Instructions on how to take computer actions may or may not be necessary.

17. Use drop down boxes only when the answering process is simplified and identify each with "click here."

18. Do not require the respondent to provide an answer to each question before being allowed to answer any subsequent question, unless a branching instruction depends on it.

19. Provide missing item requests in non-threatening language.

20. Choose scroll, page by page, or mixed construction deliberately based upon measurement and response considerations.

21. Avoid question structures that require scrolling or toggling between screens.

22. Avoid excessive use of "check all that apply" questions because of the tendency of respondents to satisfice and choose earlier listed answer choices.

23. To avoid premature termination, insert words and/or symbols that accurately communicate progress towards completion.

24. Recognize that non-response stems from multiple sources: technological considerations, questionnaire design decisions, respondent computer skills, as well as implementation decisions.

25. Develop an implementation strategy that includes elements past research has shown to be effective in improving the response to self-administered questionnaires.

26. If a web survey is short, consider embedding it into an email message so that one does not have to click to another location.

27. Tailor implementation procedures to the population.

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This list was developed based on several short courses taught by Dr. Dillman.