Economic Competitiveness of Warehousing in California

Requested by
Jeff Morneau, Division of Transportation Planning

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Executive Summary

Background

There is a growing need in California to explore current and future land use and transportation network factors that impact the economic competitiveness of warehousing in the state. California Department of Transportation (Caltrans) is seeking insights into these factors to help the department deliver a future for freight that is resilient, environmentally sustainable, socially equitable and economically competitive.

Of interest to Caltrans are site selection strategies and considerations that are prevalent in the private sector, factors that influence a company's decision to locate warehousing operations in California or to leave the state for more favorable opportunities elsewhere, and the critical links between warehousing and goods movement along the state highway system.

Findings from this effort will inform the development of a statewide warehousing report that aims to improve the understanding of relationships between warehousing trends and transportation networks. Data from the warehousing report will then be used in an update to the next California Freight Mobility Plan.

Summary of Findings

Survey of Practice

An online survey was distributed to state department of transportation (DOT) members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Planning, the California Freight Advisory Committee and the Regional Transportation Commission of Washoe County, Nevada. Survey questions are provided in Appendix A. The full text of survey responses is presented in a supplement to this report.

Seven organizations responded to the survey:

- Arkansas DOT.
- Bay Area Air Quality Management District (BAAQMD).
- BNSF Railway.
- Idaho Transportation Department.
- Los Angeles County Metropolitan Transportation Authority (LA Metro) (partial response).
- Los Angeles World Airports (LAWA).
- Majestic Realty (partial response).

Summarized below are survey findings from these agencies in the following topic areas:

- Site selection.
- Incentives for development and retention.
- Other impacts on warehousing competitiveness.

Site Selection

Respondents rated the significance of specific factors that may contribute to the selection of a private sector warehouse site. Using a rating scale of 1 = not at all important to 5 = extremely important, respondents rated factors in the following categories:

- **Facility.** Factors in the supply of certain types of facilities that increase competitiveness.
- **Infrastructure.** Factors that increase competitiveness because of the supply of certain types of infrastructure.
- **Location.** Factors of locational advantage within the supply chain that make certain locations more competitive than others.
- **Workforce.** Factors that involve the workforce and community.
- **Environmental.** Factors concerning the health and safety of the community that make for more competitiveness.
- **Equity.** Factors that increase competitiveness by increasing equity.
- **Regulatory.** Regulatory and economic development initiatives that increase competitiveness.

Overall, respondents gave the highest ratings to factors in the workforce, infrastructure, location and regulatory categories (primarily rated very important). Only one factor across all categories was rated extremely important by all respondents: available workers in the workforce category. (*Note:* The factor with the second highest overall rating—available truckers—is also in the workforce category.) Below are additional factors within these categories that received high ratings:

- *Infrastructure*: Proximity to interstate highways.
- *Infrastructure*: Freight transportation capacity.
- *Location*: Available land.
- *Regulatory*: Energy and utilities.

Equity-related factors received the lowest ratings of all the categories surveyed followed by the environmental category. All factors in the equity category were rated moderately important; two of the four factors in the environmental categories were also rated moderately important.

Below are highlights of all survey responses by category. Following these highlights is a listing of the factors that contribute to the selection of a warehouse site and the corresponding weighted average of survey responses for that factor. A more thorough presentation of survey results is provided in the **Detailed Findings** section of this report, including a breakdown of survey responses by responding agency.

Facility

LAWA, BNSF Railway, Idaho Transportation Department and BAAQMD rated facility-related factors as more significant to making a site more competitive, particularly the cost of the facility development process to supply needed warehousing through retrofits and to develop new facilities. Arkansas DOT rated most of these factors as only slightly important.

Factor	Weighted Average
Cost of facility development process to supply needed warehousing through retrofits	4.14
Cost of facility development process to develop new facility	4.14
Supply of facilities with layout/design requirements fitting industry priorities	4.00
Cost of developing new space for yards (versus warehousing space)	3.71

Infrastructure

BNSF Railway rated all infrastructure-related factors as extremely important. Idaho Transportation Department and Majestic Realty rated the factors as either very important or extremely important. LAWA also rated most factors as either very important or extremely important, while BAAQMD rated them as moderately to very important.

Factor	Weighted Average
Proximity to interstate highways	4.57
Freight transportation capacity	4.50
Last-mile access conditions	4.43
Proximity to intermodal facilities	4.43
Freight transportation reliability	4.33
STAA truck access	4.17
Heavy truck traffic	4.14
Proximity to rail ramps	3.86

Location

LAWA rated all location-related factors as extremely important, and Idaho Transportation Department rated these factors as either very important or extremely important. Ratings from the remaining agencies ranged from slightly important to extremely important.

Factor	Weighted Average
Available land	4.57
Goods movement	4.43
Shortening last-mile delivery	4.17
Land development costs	4.14
Congestion	4.00
Vehicle miles traveled	4.00
Access to materials	3.43
Proximity to residential areas or schools	3.43
Natural resources	3.00

Workforce

All respondents rated available workers as extremely important and truckers as very important or extremely important to making a site more competitive. LAWA rated all workforce-related factors as either very important or extremely important. BAAQMD, BNSF Railway and Idaho Transportation Department also gave higher ratings to these factors with the exception of population growth (BAAQMD) and temporary workers (BNSF Railway and Idaho).

Factor	Weighted Average
Available workers	5.00
Available truckers	4.67
Semiskilled workers	4.00
Cost of living	4.00
Higher skilled workers	3.83
Qualified managers	3.83
Affordable housing	3.83
Population growth	3.50
Temporary workers	3.17

Environmental

BAAQMD and LAWA rated all environmental factors as extremely important in making a site more competitive. Arkansas DOT and Idaho Transportation Department rated these factors as moderately important, and LA Metro rated three of four factors as slightly important or moderately important.

Factor	Weighted Average
Existing policy environment considers emissions and environmental impacts of facilities in general	4.17
Existing policy environment considers emissions reduction	4.00
Existing regulations consider the contribution of emissions to the environment	3.67
Existing regulatory frameworks encourage adoption of emissions mitigating technologies	3.67

Equity

BAAQMD rated all equity-related factors as extremely important, and LAWA rated these factors as extremely or very important to making a site competitive. Arkansas DOT and LA Metro rated the factors as either moderately or slightly important.

Factor	Weighted Average
Surrounding communities maintain a relationship with the facility in general in which they can discuss impacts	3.83
Emissions reduction requirements for disadvantaged communities	3.67
Existing regulations consider the relationship of the proposed business to the community in making the situation	3.60
Existing regulations are clear about the level of engagement with surrounding communities	3.33

Regulatory

BNSF Railway and LAWA rated all regulatory factors as extremely important in making a site more competitive. The LAWA respondent noted that South Coast Air Quality Management District (SCAQMD) Warehouse Regulation 2305 weighs heavily in warehouse site selection. BAAQMD and Idaho Transportation Department rated regulatory factors as either very or extremely important, while LA Metro rated them as either slightly or moderately important.

Factor	Weighted Average
Energy and utilities	4.50
Input costs	4.17
Affordable wage rates	4.00
Other regulatory issues	4.00
Environmental regulations	4.00

Incentives for Development and Retention

Local- or state-level economic incentives that encourage new warehousing facilities typically take the form of financial assistance (Arkansas DOT and BAAQMD). Arkansas DOT also offers tax incentives and provides early stage site development, such as utilities and access. BAAQMD offers low-cost loans and relaxes zoning regulations.

To retain existing warehousing facilities, Idaho Transportation Department encourages access partnerships and growth of intermodal facilities.

Other key incentives or types of economic development support that encourage new development or the retention of existing facilities include:

- Collaborating with educational institutions to provide a well-trained workforce (Arkansas, BAAQMD, BNSF Railway and LA Metro).
- Assistance with employee recruitment (Arkansas, BAAQMD and LAWA).
- Permitting assistance for shovel-ready sites (Arkansas, BNSF Railway and Idaho).
- Public/private partnerships (BAAQMD, BNSF Railway and Idaho).

Other Impacts on Warehousing Competitiveness

Regulatory Issues, E-Commerce and Technology Needs

Respondents from BNSF Railway, Idaho Transportation Department and LAWA described other factors that affect the demand and competitiveness of warehousing. Regulatory issues have negatively affected warehousing site development for BNSF Railway and LAWA, including an increase in the cost of doing business (BNSF Railway). In Idaho, relaxed zoning considerations have encouraged new warehousing facilities, but concerns over warehouse retention remain because of new federal regulations in the Infrastructure Investment and Jobs Act.

E-commerce has also significantly impacted warehousing demand and/or competitiveness for Idaho and BNSF Railway. The technology demands noted by respondents focused on emissions reduction and truck parking communications.

Survey responses from BNSF Railway, Idaho Transportation Department and LAWA are summarized in the case studies below.

BNSF Railway

Topic	Description
Regulatory issues that encourage/discourage new warehousing sites	• Air emission and truck traffic reduction efforts. • Cost of doing business is increasing because of various regulatory requirements, including the Environmental Impact Report (EIR) process.
Regulatory issues that result in retaining/losing existing warehouses	Cost of doing business is increasing because of various regulatory requirements, including the EIR process.
E-commerce and warehouse demand/competitiveness	Has "significantly" affected demand/competitiveness. As a logistics company, BNSF Railway needs to increase business services as more people order online.
Technology critical to the needs of warehousing stakeholders	Carbon emission reduction technology.

Idaho Transportation Department

Topic	Description
Regulatory issues that encourage/discourage new warehousing sites	Relaxed zoning considerations.
Regulatory issues that result in retaining/losing existing warehouses	Concern about losing existing warehouses, especially as a result of the new federal regulations in the Infrastructure Investment and Jobs Act.
E-commerce and warehouse demand/competitiveness	• Explosion of new local distribution facilities. • Future air distribution facilities. • First and last mile connections.
Technology critical to the needs of warehousing stakeholders	Truck parking communications systems near warehouse/distribution facilities.

Los Angeles World Airports

Topic	Description
Regulatory issues that encourage/discourage new warehousing sites	SCAQMD Warehouse Regulation 2305.
Regulatory issues that result in retaining/losing existing warehouses	SCAQMD Warehouse Regulation 2305.
E-commerce and warehouse demand/competitiveness	N/R
Technology critical to the needs of warehousing stakeholders	• Near-zero and zero-emission trucks. • Vehicle charging infrastructure. • Truck appointment systems.

N/R No response

COVID-19 Pandemic

The COVID-19 pandemic has had no impact on BNSF Railway's ability to encourage new or retain existing warehousing facilities. Idaho Transportation Department reported only a minimal impact, noting that the pandemic has affected its workforce availability, but "new warehousing/industrial growth has continued."

Specific warehouse-related changes resulting from the pandemic caused agencies to increase wage rates (BAAQMD, BNSF Railway and Idaho); expand warehouse information technology (BAAQMD and BNSF Railway); and implement warehouse management systems (BAAQMD and BNSF Railway). BNSF Railway has also improved warehouse processes.

The BNSF Railway respondent also noted that the organization has had to learn to do more with a reduced workforce and that delays in the supply chain are significantly impacting business and customers, adding that the "supply chain is strained."

Both BNSF Railway and LAWA expect pandemic-related impacts to continue long term, particularly as they affect the supply chain. The BNSF Railway respondent noted that "the supply chain will forever be altered." However, Arkansas DOT, BAAQMD and Idaho Transportation Department do not anticipate impacts to continue.

Consultation With Selected Experts

Subject matter experts from the private sector were contacted to learn about warehouse site selection strategies and considerations, factors that influence a company's decision to locate or retain warehousing operations in California, state and local economic development incentives and regulatory initiatives that encourage or discourage warehouse siting or retention, and other warehousing-related issues. The following organizations were contacted:

- California Warehouse Association.
- Customized Logistics and Delivery Association.
- Distribution Management Association of Southern California.
- International Warehouse Logistics Association.
- Prologis.
- Warehousing Education and Research Council.

At the time of publication of this report, none of the representatives from these organizations had responded to our request for information.

Related Research and Resources

A literature search of recent publicly available resources identified publications presented below in two topic areas:

- California regional agency resources.
- Other research and resources.

California Regional Agency Resources

Several publications produced for California metropolitan planning organizations (MPOs) examine site selection, factors impacting warehousing location decisions, the links between

warehousing and goods movement, and other elements of warehousing. A 2021 Kern Council of Governments report examines four options for sustainable goods movement strategies for Kern County: targeted logistics transportation fees, a program to shift from road to rail, use of clean technologies and building code revisions.

A discussion of more coordinated goods movement planning among selected California MPOs is presented in a 2019 Metropolitan Transportation Commission report, which recommends organizing stakeholders, matching funds and establishing public/private partnerships, and preparing grant applications that bundle multiple projects. A 2016 San Diego Association of Governments study describes the warehousing infrastructure in San Diego and Imperial counties and in Baja California, and includes a discussion of policy constraints, market conditions and regulatory issues.

Goods movement and goods movement-dependent industries are examined in a 2020 Southern California Association of Governments (SCAG) report, including the challenges resulting from technology and automation. A 2020 SCAG toolbox of strategies for last-mile freight is highlighted. Toolbox solutions address managing physical space in the curb area, providing more efficient deliveries and using resources effectively to improve delivery conditions. Another SCAG resource, produced in 2018, presents a regional warehousing space forecast model that was developed to estimate how warehousing space supply and demand changes over time.

Other Research and Resources

Publications and resources are presented about a range of warehousing and goods movement topics, including:

- *Analysis methods and algorithms*, which includes a 2017 conference paper that provides "a data-smart approach" to connected capacitated warehouse location. This approach searches for the minimum total transportation cost of the warehouse network.
- *COVID-19*, which features a 2020 white paper that reexamines disruptions to cities caused by emerging transportation technologies on land use, urban design, building design, transportation and real estate in the Urbanism Next framework.
- *Environmental factors*, providing best practices and mitigation measures to comply with California Environmental Quality Act (CEQA) requirements and promote environmentally just development in warehouse project proposals.
- *Equity factors*, including a 2021 journal article that assesses the relationship between the spatial distribution of warehouses and neighborhoods with different demographic and socioeconomic characteristics, indicating that warehouses are disproportionately located in both low-income and medium-income minority neighborhoods, and a 2020 report examining the influence of e-commerce on the distribution of warehouses and distribution centers.
- *Location factors*, which features several resources related to the spatial dynamics of warehousing and distribution, including a 2020 case study of spatial decentralization in Los Angeles and why warehouses have moved from central urban areas to the urban periphery over time, and a 2017 analysis of freight patterns of warehouses and distribution centers in Southern California. A 2019 NCHRP research report presents guidance for transportation agency decision-makers responsible for addressing issues related to transportation system investment and land development that result from transformational technologies.

Gaps in Findings

Although the survey was distributed to a comprehensive group of respondents, response was very limited from both public and private sector representatives. Useful information was obtained from those agencies that did respond, however, additional information from public and private sector representatives could potentially increase the findings of this effort and provide further insight about warehousing and the transportation network.

The lack of response from the subject matter experts also limited the information gathered for this effort. Continued outreach to these and other industry professionals could produce insights and experiences of value.

Next Steps

Moving forward, Caltrans could consider:

- Following up with survey respondents to obtain additional information about factors that impact warehousing in California, specifically:
    - Reasons that companies are relocating from urban areas to more rural areas, or moving from California to other states.
    - Additional examples of financial support or assistance used as incentives.
    - Local laws and local zoning/planning that has hurt warehousing competitiveness.
    - Information about training programs or other educational opportunities offered to prepare new warehouse workers.
- Contacting representatives from the private sector and from California public agencies to gather supplemental information about the impacts to warehousing.
- Reaching out to subject matter experts from the selected warehousing industries and associations to encourage them to share their experience with warehouse site selection strategies, incentives and regulatory initiatives that encourage or discourage warehouse siting or retention, and other warehousing-related issues.
- Reviewing the resources provided in the literature search, specifically, the findings and actionable strategies shared in various MPO resources and the analysis of spatial distribution and warehousing trends produced by other resources.

Detailed Findings

Background

There is a growing need in California to explore current and future land use and transportation system factors that impact the economic competitiveness of warehousing in the state. California Department of Transportation (Caltrans) is seeking insights into these factors to help the department deliver a future for freight that is resilient, environmentally sustainable, socially equitable and economically competitive.

Of interest to Caltrans are site selection strategies and considerations that are prevalent in the private sector, factors that influence a company's decision to locate warehousing operations in California or to leave the state for more favorable opportunities elsewhere, and the critical links between warehousing and goods movement along the state highway system.

Findings from this effort will inform the development of a statewide warehousing report that aims to improve the understanding of relationships between warehousing trends and transportation networks. Data from the warehousing report will then be used in an update to the next California Freight Mobility Plan (CFMP). The March 2020 CFMP includes the following strategy that is central to this investigative effort:

> Strategy EP-4-A: Identify incentives for the retention, expansion and new development of logistics industry facilities (warehouses). For this strategy, Caltrans is advised to:
>
> > Develop a comprehensive assessment of available [s]tate and local economic development incentives. The focus of this assessment will be to evaluate the current practices of Caltrans and how they fit within the bigger picture of economic development.

Several strategies were used to gather information for this effort, including an online survey of state transportation agencies and public and private sector freight stakeholders. The survey inquired about critical factors in warehouse site selection, and the state and local economic development incentives that encourage new warehousing development or the retention of existing warehouse sites. A selected group of subject matter experts were also contacted to learn about their experiences with warehouse site selection. Results of a literature search of publicly available domestic research and resources examine various elements of warehousing. Finding from these efforts are presented below in the following categories:

- Survey of practice.
- Consultation with selected experts.
- Related research and resources.

Survey of Practice

An online survey was distributed to state department of transportation (DOT) members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Planning, which supports the Freight Planning Task Force. The survey was also distributed to members of the California Freight Advisory Committee, a "charted member advisory body representing public and private sector freight stakeholders, including representatives of ports, shippers, carriers, freight-related associations, the freight industry workforce, the transportation department of the [s]tate and local governments," and to the Regional Transportation Commission of Washoe County, Nevada.

Survey questions are provided in Appendix A. The full text of survey responses is presented in a supplement to this report.

Seven organizations responded to the survey:

- Arkansas DOT.
- Bay Area Air Quality Management District (BAAQMD).
- BNSF Railway.
- Idaho Transportation Department.
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- Los Angeles World Airports (LAWA).
- Majestic Realty (partial response).

Below are survey findings from these agencies, summarized in the following topic areas:

- Site selection.
- Incentives for development and retention.
- Other impacts on warehousing competitiveness.

Site Selection

Respondents rated the significance of specific factors that may contribute to the selection of a private sector warehouse site. Using a rating scale of 1 = not at all important to 5 = extremely important, respondents rated factors in the following categories:

- **Facility.** Factors in the supply of certain types of facilities that increase competitiveness.
- **Infrastructure.** Factors that increase competitiveness because of the supply of certain types of infrastructure.
- **Location.** Factors of locational advantage within the supply chain that make certain locations more competitive than others.
- **Workforce.** Factors that involve the workforce and community.
- **Environmental.** Factors concerning the health and safety of the community that make for more competitiveness.
- **Equity.** Factors that increase competitiveness by increasing equity.
- **Regulatory.** Regulatory and economic development initiatives that increase competitiveness.

Note: Majestic Realty rated the significance of factors in the facility, infrastructure and location categories only.

Facility

The following facility-related factors were rated:

- Supply of facilities with layout/design requirements fitting industry priorities.
- Cost of facility development process to supply needed warehousing through retrofits.
- Cost of facility development process to develop new facility.
- Cost of developing new space for yards specifically (as distinguished from warehousing space).

In general, facility-related factors were more significant to LAWA, BNSF Railway, Idaho Transportation Department and BAAQMD in making a site more competitive. Among the individual factors, survey respondents gave higher ratings to the cost of the facility development process to supply needed warehousing through retrofits and the cost of the process to develop a new facility, with five respondents rating each factor as either very important or extremely important. In addition to rating these factors, the Majestic Realty respondent noted that warehouse/logistics development is "demand-conscious." Table 1 summarizes survey results.

Table 1. Significance of Facility-Related Factors in Warehouse Site Selection

Factor	Arkansas	BAAQMD	BNSF Railway	Idaho	LA Metro	LAWA	Majestic Realty	Weighted Average
Facilities with layout/design requirements fitting industry priorities	3	4	4	4	5	5	3	**4.00**
Cost to supply needed warehousing through retrofits	2	4	5	5	3	5	5	**4.14**
Cost to develop new facility	2	4	5	5	3	5	5	**4.14**
Cost of developing new space for yards specifically	2	4	5	4	3	5	3	**3.71**

Rating scale: 1 = not at all important to 5 = extremely important.

Infrastructure

The following infrastructure-related factors were rated:

- Freight transportation capacity.
- Freight transportation reliability.
- Heavy truck traffic.
- Last-mile access conditions.
- Proximity to intermodal facilities.
- Proximity to interstate highways.
- Proximity to rail ramps.
- STAA truck access.

BNSF Railway rated all infrastructure-related factors as extremely important, and Idaho Transportation Department and Majestic Realty rated the factors as either very important or extremely important. Of the individual factors, proximity to interstate highways, freight transportation capacity, last-mile access conditions and proximity to intermodal facilities received higher ratings (very important or extremely important). Heavy truck traffic and proximity to rail ramps received lower ratings. Table 2 summarizes survey results.

Table 2. Significance of Infrastructure-Related Factors in Warehouse Site Selection

Factor	Arkansas	BAAQMD	BNSF Railway	Idaho	LA Metro	LAWA	Majestic Realty	Weighted Average
Freight transportation capacity	5	3	5	5	4	N/R	5	**4.50**
Freight transportation reliability	4	3	5	4	5	N/R	5	**4.33**
Heavy truck traffic	3	4	5	4	3	5	5	**4.14**
Last-mile access conditions	4	3	5	5	5	5	4	**4.43**
Proximity to intermodal facilities	3	3	5	5	5	5	5	**4.43**
Proximity to interstate highways	5	4	5	4	5	4	5	**4.57**

Factor	Arkansas	BAAQMD	BNSF Railway	Idaho	LA Metro	LAWA	Majestic Realty	Weighted Average
Proximity to rail ramps	3	3	5	4	4	4	4	**3.86**
STAA truck access	N/A	4	5	4	3	4	5	**4.17**

Rating scale: 1 = not at all important to 5 = extremely important.

N/A Not applicable.

N/R No response.

Location

The following location-related factors were rated:

- Access to materials.
- Available land.
- Congestion.
- Goods movement.
- Land development costs.
- Natural resources.
- Proximity to residential areas or schools.
- Shortening last-mile delivery.
- Vehicle miles traveled.

LAWA rated all location-related factors as extremely important, and Idaho Transportation Department rated these factors as either very important or extremely important. Among the individual factors, available land and goods movement were rated highest followed by shortening last-mile delivery and land development costs. Factors rated moderately important included access to materials, proximity to residential areas or schools, and natural resources. Table 3 summarizes survey results.

Table 3. Significance of Location-Related Factors in Warehouse Site Selection

Factor	Arkansas	BAAQMD	BNSF Railway	Idaho	LA Metro	LAWA	Majestic Realty	Weighted Average
Access to materials	3	4	3	4	3	5	2	**3.43**
Available land	4	3	5	5	5	5	5	**4.57**
Congestion	3	4	4	4	4	5	4	**4.00**
Goods movement	5	3	5	4	4	5	5	**4.43**
Land development costs	3	4	5	4	3	5	5	**4.14**
Natural resources	2	2	3	4	2	5	3	**3.00**
Proximity to residential areas or schools	3	4	3	4	2	5	3	**3.43**
Shortening last-mile delivery	4	3	5	5	3	5	N/R	**4.17**
Vehicle miles traveled	4	3	4	5	3	5	N/R	**4.00**

Rating scale: 1 = not at all important to 5 = extremely important.

N/R No response.

Workforce

The following workforce-related factors were rated:

- Affordable housing.
- Available truckers.
- Available workers.
- Cost of living.
- Higher-skilled workers.
- Population growth.
- Qualified managers.
- Semiskilled workers.
- Temporary workers.

All respondents rated available workers as extremely important and truckers as very important or extremely important to making a site more competitive. Many respondents also rated semiskilled workers as very important, with lower ratings to higher-skilled workers, qualified managers and temporary workers.

LAWA rated all workforce-related factors as either very important or extremely important to making a site more competitive. BAAQMD, BNSF Railway and Idaho Transportation Department also gave higher ratings to these factors with the exception of population growth (BAAQMD) and temporary workers (BNSF Railway and Idaho). Table 4 summarizes survey results.

Table 4. Significance of Workforce-Related Factors in Warehouse Site Selection

Factor	Arkansas	BAAQMD	BNSF Railway	Idaho	LA Metro	LAWA	Weighted Average
Affordable housing	3	5	4	4	2	5	**3.83**
Available truckers	5	4	5	5	4	5	**4.67**
Available workers	5	5	5	5	5	5	**5.00**
Cost of living	3	4	4	4	N/R	5	**4.00**
Higher-skilled workers	4	4	4	4	3	4	**3.83**
Population growth	3	3	4	4	3	4	**3.50**
Qualified managers	3	5	4	4	3	4	**3.83**
Semiskilled workers	4	4	5	4	3	4	**4.00**
Temporary workers	4	4	2	3	2	4	**3.17**

Rating scale: 1 = not at all important to 5 = extremely important.

N/R No response.

Environmental

The following environmental factors were rated:

- Existing regulations consider the contribution of emissions to the environment.
- Existing regulatory frameworks encourage adoption of emissions mitigating technologies.
- Existing policy environment considers emissions reduction.
- Existing policy environment considers emissions and environmental impacts of facilities in general.

Both BAAQMD and LAWA rated all environmental factors as extremely important in making a site more competitive. Arkansas DOT and Idaho Transportation Department rated these factors as moderately important. LA Metro also assigned lower ratings to these factors, rating three of four factors as slightly important or moderately important.

The factors that received the highest average ratings (very important or higher) address emissions and environmental impacts of facilities in general, and emissions reduction. Table 5 summarizes survey results.

Table 5. Significance of Environmental Factors in Warehouse Site Selection

Factor	Arkansas	BAAQMD	BNSF Railway	Idaho	LA Metro	LAWA	Weighted Average
Contribution of emissions to the environment	3	5	4	3	2	5	**3.67**
Adoption of emissions mitigating technologies	3	5	4	3	2	5	**3.67**
Emissions reduction	3	5	5	3	3	5	**4.00**
Emissions and environmental impacts of facilities in general	3	5	5	3	4	5	**4.17**

Rating scale: 1 = not at all important to 5 = extremely important.

Equity

The following equity-related factors were rated:

- Existing regulations consider the relationship of the proposed business to the community in making the situation.
- Emissions reduction requirements for disadvantaged communities.
- Existing regulations are clear about the level of engagement with surrounding communities.
- Surrounding communities maintain a relationship with the facility in general in which they can discuss impacts.

Despite higher ratings from BAAQMD and LAWA, equity-related factors received the lowest ratings of all the categories surveyed. Arkansas DOT and LA Metro rated the factors as either moderately or slightly important to making a site more competitive.

Highest ratings to individual factors went to surrounding communities maintain a relationship with the facility in general in which they can discuss impacts, and emissions reduction requirements for disadvantaged communities. Table 6 summarizes survey results.

Table 6. Significance of Equity-Related Factors in Warehouse Site Selection

Factor	Arkansas	BAAQMD	BNSF Railway	Idaho	LA Metro	LAWA	Weighted Average
Existing regulations consider relationship of proposed business to the community	N/A	5	3	3	3	4	**3.60**
Emissions reduction require-ments for disadvantaged communities	2	5	5	3	2	5	**3.67**
Regulations clear about level of engagement with surrounding communities	3	5	3	3	2	4	**3.33**
Surrounding communities maintain relationship with facility to discuss impacts	2	5	4	4	3	5	**3.83**

Rating scale: 1 = not at all important to 5 = extremely important.

N/A Not applicable.

Regulatory

The following regulatory factors were rated:

- Affordable wage rates.
- Energy and utilities.
- Environmental regulations.
- Input costs.
- Other regulatory issues.

BNSF Railway and LAWA rated all regulatory factors as extremely important in making a site more competitive. The LAWA respondent added that South Coast Air Quality Management District (SCAQMD) Warehouse Regulation 2305 also weighs heavily in warehouse site selection. (See *Related Resources* below.) BAAQMD and Idaho Transportation Department rated these factors as either very important or extremely important in warehouse site selection, and LA Metro rated them as either slightly or moderately important.

Individually, energy and utilities received the highest overall rating followed by input costs. Table 7 summarizes survey results.

Table 7. Significance of Regulatory Factors in Warehouse Site Selection

Factor	Arkansas	BAAQMD	BNSF Railway	Idaho	LA Metro	LAWA	Weighted Average
Affordable wage rates	4	4	5	4	2	5	**4.00**
Energy and utilities	5	4	5	5	3	5	**4.50**
Environmental regulations	3	5	5	4	2	5	**4.00**
Input costs	4	4	5	4	3	5	**4.17**
Other regulatory issues	4	4	5	4	2	5	**4.00**

Rating scale: 1 = not at all important to 5 = extremely important.

Related Resources:

Rule 2305, Warehouse Indirect Source Rule—Warehouse Actions and Investments to Reduce Emissions (WAIRE) Program, South Coast Air Quality Management District, May 7, 2021.
http://www.aqmd.gov/docs/default-source/rule-book/reg-xxiii/r2305.pdf?sfvrsn=15
This document describes the requirements of Rule 2305, a "[f]acility-based [m]obile [s]ource [m]easure focused on reducing emissions associated with vehicles and mobile equipment operating in and out of warehouse distribution centers. *From the purpose*:

> The purpose of this rule is to reduce local and regional emissions of nitrogen oxides and particulate matter, and to facilitate local and regional emission reductions associated with warehouses and the mobile sources attracted to warehouses in order to assist in meeting state and federal air quality standards for ozone and fine particulate matter. ….
>
> This rule applies to owners and operators of warehouses located in the South Coast Air Quality Management District (South Coast AQMD) jurisdiction with greater than or equal to 100,000 square feet of indoor floor space in a single building.

Warehouses, South Coast Air Quality Management District, June 29, 2021.
https://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan/facility-based-mobile-source-measures/warehs-distr-wkng-grp
Access to documentation related to Rule 2305 and to Rule 316, Fees for Rule 2305, is available from this web page.

Incentives for Development and Retention

Financial support is a key strategy used by Arkansas DOT and BAAQMD to encourage new warehousing development in their state or business area. In addition to financial assistance Arkansas DOT provides early stage site development (for example, utilities and access) and offers tax incentives. BAAQMD provides financial incentives such as low-cost loans and also offers relaxed zoning regulations.

To retain existing warehousing facilities, Idaho Transportation Department encourages access partnerships and growth of intermodal facilities.

In addition to noting the importance of funding support and tax incentives, respondents cited workforce issues as critical to making warehousing more competitive, such as collaborating with educational institutions to provide a well-trained workforce (Arkansas, BAAQMD, BNSF Railway and LA Metro) and assistance with employee recruitment (Arkansas, BAAQMD and LAWA). Other significant measures were permitting assistance for shovel-ready sites (Arkansas, BNSF Railway and Idaho) and public/private partnerships (BAAQMD, BNSF Railway and Idaho). Least critical according to these respondents is move-in ready speculative buildings available for immediate occupancy. Table 8 summarizes survey results.

Table 8. Incentives or Economic Development Critical to Warehouse Development and Retention

Incentive/Economic Development Support	Arkansas	BAAQMD	BNSF Railway	Idaho	LA Metro	LAWA	Total
Assistance with employee recruitment	X	X				X	**3**
Collaboration with educational institutions to provide a well-trained workforce	X	X	X		X		**4**
Funding support for early stage site development	X			X	X		**3**
Move-in ready speculative buildings for immediate occupancy		X	X				**2**
Pre-permitting or expedited permitting for shovel-ready sites	X		X	X			**3**
Public/private partnership		X	X	X			**3**
Tax incentives			X	X	X		**3**

Other Impacts on Warehousing Competitiveness

Respondents from BAAQMD, BNSF Railway, Idaho Transportation Department and LAWA commented on other factors that affect the demand and competitiveness on warehousing in their areas:

- Regulatory issues that encourage or discourage new warehouse sites and that play a central role in retaining or losing existing warehouses.
- E-commerce and its impact on warehousing demand and competitiveness.
- Technology that is critical in supporting the needs of warehousing stakeholders.
- COVID-19 pandemic.

Regulatory Issues

Respondents from three agencies described regulatory issues that encourage or discourage new warehousing sites and the retention of existing warehouses in their state or business area. Relaxed zoning considerations in Idaho have encouraged new warehousing facilities. However, there are concerns about warehouse retention based on new federal regulations in the Infrastructure Investment and Jobs Act.

The BNSF Railway respondent noted that air emissions and truck traffic reduction efforts have affected new warehousing site development. The respondent added that the cost of doing business has increased because of various regulatory requirements, including the Environmental Impact Report (EIR) review process, which has affected warehousing development and retention.

The LAWA respondent noted the impact of SCAQMD Warehouse Regulation 2305 on new site development and the retention of existing sites.

E-Commerce

E-commerce has affected warehousing demand and/or competitiveness “significantly,” according to the BNSF respondent, who noted that as a logistics company, it must increase

business services as more and more people order from online sources. The effect on demand in Idaho has been an "explosion" of new local distribution facilities, future air distribution facilities, and first- and last-mile connections.

Technology Needs

Emissions reduction and truck parking communications were both reported as critical issues needed to support the demands of warehousing stakeholders, such as carbon emission reduction technology (BNSF Railway) and near-zero and zero-emission trucks (LAWA). Truck parking communications systems near warehouses and distribution facilities (Idaho) and truck appointment systems (LAWA) were also noted, along with vehicle charging infrastructure (LAWA).

Impacts of the COVID-19 Pandemic

According to two respondents, the COVID-19 pandemic has had minimal or no impact on their organizations' ability to encourage new or retain existing warehousing facilities. Idaho Transportation Department has felt the pandemic in its workforce availability, but the respondent reported that "new warehousing/industrial growth has continued." BNSF Railway reported no impact.

Specific warehouse-related changes resulting from the pandemic were noted by the respondents from BAAQMD, BNSF Railway and Idaho Transportation Department. All three agencies reported increased wage rates. BAAQMD and BNSF Railway have expanded warehouse information technology and implemented warehouse management systems. Only BNSF Railway has improved warehouse processes.

The BNSF Railway respondent also noted that the organization has had to learn to do more with a smaller workforce and that delays in the supply chain are significantly impacting business and customers, adding that the "supply chain is strained." Table 9 summarizes survey responses.

Table 9. Warehouse-Related Changes Resulting From COVID-19 Pandemic

Change	Improved Warehouse Processes	Expanded Warehouse Information Technology	Increased Wage Rates	Implemented Warehouse Management System	Other	Description
BAAQMD		X	X	X		
BNSF Railway	X	X	X	X	X	• Learning to do more with reduced workforce. • Supply chain delays: Very significant impact on business and customers.
Idaho			X			
Total	**1**	**2**	**3**	**2**	**1**	

Long term, BNSF Railway and LAWA expect pandemic-related impacts to continue, particularly as they affect the supply chain. The BNSF Railway respondent noted that "the supply chain will forever be altered." Respondents from Arkansas DOT, BAAQMD and Idaho Transportation Department do not anticipate long-term impacts from the pandemic to continue.

Consultation With Selected Experts

Subject matter experts from the private sector were contacted to learn about warehouse site selection strategies and considerations, factors that influence a company's decision to locate or retain warehousing operations in California, state and local economic development incentives and regulatory initiatives that encourage or discourage warehouse siting or retention, and other warehousing-related issues. The following organizations were contacted:

- California Warehouse Association.
- Customized Logistics and Delivery Association.
- Distribution Management Association of Southern California.
- International Warehouse Logistics Association.
- Prologis.
- Warehousing Education and Research Council.

At the time of publication of this report, none of the representatives from these organizations had responded to our request for information.

Related Research and Resources

A literature search of recent publicly available resources identified publications that examine various elements of warehousing, including site selection, factors impacting warehousing location decisions, and the links between warehousing and goods movement. These publications are presented below in two topic areas:

- California regional agency resources.
- Other research and resources.

California Regional Agency Resources

The publications cited below were produced for the following California metropolitan planning organizations (MPOs):

- Kern Council of Governments.
- Metropolitan Transportation Commission.
- San Diego Association of Governments.
- San Joaquin Council of Governments.
- Southern California Association of Governments.

Kern Council of Governments

Kern Area Regional Goods-Movement Operations; Sustainability Study Phase I: Integrated Circulation Study, Kern Council of Governments, 2021.
https://www.kerncog.org/wp-content/uploads/2021/01/KARGO_P1_2021.pdf
From the report:

> This report was prepared for Task Two of the Kern Area Regional Goods Movement Operation (KARGO) study. The objective of this task is to present a complete understanding of existing conditions as well as project future circulation conditions in the study area. … A

review of the latest regional plans, general plans, circulation plans, list of projects, existing and future land use projections, available data for traffic counts, origin-destination data, congestion and speed data, and collision history data is provided.

The report includes an examination of four options for sustainable goods movement strategies for Kern County:

- *Targeted logistics transportation fees*. A one-time logistics mitigation fee could be imposed on all new warehouse construction throughout the county, based on facility size, to help pay for specific highway improvements. Fees collected would be used toward transportation improvements such as auxiliary lanes at on-ramps and off-ramps, or widening highways to mitigate the impact of highway truck traffic serving new warehouse facilities in the county.
- *Program to shift from road to rail.* A mobility fee would focus on new development and be used to fund planned multimodal transportation facilities and services. This fee would also be sensitive to vehicle miles traveled generated by new development. Each new development, regardless of type, would pay the fee in proportion to the new travel demand it creates.
- *Utilization of clean technologies.* This option provides incentives for the use of clean technologies on the highways by tapping existing funding programs and creating a new loan program specifically designed for Kern County businesses to purchase clean technology trucks.
- *Revision to building code.* Revisions to commercial and industrial building codes would require supporting electric infrastructure for electric vehicle supply equipment in new construction and major renovations.

On page 139 of the PDF, the report's authors look ahead to the region's future success, commenting on the potential for an "autonomous intermodal district":

> Looking forward, for the success of the region and its intermodal potential, it would be a critical distinguishing factor if it could develop its road system plan as a strategic component of a future autonomous intermodal district. We project that within the next five years, there will be development of industrial districts that are purpose-built as high-efficiency logistics zones. These zones are built around a core road system that functions as the spine for autonomous/clean technologies moving cargo and equipment (empty containers) from warehouse to warehouse, and from intermodal hub to warehouse. GLDPartners is working with a number of companies now that are building the technology platform to operate such systems. This would require attention to two main areas: infrastructure/technology and road design. Regarding infrastructure/technology, the types of issues that will become important will include: road system traffic control technology, supporting telecommunications and cybersecurity protocols, and embedded electric infrastructure. In terms of road design, the sorts of issues that will be pertinent include road and lane widths, anticipation for the provision of electricity in/along key routes, etc.

Kern Goods Movement Cluster Presentation, Kern Council of Governments, 2021.
https://www.kerncog.org/wp-content/uploads/2021/04/GM_Cluster_presentation_20210413.pdf
Among the "concluding facts" (see slide 61) presented in this 68-slide presentation:

- Kern is the largest one-county market for container traffic in the valley, larger than Fresno.
- Kern is the number one agriculture and oil-producing county in the state.

- Kern is the geographic center for population for California and a western U.S. hub.
- Growth in goods movement attracts more growth as exhibited by recent Amazon and Walmart investment in Kern.

Metropolitan Transportation Commission

Northern California Megaregion Goods Movement Study, Metropolitan Transportation Commission, June 2019.
https://mtc.ca.gov/sites/default/files/Northern_California_Megaregion_Goods_Movement_Study.pdf
Conclusions and next steps begin on page 20 of this report, page 22 of the PDF. Included is a discussion of more coordinated goods movement planning among selected California MPOs, which can begin with:

- *Organizing stakeholders*. Expand technical advisory committee membership to include private industry, persuade regional and local policymakers to provide matching funds for targeted investments, and lead well-coordinated applications for state and federal discretionary funding.
- *Matching funds and establishing public/private partnerships*. Coordinate the many projects that are included in each region's regional transportation plan (RTP), advocate for additional projects not included in the fiscally constrained RTPs, and refine investment strategies to appeal to critical stakeholders—including elected officials, private industry and other advocates—to increase their likelihood of success.
- *Preparing grant applications*. Bundling multiple projects in federal discretionary funding applications (i.e., INFRA and BUILD) demonstrates a collective strategy that benefits a larger region and the nation as a whole. (The BUILD discretionary grant program is now known as RAISE (Rebuilding American Infrastructure with Sustainability and Equity).)

San Diego Association of Governments

2016 Freight Gateway Study Update, San Diego Association of Governments, December 2016.
https://www.sandag.org/uploads/projectid/projectid_437_21373.pdf
This report describes the warehousing infrastructure in San Diego and Imperial counties and Baja California. The report closes with a discussion of policy constraints, market conditions and regulatory issues.

Related Resource:

> **Freight Gateway Study Update**, Freight Systems, San Diego Association of Governments, undated.
> https://www.sandag.org/index.asp?classid=13&subclassid=96&projectid=437&fuseaction=projects.detail
> *From the web site*: SANDAG is working on the 2021 Freight Gateway Study Update to provide a revised forecast of regional freight tonnage and value in San Diego and Imperial [c]ounties through 2050.
>
> The primary objective of the study update is to give SANDAG, the Imperial County Transportation Commission and other regional stakeholders access to timely and thorough freight flow information.
> ….

The Freight Gateway Study Update will assess how freight tonnage enters/leaves the region through these gateways, as well as the domestic freight flows associated with consumption within the region, seeking to understand freight demand from a comprehensive supply chain perspective.

San Joaquin Council of Governments

Warehousing, E-Commerce and Evolving Trade Patterns in San Joaquin County, San Joaquin Council of Governments, April 2019.
https://www.sjcog.org/DocumentCenter/View/4755/2019-The-Rise-of-Warehousing-and-E-Commerce-PDF-Document?bidId=
From page 10:

> **Policy Opportunities and Challenges**
> While the [c]ounty's physical transportation infrastructure investments have been important, our analysis has shown that the dynamic growth it has enjoyed is also related to several other factors. These include the [c]ounty's human capital, its growing intra- and inter-regional integration with the Northern California Megaregion, and evolving business models such as e-commerce that are transforming the goods movement and integrating it with other parts of production and sales. Leveraging the phenomenal growth and transformation in the goods movement system to further improve the economic well-being of the [c]ounty will require a host of policies.
>
> The increased integration of San Joaquin County with the rest of the Northern California Megaregion is one of the most important contextual changes for future policy support of the goods movement system. This integration means that goods movement infrastructure investments should not be considered in isolation but as part of a broad [m]egaregion strategy and planning process. Increased commuting, migration and goods movement between the 11 MSAs [metropolitan statistical areas] in the Northern California Megaregion is a reality, and local planning and policies need to incorporate this development while simultaneously pushing for broader [m]egaregional planning and policy development.

Related Resource:

> **"Dynamic Change in San Joaquin County's Goods Movement System,"** Jeffrey Michael and Thomas Pogue, *San Joaquin Council of Governments 2019 Speaker Series*, April 2019.
> https://www.sjcog.org/DocumentCenter/View/4750/SJCOG_CBPR_Goods-Movment-powerpoint-PDF?bidId=
> This brief presentation highlights findings from the publication cited above, including these policy opportunities and challenges:
>
> - Changing production geography of the Northern California Megaregion.
> - Employment opportunities → sustained advancement.
> - New integrated business models transforming functions and roles of the goods movement system.

Southern California Association of Governments

Transportation System Goods Movement, Technical Report, Southern California Association of Governments, adopted December 2020.
https://scag.ca.gov/sites/main/files/file-attachments/0903fconnectsocal_goods-movement.pdf
This analysis of goods movement includes an examination of goods movement-dependent industries, including warehousing. *From the introduction*:

> Goods movement, and its associated industries and sectors, has traditionally been seen as reluctant and slow to change. However, when change does occur, it is normally profound and far-reaching. Since the adoption of the 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy (RTP/ SCS), there have been significant drivers of change in the goods movement industry including emerging and new technologies, more complex supply chain strategies, evolving consumer demands and shifts in trade policies. Connect SoCal recognizes that these factors will play a crucial role in the ongoing development and advancement of policies, infrastructure and strategies to address regional goods movement challenges. These challenges include, but are not limited to:
> ….
>
> > Technology and Automation: The advancement of automation is expected to have considerable impacts throughout regional supply chains. Warehouses are increasingly integrating automation to improve operational efficiencies in response to the dramatic surge in direct-to-consumer e-commerce. Additionally, continued developments and demonstrations of automated truck technologies will alter the goods movement environment with far-reaching impacts ranging from employment to highway safety.

Last-Mile Freight Delivery Study, Southern California Association of Governments, October 2020.
https://scag.ca.gov/sites/main/files/file-attachments/2958_lastmilefreightstudy-final.pdf?1604195996
A Last-Mile Freight Toolbox of Strategies begins on page S-1 of this report, page 261 of the PDF. The toolbox includes problem and solution matching for three strategy categories:

- Curb area strategies to manage physical space in the curb area.
- Deliverer and receiver strategies for more efficient deliveries.
- Administration and application strategies to make effective use of resources to improve delivery conditions.

Other freight-related studies are available at https://scag.ca.gov/freightworks-studies-and-programs.

Related Resource:

> **Case Study: Southern California Association of Governments**, Iteris, undated.
> https://www.iteris.com/system/files/content/resource/2020-10/SCAG_CASE%20STUDY.pdf
> This case study provides a concise description of the last-mile freight delivery study cited above. *From the case study:*
>
> > Iteris was selected to provide our [s]pecialized [c]onsulting services to conduct a [l]ast-[m]ile [f]reight [d]elivery [s]tudy. The purpose of this study was to increase understanding of last-mile delivery issues for the Southern California of Governments (SCAG) and its member [c]ities by examining the relationship between last-mile access conditions, the delivery of goods, and the role of last-mile delivery in the overall transportation system. The study assesses the use of curb areas for deliveries, and the magnitude of other curb uses competing for limited curb space in the study area of the City of Los Angeles. It provides stakeholder and analytical findings and recommendations for blocks in case study areas, City of Los Angeles pilot project concepts, policy considerations and a [t]oolbox of [s]trategies for cities throughout the SCAG region to utilize when faced with their own unique delivery challenges.

Industrial Warehousing in the SCAG Region, Southern California Association of Governments, April 2018.
https://scag.ca.gov/sites/main/files/file-attachments/final_report_03_30_18.pdf?1604268012
From the executive summary:

> A regional warehousing space forecast model was developed to estimate how warehousing space supply and demand would change over time. The model considers:
>
> 1) Warehouse space inventory,
> 2) Potential future warehousing space demand based on the U.S. GDP [gross domestic product] growth forecast,
> 3) San Pedro Bay Ports (Long Beach and Los Angeles) container volume forecast and the amount of goods to be warehoused in the region,
> 4) Cross-border trade flows and the amount of goods to be warehoused in the region, and
> 5) Warehousing space submarket allocation assumptions. Demand allocations and supply saturations were calculated using the Avison-Young formula, which converts cargo loads to warehousing space needs, and geographical preferences based on cargo types that drive the saturation priority order across the region.
>
> The model first computes "unconstrained" demand without accounting for the amount of suitably zoned land for future development. Then, using assumptions about how much developable land would be available in the future, a constrained demand forecast is developed and allocated across several submarkets throughout the region.
> ….
>
> To test the impacts of prevailing trends on future supply and demand, eight scenarios were developed. Considerations were given to facility operational improvements, such as the implementation of advanced technologies that would likely increase operational capacities at the facility level; changes to global supply chain practices that could influence the logistics activities in the region, such as the growth of larger facilities with higher productivity levels; and cross-dock transload facilities, or changes to trade volume through Mexico, as well as the potential growth in the amount of land designated for warehouse and distribution use. A detailed discussion of each scenario is provided in Appendix E.

The following appendices are available:

- Appendix A. Task 3 — Assessment of Supply Chain Strategies and Implications for Future Development.
- Appendix B. Task 3.2 — Freight Stakeholder Interview Report.
- Appendix C. Task 2 — Inventory of Warehousing Facilities.
- Appendix D. Task 4 — Understanding Facility Operations.
- Appendix E. Task 5 — Developing a Policy Evaluation Framework and Assessing the Implications.

Other Research and Resources

The citations below are organized into these topic areas:

- Analysis methods and algorithms.
- COVID-19.
- Environmental factors.

- Equity factors.
- Location factors.

Within each topic area, publications and resources may be categorized as specific to California warehousing or applicable to warehousing generally.

Analysis Methods and Algorithms

Warehousing Generally

"Warehouse Site Selection for Online Retailers in Inter-Connected Warehouse Networks," Can Chen, Junming Liu, Qiao Li, Yijun Wang, Hui Xiong and Shanshan Wu, *2017 IEEE International Conference on Data Mining (ICDM)*, November 2017.
Citation at https://ieeexplore.ieee.org/abstract/document/8215559/
From the abstract: Executing effective warehouse site selection has been one of the key challenges in the development of a successful supply chain system. While some effective strategies for warehouse site selection have been identified by the domain experts based on their experiences, the emergence of new ways of collecting fine-grained supply chain data has enabled a new paradigm for warehouse site selection. Indeed, in this paper, we provide a data-smart approach for addressing the connected capacitated warehouse location problem (CCWL), which searches for the minimum total transportation cost of the warehouse network including supplier-warehouses shipping cost, warehouse-customer delivering cost and the cost of warehouse-warehouse inter-transportation. Specifically, we first design a sales distribution prediction model and evaluate the importance of customer logistic service utilities on online market sales demand for online retailers. Then, we propose the E&M [expectation and maximization] algorithm to optimize warehouse locations continuously with much less computation cost. Moreover, the computation cost is further reduced through delivery demand based [h]ierarchical [c]lustering, which reduces the problem size by grouping delivering cities with close locations. Finally, we validate the proposed method on real-world e-commerce supply chain data and the selection effect of new warehouses is evaluated in terms of sales improvement with faster delivery and more effective inventory management.

"Hierarchical Value Chains Encompassing Freight Transportation and Logistics Sectors in the United States: Network Analysis Approach," Rodrigo Mesa-Arango and Indraneel Kumar, *Transportation Research Record,* Vol. 2609, Issue 1, pages 1-10, 2017.
Citation at https://journals.sagepub.com/doi/10.3141/2609-01
From the abstract: This research reveals value chain (VC) clusters in which freight transportation modes (i.e., truck, rail, air, water and pipelines), freight supporting activities (i.e., couriers and messengers and warehousing and storage), and other industry sectors have strong economic interdependencies. The most recent input–output data in the United States were used to construct the 2014 direct requirements matrix and generate a network of economic interdependencies between industry sectors. Community detection, a complex network analysis method, was used to reveal the corresponding VCs in the economic network. A novel procedure uncovered hierarchical VC communities (VCCs) for each freight transportation and logistics sector. Thus, seven distinctive VCCs with unique underlying activities were found. In general, freight industries are hierarchically clustered to VCCs related to raw materials; services; metals; agriculture; textile, apparel and paper; wood products; and others. Results are important for the areas of transportation economics, regional economic development, competitiveness and multimodal freight transportation.

COVID-19

Warehousing Generally

COVID-19—Impacts on Cities and Suburbs: Impacts to the Urbanism Next Framework, Grace Kaplowitz, Nico Larco, Amanda Howell and Tiffany Swift, Urbanism Next Center, University of Oregon, September 2020.
https://global-uploads.webflow.com/5d9f83b8b237fa6c07d5d69d/5f74a09153a98284228146a3_COVID-Paper_3_Framework-Impacts-pages.pdf
From the abstract: Before the pandemic, Urbanism Next developed a framework organizing the disruptions to cities caused by emerging transportation technologies on land use, urban design, building design, transportation and real estate. COVID-19 has disrupted the trajectory of these emerging technologies and will, in turn, change some original assumptions. This paper revisits the original Urbanism Next framework, taking into account the cascading impacts of the pandemic. Key findings include: (1) On the land use side, the authors anticipate seeing the most significant impacts to land zoned for retail/commercial/office, as well as warehousing/industrial as more people work from home and demand for delivery continues to increase. (2) These shifts could influence the footprint of cities as proximity to workplaces and goods/services may no longer be enough to attract people to dense city centers. (3) COVID-19 has disrupted previous predictions that new mobility would cause a reduction in the need for parking. There could be an increased demand for parking if people do not return to public transit and rates of driving alone accelerates.

Environmental Factors

Warehousing in California

Warehouse Projects: Best Practices and Mitigation Measures to Comply With the California Environmental Quality Act, State of California Department of Justice, March 2021.
https://oag.ca.gov/system/files/media/warehouse-best-practices.pdf
From the document: In carrying out its duty to enforce laws across California, the California Attorney General's Bureau of Environmental Justice (Bureau) regularly reviews proposed warehouse projects for compliance with the California Environmental Quality Act (CEQA) and other laws. When necessary, the Bureau submits comment letters to lead agencies, and in rare cases the Bureau has filed litigation to enforce CEQA. This document builds upon the Bureau's comment letters, collecting knowledge gained from the Bureau's review of hundreds of warehouse projects across the state. It is meant to help lead agencies pursue CEQA compliance and promote environmentally-just development as they confront warehouse project proposals. While CEQA analysis is necessarily project-specific, this document provides information on feasible best practices and mitigation measures, the overwhelming majority of which have been adapted from actual warehouse projects in California.

Warehousing Generally

"Planning Matters: Institutional Perspectives on Warehousing Development and Mitigating Its Negative Impacts," Quan Yuan, *Journal of the American Planning Association*, Vol. 85, Issue 4, pages 525-543, October 2019.
Citation at
https://www.tandfonline.com/doi/abs/10.1080/01944363.2019.1645614?journalCode=rjpa20
From the abstract:

> **Problem, research strategy and findings:** Recent research reveals growing spatial disparities in warehousing-related environmental externalities, including air pollution and

traffic safety concerns, across municipalities. The existing research, however, fails to present how institutional factors contribute to spatial variations. In this study, the author explores how variations in planning practices contribute to the different trajectories of warehousing development. The author interviewed planners, local residents, warehousing developers and regional agency staff to identify local planning practices and policy elements that affect the location choice of warehousing facilities. The results show land use policies (land use permission, industrial zoning and land parcel division schemes), job-related policies (job creation initiatives and job density requirements), financial incentives (tax rates and financial incentives) and environmental regulations (building design, land use buffering and landscaping) are the major planning elements that affect warehousing development. Relative to brownfield redevelopment in the municipalities close to the urban core of a metropolitan area, developing greenfield warehousing facilities in suburban cities is likely to cause more environmental concerns in the near future. However, unmeasured factors could be responsible for some of the warehousing development patterns the author finds in the data.

Takeaway for practice: Knowledge, communication and collaboration are needed to cope with the rapid growth and, in particular, the disproportionate concentration of warehousing-related environmental externalities in certain municipalities. In this study the author also provides planning strategies to regulate excessive warehousing development, including land use- and job-related policies, financial incentives and environmental regulations. With these strategies, planners in warehousing-intensive cities can determine the best way to reduce the impacts of environmental externalities on local communities in the long term.

Equity Factors

Warehousing in California

"Location of Warehouses and Environmental Justice," Quan Yuan, *Journal of Planning Education and Research*, Vol. 41, Issue 3, pages 282-293, September 2021.
Citation at https://journals.sagepub.com/doi/abs/10.1177/0739456X18786392
From the abstract: Warehousing activities generate substantial environmental externalities that affect surrounding neighborhoods. Using data from the Los Angeles region, this study tests the relationship between the spatial distribution of warehouses and neighborhoods with different demographic and socioeconomic characteristics. The results show that warehouses are disproportionately located in both low-income and medium-income minority neighborhoods. The distribution of warehousing facilities and activities is highly related to the percentage of minorities as expected, but its relationship with household income is nonetheless mixed. In the Los Angeles region, low-income neighborhoods are not always attractive to warehouse developers because they are not convenient for warehousing development.

E-Commerce, Warehousing and Distribution Facilities in California: A Dynamic Landscape and the Impacts on Disadvantaged Communities, Miguel Jaller, Xiaodong Qian and Xiuli Zhang, University of California Institute of Transportation Studies, January 2020.
Publication available at https://escholarship.org/uc/item/1pv6t7q9
From the abstract: This work addresses the distribution of warehouses and distribution centers (W&DCs) influenced by e-commerce, through spatial analysis and econometric modelling. Specifically, this work analyzes the concentration of W&DCs in various metropolitan planning organizations (MPOs) in California between 1989 and 2016-18; and studies the spatial relationships between W&DC distribution and other demographic and environmental factors through econometric modeling techniques. The work conducts analyses to uncover common trends in W&DC distribution. The analyses used aggregate establishment, employment and

other socio-economic information, complemented with transportation related variables. The results: 1) confirm that the weighted geometric centers of W&DCs have shifted slightly towards city central areas in all five MPOs; 2) W&DCs show a non-decreasing trend between 2008 and 2016; and 3) areas with more serious environmental problems are more likely to have W&DCs. A disaggregate analyses of properties sold and leased in one of the study regions shows a trend where businesses are buying or leasing smaller facilities, closer to the core of consumer demand. Among other factors, the growth of e-commerce sales, and expedited delivery services, which require proximity to the customers, may explain these trends. The study results provide insights for planners and policy decision makers, and will be of interest to practitioners, public and private entities, and academia. Caltrans, MPOs and affiliated institutions of the National Center for Sustainable Transportation will directly benefit from the results as they want to avoid equity issues brought by the fast development of e-commerce, and its potential impact on W&DC distribution.

Warehousing Generally

"Big Boxes in My Backyard: A Longitudinal Study of Environmental Justice in Warehousing Location," Quan Yuan, *Transportation Research Board 97th Annual Meeting*, Paper #18-00626, 2018.
Citation at https://trid.trb.org/view/1494512
From the abstract: Environmental impacts of warehousing activities have attracted increasing attention from the governments, the public and researchers. While a few studies have investigated the cross-sectional spatial relationship between warehousing distribution and disadvantaged populations, little is known about causal relationships. Using data of the Los Angeles Combined Statistical Area in 2000 and 2010, this paper estimates a two equation simultaneous model of the location choices of warehousing facilities and minority populations. Results show that, all else equal, changes in the percentage share of minorities during 2000 and 2010 significantly affect the changes in warehousing activity density during the same period, but not vice versa. That is, the environmental justice problem in warehousing location is found to be solely from the disproportionate siting of warehouses in minority areas, rather than from minority populations moving near warehousing. Furthermore, the variants of the model regarding different minority groups including Latinos, Blacks and Asians suggest that the patterns of warehouse-minority interactions are generally consistent across these groups. Governments and planning agencies should step in and evaluate whether the local land use and environmental policies are compatible with the objectives of mitigating freight-related environmental injustice.

Location Factors

Warehousing in California

"Warehouse Location Choice: A Case Study in Los Angeles, CA," Sanggyun Kang, *Journal of Transport Geography*, Vol. 88, October 2020.
Citation at https://doi.org/10.1016/j.jtrangeo.2018.08.007
From the abstract: The purpose of this research is to understand how and why warehouses have changed location over time from central urban areas to the urban periphery: spatial decentralization. Over the last decade, the logistics industry has been restructured to transport large volumes of goods more quickly and reliably. Concurrently, the warehousing industry experienced changes in facility size and location: large warehouses have been built on the urban outskirts. This spatial shift is attributed to inventory and transport cost trade-offs: the gains from lower land prices and scale operation outweigh the increase in transport costs as warehouses decentralized from central urban areas. As a case study, I examine location choices of 5364 warehousing facilities in Los Angeles, CA. I hypothesize that (a) the location

choice varies by facility size and (b) the location choice logic has changed over time. Results suggest significant differences in the effect of location choice factors over facility size and over time. For warehouses built before 1980, the most influential factors are local market, labor and seaport/intermodal terminal proximity. In contrast, for warehouses built after 2000, lower land price and airport/intermodal terminal proximity have the greatest effects.

Warehousing and Distribution Center Facilities in Southern California: The Use of the Commodity Flow Survey Data to Identify Logistics Sprawl and Freight Generation Patterns, Miguel Jaller and Leticia Pineda, National Center for Sustainable Transportation, July 2017.
https://escholarship.org/content/qt5dz0j1gg/qt5dz0j1gg.pdf?t=qep8ha
From the executive summary: This work addresses an important research topic of freight modeling by analyzing the freight patterns, in terms of freight generation and logistics sprawl, of warehouses and distribution centers in Southern California. Specifically, this work analyzes the concentration of Warehouses and Distribution Centers (W&DC) (NAICS 493) in five counties in Southern California between 1998 and 2014; and explores spatial relationships between W&DC and other industry sectors through centrographic and econometric modeling techniques. Furthermore, the authors estimate factors that explain the concentration of W&DC in the area.

Related Resource:

> **"Spatial Analysis of Warehouses and Distribution Centers in Southern California,"** Miguel Jaller, Leticia Pineda and David Phong, *Transportation Research Record*, Vol. 2610, Issue 1, pages 44-53, 2017.
> Citation at https://journals.sagepub.com/doi/abs/10.3141/2610-06
> *From the abstract*: This paper analyzes the concentration of warehouses and distribution centers (W&DCs) in five counties in Southern California between 1998 and 2014, and it explores spatial relationships between W&DCs and other industry sectors through centrographic and econometric modeling techniques. Furthermore, the authors estimate factors that explain the concentration of W&DCs in the area. The analyses used aggregate establishment, employment and other socioeconomic data for different industries, complemented with transportation-related variables. The results confirm the existence of logistics sprawl, although the analyses indicate that this trend did not continue to increase after 2007. Additional results follow: (a) W&DCs showed a lower spatial correlation compared with other industries, (b) the locations of the weighted geometric center shifted slightly differently for the W&DC industry and within its subindustries, (c) concentration levels for some subindustries were much lower than for the aggregated W&DC industry, and (d) the number of W&DCs could be explained by the number of establishments in the manufacturing and transportation service industries, proximity to highways and intermodal facilities, the number of W&DCs and accommodation and food services in neighboring [ZIP] codes, population, the number of adults using public transit, and per capita income.

Spatial Dynamics of Warehousing and Distribution in California, Genevieve Giuliano and Sanggyun Kang, Division of Research, Innovation and Systems Information, California Department of Transportation, January 2017.
https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/f0016824-ca17-2640-finalreport.pdf
From the abstract: The purpose of this research is to document and analyze the location patterns of warehousing and distribution activity in California. The growth of California's warehousing and distribution (W&D) activities and their spatial patterns is affected by several factors, including population and economic growth, shifting supply chains and distribution practices, scale economies in warehousing, and the state's role in international and domestic

trade. The location of W&D activities has implications for freight demand and flows, and thus is a critical element in statewide transportation planning.

Spatial Dynamics of the Logistics Industry and Implications for Freight Flows, Genevieve Giuliano, Sanggyun Kang and Quan Yuan, National Center for Sustainable Transportation, June 2016.
Publication available at https://escholarship.org/uc/item/94h6t7s9
From the abstract: This project examines changes in the spatial pattern of warehousing and distribution (W&D) activities. W&D activities are decentralizing in response to rising land values and scale economies. Ultimately, the authors seek to understand whether these spatial shifts result in more truck VMT [vehicle miles traveled], or whether the efficiencies gained by larger scale operations allow offsetting savings, such as enabling the use of larger trucks or achieving higher average load factors. Understanding how these shifts are affecting truck VMT is essential for developing effective policies for managing truck VMT and their associated emissions. However, there is no good source for tract or zone level truck flow data, or for intra-metropolitan truck origin-destination data. As a first step, the authors focus on accessibility. From the literature on passenger travel, the authors know that travel distance is related to accessibility. Thus, changes in accessibility to goods markets should be a proxy for goods travel distance, all else equal. The authors examine changes in the spatial pattern of warehousing and distribution activities for the four largest California metropolitan areas: Los Angeles, San Francisco, Sacramento and San Diego, using ZIP Code Business Patterns data for 2003 and 2013. The authors develop measures of decentralization and concentration. Their results are mixed. When using establishment counts, only Los Angeles shows a consistent pattern of decentralization. There is more evidence of decentralization when using employment counts, which is consistent with larger scale facilities being built at the periphery. Spatial patterns for the largest metro areas are quite different from those of the smaller metro areas. The authors surmise that higher development density and associated land prices push W&D activity to more distant areas. In contrast, W&D location in San Diego and Sacramento is relatively closer to employment, population and the CBD [central business district]. If all truck traffic were local, their results suggest possible increases in truck VMT, particularly for the largest metro areas. However, more than half of all commodity flows is non-local. The decentralization the authors observe is likely related to domestic and international trade, for which access to local markets is less important. More research is necessary to determine whether decentralization is a consistent trend in large metro areas, and, if so, whether impacts on truck VMT within metro areas is positive or negative.

Warehousing Generally

"Estimating Determinants of Transportation and Warehousing Establishment Locations Using U.S. Administrative Data," Craig Carpenter, Rebekka Dudensing and Anders Van Sandt, *REGION*, Vol. 9, Issue 1, pages 1-27, January 2022.
https://www.researchgate.net/publication/358141194_Estimating_Determinants_of_Transportation_and_Warehousing_Establishment_Locations_Using_US_Administrative_Data
From the abstract: Interactions between transportation and warehousing and other industry clusters are not widely explored and the determinants of logistics locational determinants is limited in the U.S. context. These gaps in the literature, along with the U.S. transportation and warehousing sector's decentralization from urban areas and concentration in regions, highlight the importance of understanding the effects of place-based factors and interindustry clusters on the locations and employment of transportation and warehousing industries. The analysis uses restricted-access U.S. Census Bureau data aggregated to the county level, along with secondary data sources, to estimate the locational determinants of transportation and warehousing (TW) industries based on transportation infrastructure as well as sociodemographic and institutional variables. The analysis takes a cross-sectional (non-causal)

approach to focus on time-invariant location factors while testing and implementing zero-inflated count data distributions to model the data generation processes more accurately. Results indicate that subsectors are affected differently by infrastructure, sociodemographic and institutional variables. Additionally, different factors are associated with industry presence versus size. Finally, we show that data using aggregated industries obscures locational factors' importance for individual sub-sectors and, further, that industrial aggregation obscures TW sectors' relationships to other clusters.

"Why Do Warehouses Decentralize More in Certain Metropolitan Areas?" Sanggyun Kang, *Journal of Transport Geography*, Vol. 88, October 2020.
Citation at https://doi.org/10.1016/j.jtrangeo.2018.10.005
From the abstract: Over the last decade, warehousing and distribution centers have decentralized to the urban peripheries where land is cheaper and readily available. This change in location patterns has been driven by the demand to build more modernized and larger facilities to accommodate an ever-increasing influx of freight. Since efficient freight movement is essential for the smooth functioning of metropolitan areas, decentralization should occur everywhere. However, this is not necessarily true. It is hypothesized that depending on the volume of goods movement and the spatial distribution of land prices, the extent of decentralization varies across metropolitan areas. This hypothesis is tested using 48 US metropolitan areas. Results provide robust evidence that high land prices push large warehouses away from central locations. When freight demand and land prices are not as high, the effect becomes insignificant. Indeed, not only is decentralization linked with large metro areas but also with very large warehouses.

NCHRP Research Report 924: Foreseeing the Impact of Transformational Technologies on Land Use and Transportation, Kittelson & Associates, Inc., Bluemac Analytics and Irwin Writing/Editing, 2019.
Publication available at https://www.nap.edu/download/25580
From the foreword: Rapidly evolving technologies in a number of fields seem likely to have transformational impacts on land use and transportation in urban and rural settings, raising issues for how to manage public investments in transportation facilities and services to maintain economic vitality and high quality of life. For example, changes in telecommunications are fostering growth of telecommuting and development of on-demand delivery and transportation services that in turn may be changing patterns of work and home locations, vehicle ownership and use, demand for parking facilities, and utilization of curb space in urban centers. Expanding applications of 3-D printing, e-commerce and unmanned aerial systems (popularly referred to as drones) may shift industrial supply chains and locations of warehousing, distribution and intermodal transfer facilities and jobs. *NCHRP Research Report 924: Foreseeing the Impact of Transformational Technologies on Land Use and Transportation* presents guidance for transportation agency decision-makers responsible for addressing issues related to transportation system investment and land development that may arise as a consequence of transformational technologies.

Contacts

The following people provided information for this investigation.

State Agencies

Arkansas

Brad McCaleb
Division Head, Transportation Planning and Policy
Arkansas Department of Transportation
501-569-2201, brad.mccaleb@ardot.gov

Idaho

Scott Luekenga
Freight Program Manager
Idaho Transportation Department
208-334-8057,
scott.luekenga@itd.idaho.gov

California Agencies

Bay Area Air Quality Management District

Leonid Bak
Economist/Executive
415-745-5075, lbak@baaqmd.gov

Los Angeles County Metropolitan Transportation Authority

Michael Cano
Deputy Executive Officer, Goods Movement, Countywide Planning and Development
626-319-2964, canom@metro.net

Los Angeles World Airports

Carter Atkins
Environmental Specialist III
424-646-6441, catkins2@lawa.org

Private Sector Agencies

BNSF Railway

Jennifer Fitzgerald
Regional Manager, Economic Development
909-499-5364, jennifer.fitzgerald@bnsf.com

Majestic Realty

Fran Inman
Senior Vice President
562-948-4375, finman@majesticrealty.com

Appendix A: Survey Questions

The following survey was distributed to members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Planning, the California Freight Advisory Committee, and the Regional Transportation Commission of Washoe County, Nevada.

Survey on Economic Competitiveness of Warehousing
The survey questions that follow ask you to report on your knowledge of or experience with warehousing-related issues in your state or the area in which you do business. You may be responding as a public agency employee working with the private sector, or as a freight stakeholder with experience in the warehousing and logistics fields.

Not all questions may relate to your knowledge or experience. Please respond to as many questions as you can.

Site Selection
The questions below ask you to rate the significance of drivers that may contribute to selection of a private sector warehouse site in the following categories:

- *Facility factors*: Factors in the supply of certain types of facilities that increase competitiveness.
- *Infrastructure factors*: Factors that increase competitiveness because of the supply of certain types of infrastructure.
- *Location factors*: Factors of locational advantage within the supply chain that make certain locations more competitive than others.
- *Workforce factors*: Factors that involve the workforce and community.
- *Environmental factors*: Factors concerning the health and safety of the community that make for more competitiveness.
- *Equity factors*: Factors that increase competitiveness by increasing equity.
- *Regulatory factors*: Regulatory and economic development initiatives that increase competitiveness.

Facility Factors

1. Please rate the significance of each of the facility-related factors below in making a site more competitive using the rating scale of 1 = not at all important to 5 = extremely important.
    - Supply of facilities with layout/design requirements fitting industry priorities
    - Cost of facility development process to supply needed warehousing through retrofits
    - Cost of facility development process to develop new facility
    - Cost of developing new space for yards specifically (as distinguished from warehousing space)
2. Are there other facility factors that you think would weigh heavily in the selection of a warehouse site?

Infrastructure Factors

3. Please rate the significance of each of the infrastructure-related factors below in making a site more competitive using the rating scale of 1 = not at all important to 5 = extremely important.
    - Freight transportation capacity

- Freight transportation reliability
- Heavy truck traffic
- Last-mile access conditions
- Proximity to intermodal facilities
- Proximity to interstate highways
- Proximity to rail ramps
- STAA truck access

4. Are there other infrastructure factors that you think would weigh heavily in the selection of a warehouse site?

Location Factors

5. Please rate the significance of each of the location-related factors below in making a site more competitive using the rating scale of 1 = not at all important to 5 = extremely important.
    - Access to materials
    - Available land
    - Congestion
    - Goods movement
    - Land development costs
    - Natural resources
    - Proximity to residential areas or schools
    - Shortening last-mile delivery
    - Vehicle miles traveled
6. Are there other location factors that you think would weigh heavily in the selection of a warehouse site?

Workforce Factors

7. Please rate the significance of each of the workforce-related factors below in making a site more competitive using the rating scale of 1 = not at all important to 5 = extremely important.
    - Affordable housing
    - Available truckers
    - Available workers
    - Cost of living
    - Higher-skilled workers
    - Population growth
    - Qualified managers
    - Semiskilled workers
    - Temporary workers
8. Are there other workforce factors that you think would weigh heavily in the selection of a warehouse site?

Environmental Factors

9. Please rate the significance of each of the environmental factors below in making a site more competitive using the rating scale of 1 = not at all important to 5 = extremely important.
    - Existing regulations consider the contribution of emissions to the environment
    - Existing regulatory frameworks encourage adoption of emissions mitigating technologies

- Existing policy environment considers emissions reduction
- Existing policy environment considers emissions and environmental impacts of facilities in general

10. Are there other environmental factors that you think would weigh heavily in the selection of a warehouse site?

Equity Factors

11. Please rate the significance of each of the equity factors below in making a site more competitive using the rating scale of 1 = not at all important to 5 = extremely important.
    - Existing regulations consider the relationship of the proposed business to the community in making the situation
    - Emissions reduction requirements for disadvantaged communities
    - Existing regulations are clear about the level of engagement with surrounding communities
    - Surrounding communities maintain a relationship with the facility in general in which they can discuss impacts
12. Are there other equity factors that you think would weigh heavily in the selection of a warehouse site?

Regulatory Factors

13. Please rate the significance of each of the regulatory factors below in making a site more competitive using the rating scale of 1 = not at all important to 5 = extremely important.
    - Affordable wage rates
    - Energy and utilities
    - Environmental regulations
    - Input costs
    - Other regulatory issues
14. Are there other regulatory factors that you think would weigh heavily in the selection of a warehouse site?

Incentives

1. Please describe the local- or state-level economic incentives your state has offered, or you are aware of, to encourage new warehousing facilities to locate in your state or business area and how they make a site more competitive.
2. Please describe the local- or state-level economic incentives your state has offered, or you are aware of, to retain existing warehousing facilities and how they make a site more competitive.
3. Please select below the incentives or types of economic development support you feel are most critical to encouraging or retaining warehousing in your state or business area and making it more competitive. Select all that apply.
    - Assistance with employee recruitment
    - Collaboration with educational institutions to provide a well-trained workforce
    - Funding support for early stage site development
    - Move-in ready speculative buildings for immediate occupancy
    - Pre-permitting or expedited permitting for shovel-ready sites
    - Public/private partnership
    - Tax incentives

- Other (Please describe.)

Other Factors

1. What regulatory issues have been most important in encouraging (or discouraging) new warehousing sites in your state or business area?
2. What regulatory issues have played a central role in retaining (or losing) existing warehouses in your state or business area?
3. How has e-commerce affected warehousing demand and/or competitiveness in your state or business area?
4. Please describe the technology you feel is most critical in supporting the needs of warehousing stakeholders in your state or business area.

Impacts of the COVID-19 Pandemic

1. How has the COVID-19 pandemic impacted the ability of your state or business area to encourage new or retain existing warehousing facilities?
2. What warehouse-related changes are you aware of, or have you experienced, as a result of the COVID-19 pandemic? Select all that apply.
    - Improved warehouse processes
    - Expanded warehouse information technology
    - Increased wage rates
    - Implemented warehouse management system
    - Other (Please describe.)
3. Do you expect pandemic-related impacts to continue over the longer term?
    - No
    - Yes (Please describe these continued impacts.)

Wrap-Up

1. Please provide links to documents related to expanding or retaining warehousing in your state or business area. Send any files not available online to chris.kline@ctcandassociates.com.
2. Please use this space to provide any comments or additional information about your previous responses.