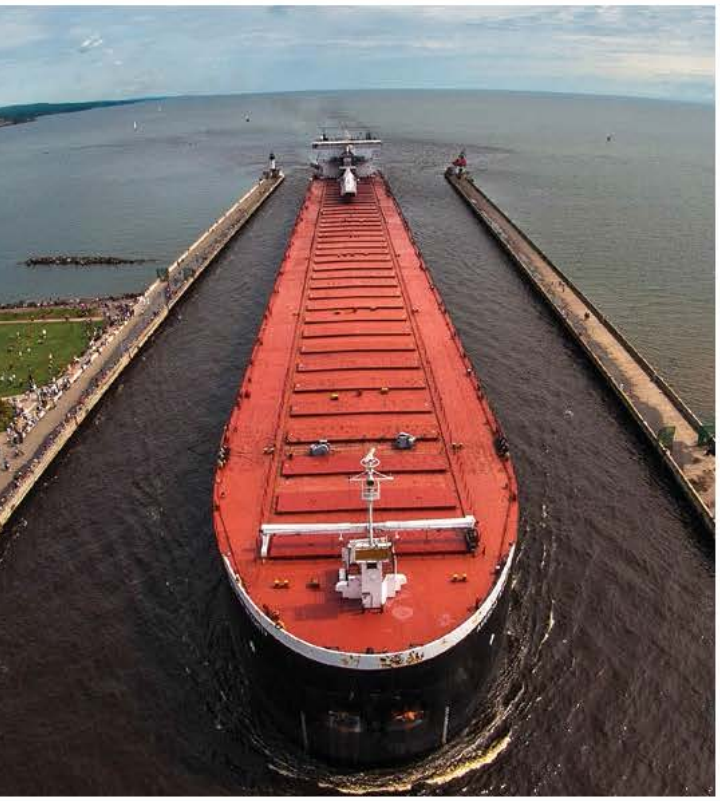
Economic Feasibility of Mass Timber Manufacturing in Minnesota

March 6, 2019





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DISCLAIMER –The Bureau of Business and Economic Research (BBER) and the Center for Economic Development (CED) at the University of Minnesota Duluth were contacted by APEX as an unbiased research entities. Publication and dissemination of this report, or any of its data, is not an endorsement by the BBER/CED/UMD of APEX or its projects.

The researchers were asked to supply a market demand study, a lumber availability and an economic impact analysis only. This analysis does not consider the social or environmental impacts of the project and should not be viewed as a cost benefit analysis or environmental impact assessment.

Executive Summary

The Bureau of Business and Economic Research (BBER) at the University of Minnesota Duluth's Labovitz School of Business and Economics was contacted by Area Partnership for Economic Expansion (APEX) to study the market and economic feasibility of introducing Mass Timber manufacturing (e.g. cross-laminated timber (CLT) production) for the state of Minnesota and/or Minnesota's Arrowhead Region. The BBER partnered with the UMD Center for Economic Development (CED) on this project. The overall study addresses three primary objectives: an analysis of building construction market demand growth and projections, an estimate of the current and potential ability of local lumber producers and wholesalers, and an economic impact analysis of the new industry in the region.

Cross-laminated timber (CLT) is a wood panel system that has been gaining popularity after being widely adopted in Europe. CLT can be described as large-scale, prefabricated, engineered wood panels. It is made up of several layers (typically three, five, or seven) of dimension lumber stacked in alternating directions, bonded with structural adhesives, and pressed to form a solid, rectangular panel. Its strength, dimensional stability, and rigidity make it an advantageous construction material.

The first objective of this study was to complete a current market analysis of the cross-laminated timber (CLT) industry, including a summary of recent and projected market trends, statistics on recent building and construction trends, and an overview of the benefits and challenges associated with CLT construction. The UMD Center of Economic Development (CED) relied on secondary data sources to compile the information included in this section.

Grand View Research reports that in 2016, the global cross-laminated timber market was valued at $558.6 million and expected to grow to $2.07 billion by 2025. Areas of the world that show increased awareness and use of CLT include Europe, North America, and Asia Pacific regions. In North America, demand for CLT was valued at $118.8 million in 2016, and the expectation is that the region will be the second largest CLT market for the foreseeable future.

Recent trends in multi-family housing along with a trend toward more sustainable building practices have also positively impacted the demand for CLT. Both the number of multi-family housing unit permits issued in the U.S. as well as nonresidential construction expenditures in the commercial, manufacturing, and office sectors has exhibited positive growth. These construction types are among the most popular projects involving CLT and mass timber. Sustainable building systems such as LEED-certified projects and the ICC 700 National Green Building Standard are also likely to drive demand for more green building materials.

Challenges that face the effective implementation of mass timber and CLT products include a potential lack of experience with/understanding of the construction method, restrictive building codes and permits, and learning curves among engineers, architects, and developers. Benefits of this type of construction include speed and ease of constructing modular systems, durability and strength, lower costs, and the opportunity for a green alternative to traditional construction materials.

The second objective of the study was to estimate the current and potential abilities of local lumber producers and wholesalers to supply CLT-suitable lumber. To accomplish this objective, the BBER distributed surveys to Great Lakes states' sawmills and lumber distributors with the intent of determining the current and potential lumber being produced and distributed in the Great Lakes region that would be suitable for CLT manufacturing. Eight regional sawmills and eleven distribution locations provided data for the study.

Regional sawmills reported currently producing 300 million board feet (MMBF) of lumber in the grades and species suitable for producing CLT. Nearly three-quarters of that total volume (223.5 MMBF) was red pine. The remaining quarter was split about equally between spruce and jack pine (41.5 and 40.8 MMBF,

respectively). Only a very small volume of balsam fir was produced in the region (0.7 MMBF).

More than half of the surveyed mills' current production was reported as 2 x 4 lumber, which is not currently preferred for CLT. When asked, however, about potential production capabilities in 2 x 6 or 2 x 8 dimensions, mills reported the ability to increase production to roughly 250 MMBF if there was a preference for wider lumber. This U.S. lumber is from the spruce-pine-fir south species classification (SPFs).

Wholesalers reported that they distribute roughly 100 MMBF of 2 x 6 and 2 x 8 lumber suitable for CLT but predicted they could supply more than double that volume if there was demand for the product. Roughly 60% of the total volume (58.4 MMBF) distributed in the last year was spruce-pine-fir (SPF), and 37% was southern yellow pine. Only a very small volume of Douglas fir-larch was distributed in the region (4.8 MMBF).

Additionally, the BBER estimated that more than 1,200 MMBF of lumber are being exported from Canada to Minnesota and Wisconsin. While not all of the lumber exported from Canada is suitable for CLT production, it highlights the significant opportunity for additional material just across the border. For example, if even a quarter of that amount was suitable for CLT, it would mean an additional 300 MMBF of lumber.

The third and final objective of the study was to estimate the potential economic impacts of a CLT firm locating in the state of Minnesota or the Arrowhead region. According to the results of modeling, for every worker directly employed by a CLT manufacturing firm, the state of Minnesota could see an estimated 0.9 additional jobs created in supporting industries, such as wholesale trade, management of companies and enterprises, and sawmills.

In total, if a small CLT firm (employing 20 workers) was to locate somewhere within the state of Minnesota, the state's economy could see an additional $2.5 million in labor income, $3.3 million in value added spending, and 38 jobs throughout the state as a result of the new firm. If a large firm or cluster of firms were to locate somewhere within the state, these impacts could be significant: $12.4 million in new labor income, $16.4 million in value added spending, and 190 jobs could result from such an investment.

The results of this study demonstrate increasing awareness and use of CLT in North America, due primarily to the growth of multi-family construction and a demand for more sustainable building materials. In addition, the study found that lumber mills and wholesalers in the Great Lakes region produce and distribute more than enough lumber in the grades and dimensions suitable for CLT manufacturing and have the ability to increase production and distribution volumes if there was a demand for the product. Finally, the results show the significant economic impacts that could result from a new CLT firm locating in the region: for every CLT employee, the state could see an additional 0.9 workers in supporting industries as a result of the firm's direct, indirect, and induced effects.

Introduction

The Bureau of Business and Economic Research (BBER) at the University of Minnesota Duluth's Labovitz School of Business and Economics was contacted by APEX to study the economic feasibility of introducing Mass Timber manufacturing, including cross-laminated timber (CLT) production, to the state of Minnesota and/or Minnesota's Arrowhead Region. The feasibility study included three primary components: an analysis of mass timber market demand growth and projections, an estimate of the current and potential ability of local lumber producers to produce CLT-suitable lumber, and an economic impact analysis of the new industry in the region.

The BBER partnered with the UMD Center for Economic Development (CED) on this project. In addition, representatives from Minnesota's Department of Natural Resources (MnDNR), U.S. Forest Service (USFS), Minnesota College of Design (MCD), and the Area Partnership for Economic Expansion (APEX) served as subject matter experts, participated in regular team meetings, and provided the BBER and CED with connections to CLT industry leaders, local timber producers, forestry professionals, and other appropriate resources needed to support the project.

Descriptions of the three chapters of the report are listed below.

Market Demand

In this section, the CED outlines an overview of CLT, provides a market analysis of the CLT industry, and summarizes construction data on the recent national and Midwest trends. In addition, the chapter highlights some common barriers to market, such as the existing regional codes and regulations, which may impact the usage of CLT in residential, commercial, or industrial construction.

Lumber Availability

This section provides the evaluation of the current and potential volume of CLT-suitable lumber being produced and distributed throughout the state of Minnesota and the surrounding region. The chapter includes the results of two surveys developed and distributed by the BBER: one given to lumber producers and one to distributors. The surveys evaluated the current and potential ability of local producers and distributors to supply lumber to a potential CLT manufacturer. In addition, the chapter provides information on the volume of lumber imported to the region from Canadian lumber producers.

Economic Impact Analysis

In this section, the BBER estimates the potential economic impacts that could result from a CLT manufacturing firm in the Arrowhead region or the state of Minnesota. The chapter includes information on the economic characteristics of the two study areas, the inputs used in modeling (number of employees, wages, and annual sales), and the results of three scenarios, each of which represents a different size firm.

The primary geographic scope for the study (i.e. the study area used for modeling the economic impact analysis) is the state of Minnesota with a special focus on the Arrowhead Region of the state. For the other portions of the study (market demand and lumber availability) the geographic scope was determined based on factors such as data availability, building code requirements, and transportation costs.

Chapter I. Market Demand

For this portion of the study, the Center for Economic Development (CED) relied on secondary data sources to provide an overview of cross-laminated timber (CLT), a market analysis of the CLT industry, and a summary of recent construction data on national and Midwest trends. Finally, the chapter concludes with some high-level benefits and challenges associated with CLT construction that should be considered.

Overview

While most people are knowledgeable with what is known as stick framing in construction, mass timber takes engineered wood construction to a new level. Mass timber is defined as building construction where the primary load bearing members in the structure are made up of wood, including engineered wood products and/or large dimension solid sawn wood (The Beck Group 2018).

Forms of Mass Timber

- Cross-Laminated Timber (CLT)
- Nail-Laminated Timber (NLT)
- Dowel-Laminated Timber (DLT)
- Glue-Laminated Timber (Glulam) (GLT)
- Structural Composite Lumber (SCL)

While there are five forms of mass timber, this report focuses primarily on the first form, cross-laminated timber, or CLT.[1]

Cross-laminated timber (CLT) is a wood panel system that is gaining in popularity in the U.S. after being widely adopted in Europe. CLT is the basis of the tall wood movement, due to the material's high strength, dimensional stability, good fire performance, and rigidity allow it to be used in commercial construction applications.

MARTINELL, 2018

According to Think Wood (2019), CLT panels are typically three, five, or seven layered boards that are stacked crosswise at 90-degree angles and glued together. Dimensions for the manufactured panels can be customized, however, the length is affected by transportation restrictions.

CLT may be utilized with other traditional engineered wood products and building systems and can be used in

[1] Definitions for nail-laminated, dowel-laminated, glue-laminated timber, and structural composite lumber, along with all other report definitions, can be found in Appendix A.

hybrid applications with materials such as concrete and steel. It can also be used in prefabricated buildings, which can shorten construction timelines (Think Wood 2019).

The growing market for CLT and tall wood construction, according to Think Wood (2019) is impacted by three main factors: advances in wood connectors, the development of hybrid materials and building systems, and the commercialization of CLT and growth in its off-site fabrication.

In structural systems, such as walls, floors and roofs, CLT panels are load-bearing, Think Wood (2019) reports. For use in wall construction, the outer layers of lumber in a CLT panel are typically vertical. This maximizes the wall's vertical load capacity. In floor and roof applications, the outer layer of lumber used in the panels runs parallel with the span (Think Wood 2019).

Due to CLT's tremendous strength, architects and other designers are developing new uses for wood, such as in wide prefabricated floor slabs and single-level walls and taller floor plate heights explains Think Wood (2019). Additionally, designers know that building interiors gain more aesthetic qualities with exposed CLT.

Cross-Laminated Timber (CLT) Market Analysis

According to Grand View Research (2017), the global cross-laminated timber market size was valued at $558.6 million in 2016 and is expected to reach $2.07 billion by 2025.

In terms of volume, the research company states that the CLT market is expected to grow at a compound annual growth rate (CAGR) of 15.1% from 2017 to 2025 due to increasing awareness of sustainable housing. The residential segment is expected to witness the fastest growth, at a rate of 15.4%, in terms of revenue, from 2017 to 2025 owing to high product demand in developed countries.

Educational facilities and residential builders are anticipated to drive the CLT market significantly upward in North America, where in 2016, the CLT market size value was $65 million (Grand View Research 2017).

In 2016, the demand for CLT in North America was valued at $118.8 million, and the continent is anticipated to continue as the second largest market until 2025 (Grand View Research 2017). CLT is expected to see market growth until 2025 due to several factors, such as its competitive price, high thermal performance, and insulation properties complemented by consumers' increased knowledge of wood's uses for construction, and continued worldwide sustainability issues, reports Grand View Research in its study for years 2017-2025.

Increasing consumer demand for upscale apartments is likely to have a positive impact on the industry growth as is the increasing use of the wood for walls, floors, and ceilings in residences.

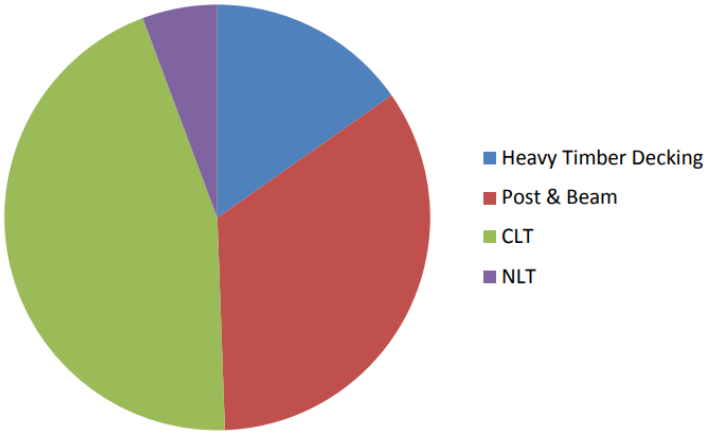
With its simple construction, durability, fire and earthquake resistance ability, and other factors, CLT is becoming a popular construction material that will likely drive the demand for the market over the next seven years (Grand View Research, 2017). CLT is seen as a sustainable with a lower carbon footprint and is a low-cost alternative to steel and concrete building materials.

North America, Europe, and Asia Pacific regions are also becoming aware of CLT, increasing its popularity and thus, its potential impact on the market. Major players in the industry continually pursue technological advancements to manufacture quality products and increase efficiency (Grand View Research 2017).

Material Use and Market Trends

The chart below from The Beck Group shows what primary structural material is being used for mass timber projects. At the end of 2018, mass timber projects were about evenly split between projects that primarily used solid sawn lumber (post and beam, heavy timber decking) and those that used mass timber panels (CLT, NLT).

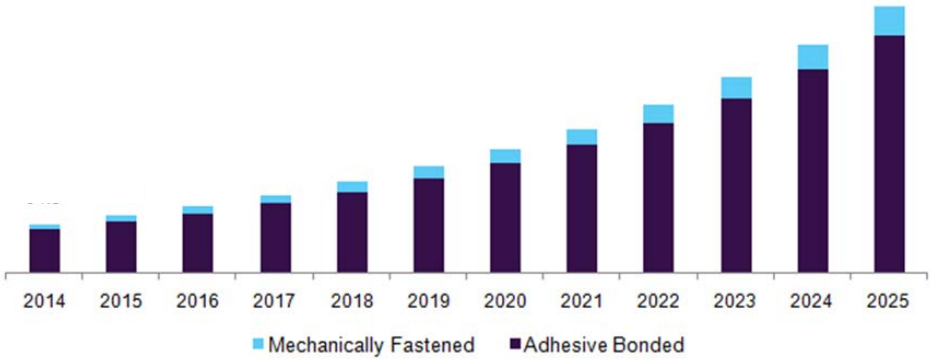
Figure 1. Mass Timber Projects by Primary Structural Material



THE BECK GROUP, 2018

Shown in Figure 1 is the U.S. cross-laminated timber market revenue by type from 2014 to the projected 2025 levels. With the adhesively bonded type represented in purple, it is clear that this style dominates the market; most likely due to its enhanced durability and performance. The segment is expected to account for a significant market share over the period of 2017-2025.

Figure 2. U.S. Cross-laminated timber Market Revenue, by Type, 2014-2025 (Millions of USD)



GRAND VIEW RESEARCH, 2017

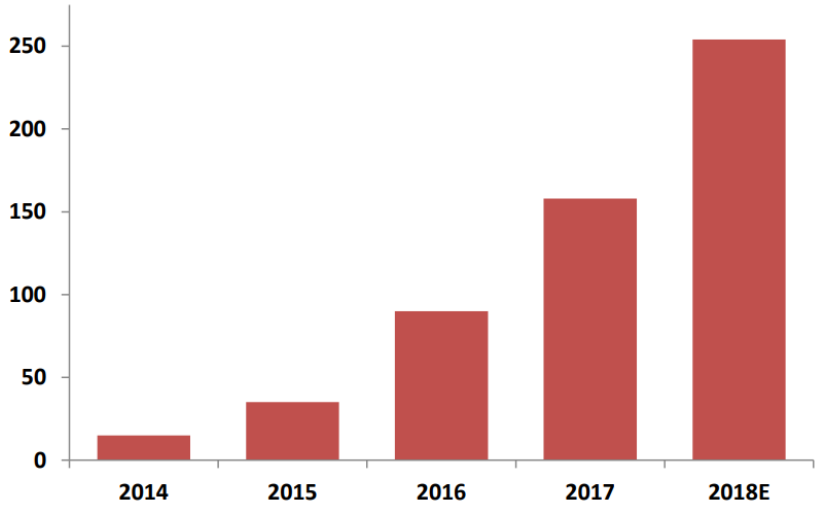
According to a study conducted by Grand View Research (2017), 88% of the CLT global market in 2016 utilized adhesive bonding. With CLT's strength and seismic performance, demand for CLT products is expected to grow significantly over the coming years, and adhesive bonded CLT is predicted to continue to dominate the market. However, environmental concerns about adhesives are anticipated to hamper the growth of this type of CLT.

In 2016, the mechanically fastened segment of CLT was valued at $63.7 million. While mechanically fastened CLT represents a relatively small portion of the market as compared to the adhesive bonded form, Grand View Research expects this segment to grow with respect to its overall market share due to the product's effective recycling and increased demand from the North American and European regions (Grand View Research 2017). The trend to environmentally friendly products by consumers is also expected to heighten product appeal and use.

National CLT Projects

The Beck Group cites WoodWorks as having the most input regarding the designed and/or built Mass Timber structures in the U.S. and with tracking the number of Mass Timber projects (whether WoodWorks offers direct assistance or not). Figure 3 illustrates the number of new U.S. Mass Timber projects by year (The Beck Group 2018). However, Woodworks[2] (2018) has accounted for 487 total projects for 2018. This means that more than 230 projects (roughly) were completed over what the firm anticipated, as shown in Figure 3. See Appendix B for more detail.

Figure 3. U.S. Mass Timber Projects by Year (2014-2018 Expected)



THE BECK GROUP (WOODWORKS), 2018

Midwest CLT Projects

As of December 2018, WoodWorks data shows that Minnesota had one building where construction was started or completed using mass timber and two buildings made of mass timber in design.

The Midwest Region of Minnesota, Wisconsin, Iowa, North Dakota, South Dakota, Michigan, Illinois, Kansas, Montana, Nebraska, and Ohio had 14 buildings where construction was started or completed with mass timber. There are also 38 buildings made of mass timber in design in the Midwest (WoodWorks 2018).

Of note, is Minneapolis's T3 building—the first modern, tall wood building in the U.S. Built in November 2016, the seven-story, 220,000-square-foot structure, altered parameters within the commercial building industry. T3 demonstrated how extremely large timber projects could be used to reduce the carbon footprint of the

[2] See Appendix B for the full WoodWorks data.

built environment while also creating engaging and inviting spaces. Inside, exposed glulam columns and beams, and nail-laminated timber (NLT) floors, offer a modern interpretation of historic wood buildings found in many U.S. cities. According to Woodworks, the development of efficient systems took considerable effort, resulting in a reduced production schedule from the perspective of cost and construction. The timber erection was completed in 2.5 months at an average of nine days per 30,000-sf floor. The project team estimates that T3 is 30% lighter than a comparable steel design and 60% lighter than post-tensioned concrete, which allowed them to reduce the depth of the foundation. Hines, the firm that developed T3, plans to leverage the design for a suite of similar wood office buildings. (WoodWorks n.d.)

Competitive Insights

The global CLT market is dominated by the principal entities of Stora Enso, Mayr-Melnhof Holz, Binderholz, XLam Ltd., Sterling Lumber, Schilliger Holz AG, KLH Massivholz GmbH, B & K Structures, Eugen Decker Holzindustrie KG, Structurlam, SmartLam, and Meiken Lamwood Corp. These companies are increasing their ability to produce CLT-suitable lumber to fulfill the worldwide massive product demand (Grand View Research 2017).

Manufacturers are investing heavily in CLT research and development not only to enhance product quality but also to overcome the barriers of using CLT (Grand View Research 2017). These technological advancements along with competitive pricing are expected to aid manufacturers in increasing their market share over 2017-2025, reported Grand View Research (2017).

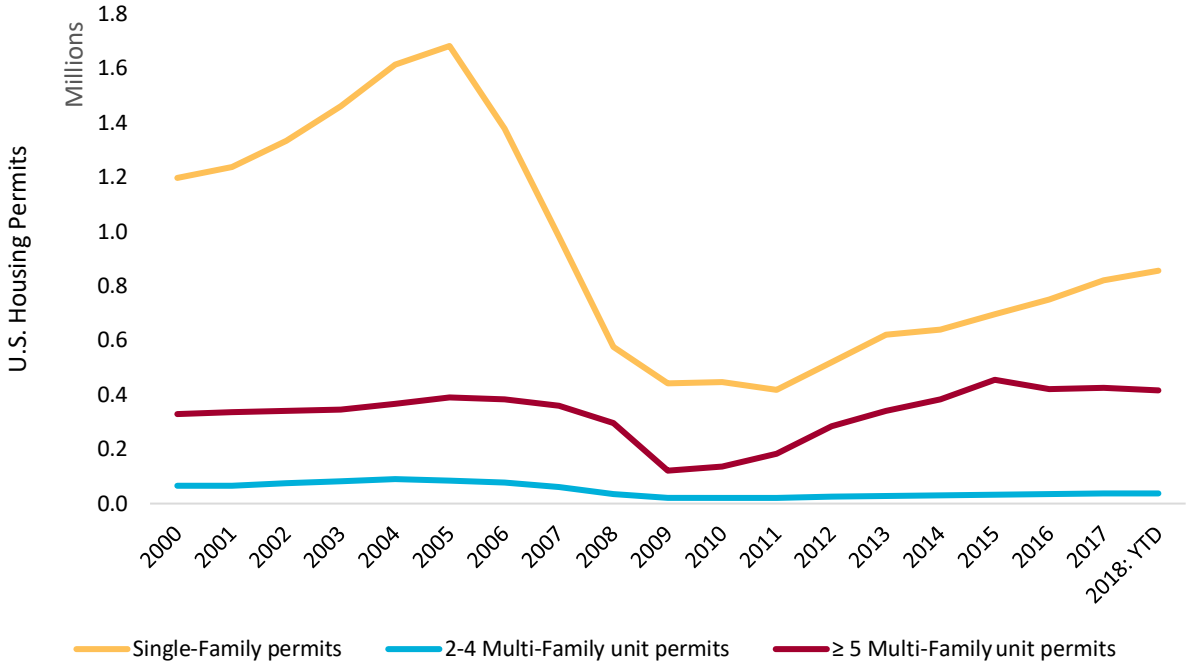
Katerra, an advanced technological construction firm, has invested in a CLT plant in Spokane, Washington, with production slated to begin in early 2019. The plant is expected to help scale up the U.S. production of CLT and increase the adoption of CLT across the construction industry. (Katerra 2019) (Dalheim, Katerra receives $865 million to fund massive cross-laminated timber plant 2018)

In 2017, SmartLam, the first commercial manufacturer of CLT in the nation, expanded its operations and headquarters into a former Weyerhaeuser lumber mill property—quadrupling the manufacturer's production. (Dalheim, SmartLam Quadruples Cross-laminated Timber Production at Former Weyerhaeuser Site 2017)

Construction Statistics

The statistics shown in this section include trends in housing and commercial construction, both nationally and in the Midwest. The information shown was provided primarily by Delton Alderman, Research Forest Products Technologist, USDA Forest Service in his report, *Housing Market Statistics: Nation, Midwest Region, and Minnesota Metropolitan Statistical Areas,* unless otherwise noted. The additional citations in these sections are those from his report. Please see Appendix C. for the full report.

Figure 4. U.S. Housing Permits, 2000-2018.



DELTON ALDERMAN, U.S. CENSUS, BBER

Figure 4 shows the change in U.S. housing permits since 2000. The number of housing permits has been slightly increasing since 2011 after the dramatic decline resulting from the Great Recession. It is important to note, however, the stability of 5 multi-family or larger housing permits. These types of permits saw less of a decline from 2008-2012 and have rebounded past pre-recession levels. It is also important to note that CLT, when used for housing, is more commonly used in large apartment buildings. CLT has been used in this capacity in new apartment complexes in Montreal (Menayang), East London (Block) and is slated for a proposed complex in Las Vegas (Glenn).

Approximately 121.2 million primary residences existed in the United States in 2017. Of those, almost 26.7 million units were in the Midwest region (U. S. Census Bureau-American Housing Survey, 2018a). Estimates from the U.S. Energy Information Administration (2018) for commercial buildings show almost 5.6 million commercial buildings in 2016 with 1.2 million in the Midwest. Moreover, nearly 55 percent of the buildings were constructed before 1990, and of those, 63 percent were only one level. In 2017, an estimated $6.2 billion were spent for residential construction with $519 million spent in the Midwest (U.S. Census). Also in 2017, $624 billion of non-residential building expenditures were estimated for the nation, while the Midwest spent an estimated $112.7 billion (U.S. Census-Construction Spending, 2018b).

Table 1. Annual Value[1] of Private Nonresidential Construction Put in Place by Region, 2017

Sector	*Northeast*	*Midwest*	*South*	*West*	*United States*
Commercial	12,224	16,529	35,978	19,907	84,637
Manufacturing	5,247	12,602	40,436	7,512	65,796
Office	15,745	7,914	19,703	15,201	58,564
Health Care	6,069	7,362	11,867	7,348	32,645
Lodging	5,834	4,085	10,397	7,669	27,985
Educational	7,614	3,843	5,967	2,839	20,263
Amusement and Recreation	2,279	2,946	4,738	3,795	13,757
Transportation	1,527	343	1,664	1,158	4,692
Religious	414	648	1,717	587	3,366
Total: nonresidential expenditures	57,033	56,386	132,851	66,160	312,430

[1] millions of dollars, nominal.

SOURCE: U.S. CENSUS-CONSTRUCTION, 2018B

Table 1 shows the annual value of non-residential construction by sector for each of the four regions in the U.S. Private nonresidential construction expenditures were greatest in the commercial, manufacturing, and office sectors in 2017. The percentage of nonresidential construction expenditures by sector in the Midwest was similar to those of the U.S.

Daum *et al.* (2019) forecast that approximately $545.3 billion will be spent on nonresidential structures in 2019. Also in 2019, they project approximately $67.9 billion to be spent in the East North Central region—Illinois, Indiana, Michigan, Ohio, and Wisconsin. While in the subsequent years of 2020, 2021, and 2022, they project that area to spend approximately $70 billion, $71.5 billion, and $78.6 billion respectively. The West North Central region—Iowa, Kansas, Missouri, Minnesota, Nebraska, North Dakota, and South Dakota—is projected to spend approximately $46.7 billion in 2019, $45.6 in 2020, $45.6 in 2021, and $47.4 in 2022.

Table 2. Top 10 Building Permits: Total Units, Midwest MSAs[2]: 2017

MSA	**Total units**
Chicago-Naperville-Elgin, IL-IN-WI	22,132
Minneapolis-St. Paul-Bloomington, MN	15,100
Detroit-Warren-Dearborn, MI	10,089
Indianapolis-Carmel-Anderson, IN	9,079
Columbus, OH	8,892
St. Louis, MO-IL	7,295
Cincinnati, OH-KY-IN	6,465
Des Moines-West Des Moines, IA	6,367
Louisville-Jefferson County, KY-IN	5,785
Omaha-Council Bluffs, NE-IA	4,955
Total Midwest MSAs	155,171

[2]Eighty-one total MSAs are reported in the Midwest by U.S. Census-Construction.

SOURCE: U.S. CENSUS-CONSTRUCTION, BUILDING PERMITS SURVEY, 2018D.

To gather further data, metropolitan statistical areas (MSA) were analyzed in 2017 in regard to housing construction as well (Table 2). The MSAs of Chicago, Minneapolis, Detroit, and Indianapolis issued the most permits.

Table 3. Top 10 Building Permits Among Midwest MSAs[3]: Multi-Family, 5 or More Units (2017)

MSA	5-units or more
Chicago-Naperville-Elgin, IL-IN-WI	12,692
Minneapolis-St. Paul-Bloomington, MN	6,082
Columbus, OH	4,439
Detroit-Warren-Dearborn, MI	2,919
Madison, WI	2,838
Des Moines-West Des Moines, IA	2,623
Louisville-Jefferson County, KY-IN	2,265
Indianapolis-Carmel-Anderson, IN	2,127
Milwaukee-Waukesha-West Allis, WI	1,975
Cincinnati, OH-KY-IN	1,880
Total: Midwest MSAs	58,074

[3]Eighty-one total MSAs are reported in the Midwest by U.S. Census-Construction.
SOURCE: U.S. CENSUS-CONSTRUCTION, BUILDING PERMITS SURVEY, 2018D.

Table 3 shows that the MSAs of Chicago, Minneapolis, Columbus, and Detroit recorded the most five- or greater multi-family unit permits in 2017.

Supporting data from Construction Monitor (2018) shows Minnesota had a total of 5,242 commercial building permits from January through November 2018. Residential and commercial permit information for Minnesota, Wisconsin, Iowa, Michigan, North Dakota, Illinois, and South Dakota for the same time period is located in Appendix D. During this time period, there were a total of 19,377 commercial building permits among all seven states (Construction Monitor 2018).

As shown in Table 4, in Minnesota, the Minneapolis MSA had the most housing permits issued by far with nearly 74 percent of the total permits. Also, 74 percent of single-family permits and 75 percent of multi-family permits issued were in the Minneapolis MSA.

Table 4. Building Permits: Minnesota MSAs, 2017

MSA	Total units	Single-Family units	2-4 Multi-Family units	≥ 5 Multi-Family units
Minneapolis-St. Paul-Bloomington	15,100	8,782	236	6,082
Fargo, ND-MN	1,891	1,065	0	826
Rochester	1,449	818	6	625
Duluth, MN-WI	665	508	4	153
Mankato-North Mankato	516	342	12	162
La Crosse-Onalaska, WI-MN	432	278	16	138
Grand Forks, ND-MN	417	227	4	186
Total: Minnesota	20,470	12,020	278	8,172

*Seven total MSAs are reported in Minnesota by U.S. Census-Construction.
SOURCE: U.S. CENSUS-CONSTRUCTION, BUILDING PERMITS SURVEY, 2018D.

Over the past several years, the majority of buildings constructed have been apartments built for more affluent renters (Class A construction). However, according to Sebree and Chang (2019) "much of the rental demand will center on apartments that serve the traditional workforce: Class B and C properties." They also state that Minneapolis-St. Paul's "sustained apartment demand kept vacancy persistently tight, allowing steady rent growth. It is the only Midwest market to break into the top 20" [in the U.S.].

The quantity of MF completions is a net inventory gain of about 13 percent in the past eight years. Despite the completion of the "most apartments since the 1980s, vacancy is forecast to remain at just 4.6 percent in 2019. With rising labor and materials costs, tighter lending, and a shortage of skilled construction labor available, the pace of construction should begin to ebb in 2020" (Sebree and Chang, 2019).

Building Trends

Two significant trends in residential and commercial construction are the movement toward green, or sustainable, construction and the rise in modular construction. Both have significant implications for the CLT industry, as CLT construction is both sustainable and modular by nature. This section highlights some recent and projected trends these two areas.

As the demand for more sustainable building options increases, green construction has become increasingly profitable and desirable within the global construction market (Statista, n.d.). For example, buildings certified by the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) have lower energy and water consumption, save taxpayers money, and reduce carbon emissions, making them an environmentally favorable building system, according to Statisa (n.d.). The statistics and research company also reports that the green building market is anticipated to be among the fastest growing industries worldwide. The number of LEED-certified projects in the United States rose from 296 certifications in 2006 up to over 65,000 in 2017.

In 2017, the U.S. Green Building Council cited that the top 10 states for LEED completed 1,399 projects (over half of the 2,647 projects completed in the country) over the course of the year. According to that same list, Minnesota ranked sixth out of the entire country, with 47 LEED certified projects completed in 2017 (U.S. Green Building Council 2018).

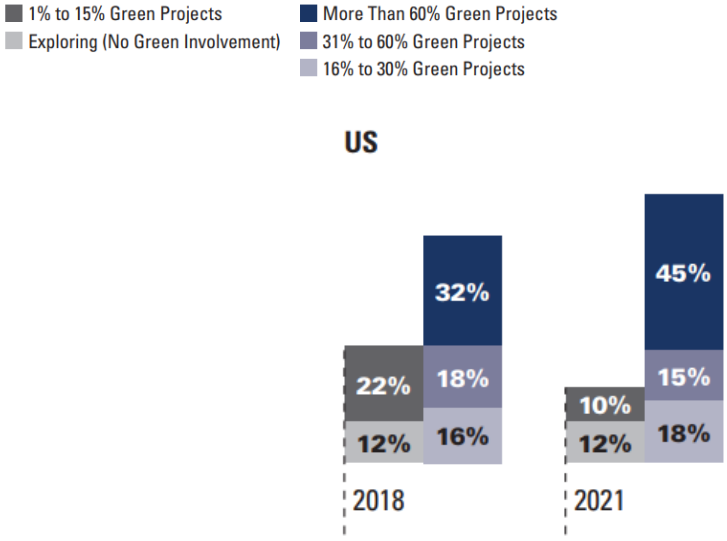
Minnesota had 1.36 gross square feet of LEED-certified space per capita in 2018, with the Wells Fargo Center, the third tallest building in Minneapolis, coming in with 1.34 million square feet of LEED space.

Green building systems like LEED and the ICC 700 National Green Building Standard will likely continue to drive demand for green building projects. (statista n.d.)

Minnesota also utilizes the Buildings, Benchmarks, & Beyond (B3) sustainable building guidelines. The Minnesota Department of Commerce, the University of Minnesota's Center for Sustainable Building Research and outside contractors and consultants developed and supports B3. The guidelines are similar to LEED but are tailored to meet the specific building construction needs for Minnesota. (Minnesota Department of Administration, n.d.)

Approximately 2,000 green building industry individuals, which include architects, engineers, contractors, owners, specialists/consultants and investors, from 86 countries participated in a study on the level of their green building activity. Figure 5 below shows responses of U.S. participants (World Green Building Council 2018).

Figure 5. Levels of Green Building Activity for Respondents in North America (2018 and 2021 Expected)



DODGE DATA & ANALYTICS, 2018

According to Dodge Data and Analytics (2018) 32% of respondents indicated that more than 60% of their building activities are green projects. This amount is estimated to reach 45% in 2021, which is an increase of 13%.

Studies show that the modular construction market will grow in the coming years, according to Thomas Industry Update (2018), a data, platform, and technology company for the industrial market. In 2017, Markets and Markets, a leading business research firm, showed a $106.15 billion value in the modular construction market. The firm anticipated that this value will reach $157.19 billion by 2023, with a compound annual growth rate of 6.9% (Modular Construction Market Trends and Predictions for 2019 2018).

Although most prefabricated buildings are constructed with wood using conventional light framing, mass timber products using CLT and glulam are increasingly specified in commercial and multi-family projects. (Think Wood 2018)

Building Codes for Mass Timber

As of January 2019, tall wood buildings will be included as part of the 2021 International Building Code (IBC), according to WoodWorks (2019). Based on approved proposals from the International Code Council (ICC), the 2021 code will include the new construction types of Type IV-A, IV-B, and IV-C, thereby accepting the use of mass timber or noncombustible elements. WoodWorks reports that the three construction types are derived from the previous Heavy Timber construction type (renamed Type IV-HT) but with additional fire-resistance ratings and levels of required non-combustible protection. Businesses and residential projects will be able to be constructed up to 18 stories according to the new code Type IV-A.

The 2015 IBC streamlined the acceptance of CLT buildings by recognizing CLT products manufactured to the ANSI/APA PRG 320: Standard for Performance-Rated Cross-laminated timber. Under the 2015 IBC, CLT at the required size is specifically for prescribed use in Type IV buildings. However, CLT can be used in all types of combustible construction—i.e., wherever combustible framing or heavy timber materials are allowed.

The National Design Specification® (NDS®) for Wood Construction applies to CLT as it does for all wood products. Throughout the IBC, these design specifications are cited as the standard for all wood design, according to WoodWorks (2019).

An adoption date of the 2018 edition of the International Model Building Codes (I-codes) in Minnesota has not been cited, though the review phase of the codes is nearing completion (American Wood Council 2018). Minnesota's state building codes include the adoption of the 2012 International Building, Existing Building, Fire, Fuel Gas, Mechanical, and Residential Code. Under the 2012 and 2015 IBC, opportunities exist for constructing wood-frame structures up to six stories and 85 feet tall (measured from grade plane) (WoodWorks 2019). The total allowable height depends on two factors: the type of construction being done and its intended occupancy type.

Benefits and Challenges of Mass Timber

To summarize, Table 5 contains some of the most relevant benefits and challenges associated with mass timber (or CLT) construction.

Table 5. Benefits and Challenges of Mass Timber

Benefits	Challenges
• Can replace structural concrete, masonry or steel • Construction time is very fast • Prefabrication of CLT can lead to higher tolerances • Foundation sizes can be reduced because panels used are light weight • Less concrete is used which can reduce overall energy used • Less noise and dusts compared to traditional construction • Ability to retain heat • Compared to traditional construction, heat will enter the construction at a slower speed • Airtightness is easily achievable • Requires only limited site installation skills • 'Dry' construction prevents moisture from being admitted into the building • Flexibility in customizations – for example, windows and doors • Loads such as wall cabinets can be located without the restrictions associated with other forms of construction • Prefabrication reduces the quantity of waste associated with onsite fabrication • Stores carbon and avoids the releasing of greenhouse gas emissions • Timber is renewable and stores carbon	• Non-traditional form of construction new to North America • Few designers are familiar with this type of construction which can lead to a learning curve • Inflexibility between design and fabrication of structures. • Transformation of structure can be more difficult than traditional construction. • Requires external cladding and usually, added insulation • Utility services need careful consideration ahead of fabrication. If exposed surface finish is used, then routing is required because services are difficult to relocate once the panel is installed • CLT floor slab can be around twice as expensive than a pre-stressed concrete hollow floor slab • The tendency of wood to absorb moisture from the atmosphere is expected to pose a challenge to the industry growth • Less willingness to use performance-based fire protection engineering • Many of the existing building codes are tailored to traditional building systems such as concrete and steel for large multistory buildings, and light wood framing (dimension lumber, etc.) for smaller buildings • Urban/rural divide on understandings and perceptions about forest management

SOURCES: THE BECK GROUP (2018), GRAND VIEW RESEARCH (2017), GREENSPEC (2019), LUPIEN (2018), WOODWORKS (N.D.)

Conclusions

- Mass timber is a growing trend with increasing demand both in the U.S. and globally.
- Companies currently in the mass timber market are growing and there is increasing production of mass timber construction across the U.S.
- Adhesively bonded—as opposed to mechanically fastened—cross laminated timber currently dominates the CLT market and is projected to continue to make up a large portion of the market share; most likely due to its high durability and performance rating.
- CLT is commonly used in large, multi-family (5+) unit housing; a construction type that shows increased growth in the past 10 years based on the number of permits issued in the U.S. The Minneapolis-St. Paul-Bloomington MSA saw the second highest issuance of these permits out of eighty-one total MSAs reported in the Midwest.
- Among nonresidential construction spending in 2017, the commercial, manufacturing, and office sectors rank the highest across the U.S. This trend is consistent in the Midwest as well.
- Trends such as sustainable building practices and modular construction systems have experienced growing popularity in the U.S., positioning CLT well due to both its sustainable and modular nature.
- Environmentally conscious behaviors and attitudes are projected to increase, with Minnesota already a top ten contender in LEED certified projects, this makes the need for a more sustainable construction, such as mass timber, advantageous.
- Challenges that face the effective implementation of mass timber include: low awareness or understanding of the construction method, restrictive building codes and permits, and learning curves among engineers, architects, and developers.
- Benefits such as ease of construction, durability, low cost, and thermal regulation make mass timber a favorable building system.

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Chapter ll. Lumber Availability

For this portion of the study, the BBER developed and distributed a survey to gather data from current lumber producers and distributors located within the supply area. This information was used to determine the potential lumber supply available in the Great Lakes states (primarily Minnesota, Wisconsin, and Michigan) for a cross-laminated timber (CLT) manufacturer and to identify potential interest among sawmills and distributors in being part of a future supply chain. Specifically, the survey evaluated local producers' ability to provide the necessary species, dimensions, and grades of CLT-suitable lumber to produce CLT and wholesalers' current distribution levels of suitable lumber. Follow-up interviews conducted by BBER staff and undergraduate student researchers, as needed, supplemented the survey data.

Sawmills

A survey was developed for regional sawmills that included questions regarding each mill's familiarity with CLT; the amount of lumber the mill produced in various species, dimensions, and grades; and the mill's ability to modify production to meet an increased demand for specific species, grades, and dimensions.

Sawmills in a roughly 250-mile radius from Duluth, Minnesota, were surveyed. These included three Biewer Lumber mills (Prentice, Wisconsin; McBain and Lake City, Michigan); Cass Forest Products in Cass Lake, Minnesota; Hedstrom Lumber in Grand Marais, Minnesota; two PotlatchDeltic mills (Gwinn, Michigan, and Bemidji, Minnesota); Pukall Lumber in Arbor Vitae, Wisconsin; and two Rajala Companies mills (Bigfork and Deer River, Minnesota). Eight of these ten mills responded to the survey. In addition, two Canadian mills (Eacom Timber Corporation in Ear Falls, Ontario, and Resolute Forest Products in Thunder Bay, Ontario) were contacted to participate but did not respond to the survey. Throughout this report, the eight mills that provided data will be collectively referred to as "regional" mills or producers, and the lumber they produced will be considered to be produced "in the Great Lakes region."

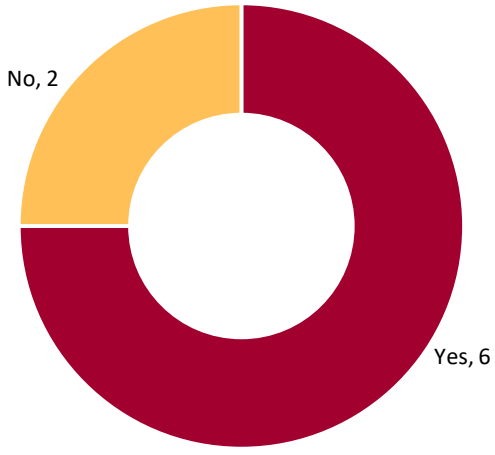
It should be noted that two of the surveyed sawmills are part of a larger corporate entity with additional mills located throughout the country. In addition to its regional mills, PotlatchDeltic has three sawmills in Arkansas and one in Idaho. Similarly, Biewer Lumber has a third sawmill in Mississippi.

Familiarity with CLT

All of the mills surveyed were asked about their familiarity with CLT. Six respondents indicated a familiarity with the product, as shown in Figure 6.

The mills were also asked whether they produced lumber that was visually or machine stress graded. Typically, visual grading is performed by a qualified grader who evaluates each piece of lumber on its strength-reducing (knots, slope of grain, and holes) and serviceability (wane, warp) characteristics (Southern Pine Inspection Bureau 2017). The highest visual grade that can be assigned to dimension lumber is "select structural," followed by No. 1, No.

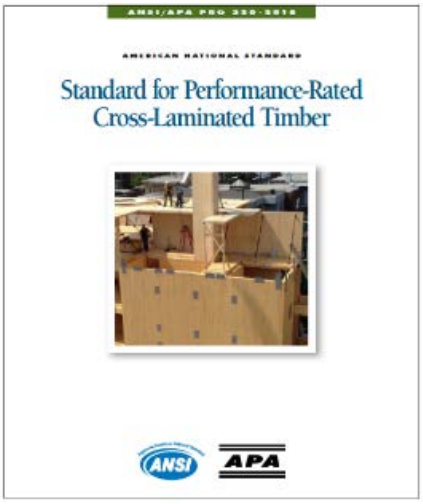
Figure 6. Are you familiar with CLT (cross-laminated timber) or other mass timber products?



SOURCE: BBER SAWMILL SURVEY

2, No. 3, and then finally five lower grades suitable for studs, framing, and other construction purposes (Southern Pine Inspection Bureau 2014). Machine stress rated (MSR) lumber, on the other hand, is evaluated by stress rating equipment, and grades are based on bending strength, stiffness class, and visual requirements (Southern Pine Inspection Bureau 2014). MSR grades and design values are in pounds per square inch with the highest values (2850 f-2.3E) indicating a stronger board and the lowest (900 f-1.0E) indicating weaker lumber (Machine Stress Rated Lumber Producers Council 2015). In response to the question regarding visually or machine stress graded lumber, all of the mills that responded indicated that they process visually graded lumber only.

Figure 7. Standard for Performance-Rated Cross-Laminated Timber (ANSI/APA PRG 320-2018)



SOURCE: ANSI/APA PRG 320-2018

CLT Lumber Specifications

Lumber used to manufacture CLT must meet specie, dimension, grade, and manufacturing specifications described in the *Standard for Performance-Rated Cross-Laminated Timber* (ANSI/APA PRG 320-2018) shown in Figure 7 and the *Standard Specification for Structural Glued Laminated Timber of Softwood Species* (ANSI/APA 117-2015). The predominant species or species combinations used are Douglas fir (DF), spruce-pine-fir (SPF and SPFs), and southern yellow pine (SYP). The minimum specific gravity is 0.35.

SPF is produced in both the U.S. and Canada. The distinction between the two sources of origin can be identified from the grade stamp on the lumber itself. Lumber stamped with SPF is produced from logs harvested in Canada. Conversely, lumber produced in the U.S. is stamped SPFs ("s" indicating that the lumber comes from south of the Canadian border). SPF includes western U.S. species, such as lodgepole pine, Engelmann spruce, and Sitka spruce and eastern U.S. species, such as red spruce, white spruce, black spruce, Norway spruce, red pine, jack pine, and balsam fir. For more information on SPF, please refer to http://sprucepinefir.us.

Figure 8. Characteristics of CLT-Suitable Lumber

- *Any softwood lumber species with specific gravity of 0.35 or higher (i.e. spruce-pine-fir, southern yellow pine, or Douglas fir-larch)*
- *Visually graded lumber with grades of "select structural," No. 1, No. 2, or No. 3*
- *Machine stress rated lumber of 1200f-1.2E MSR or higher*
- *Preference for wider lumber (2 x 6 or wider)*
- *Preference for longer lumber (8 feet or longer)*

SOURCE: ANSI/APA PRG 320-2018, STANDARD PS 20; KARACABEYLI 2013; BBER

The SYP species group includes shortleaf pine, slash pine, longleaf pine, and loblolly pine.

Most CLT manufacturers use 2 x 6 and 2 x 8 dimension lumber for their layups due to availability, cost, and efficient manufacturing processes (National Institute of Standards and Technology 2015). Based on ANSI/APA PRG 320-2018, dimension lumber used in the manufacture of CLT panels must be at least No. 2 (visual grade) or 1200f-1.2E MSR (machine grade) for the parallel layers, and No. 3 (visual grade) for the perpendicular layers. Figure 8 provides an overview of CLT-suitable lumber.

There are four species that meet those specifications and grow in the Great Lakes Region. These include red pine, spruce, jack pine, and balsam fir.

Current Lumber Production

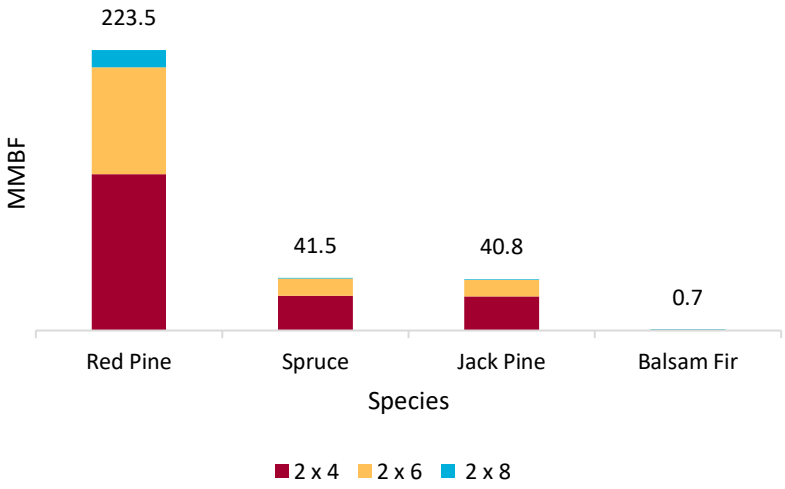
The survey asked sawmills to estimate the quantity of red pine, spruce, jack pine, and balsam fir produced in the most recent year.[3] Mills were specifically asked to break out their answers by grade (No. 3, No. 2, and No. 1 or better[4]) and width (2 x 4, 2 x 6, and 2 x 8 lumber).

The survey found that Great Lakes sawmills produced roughly 300 million board feet (MMBF) of lumber that was 2 x 4 or larger with grades of No. 3 or better (Figure 9). Of this production, roughly 180 MMBF was 2 x 4, and 127 MMBF was 2 x 6 or 2 x 8.

Nearly three-quarters of that total volume (223.5 MMBF) was red pine. The remaining quarter was split about equally between spruce and jack pine (41.5 and 40.8 MMBF, respectively). Only a very small volume of balsam fir was produced in the region (0.7 MMBF). For all species, approximately 60% of the volume produced was 2 x 4, about 35% in 2 x 6, and roughly 5% in 2 x 8.

More details on the volumes produced in each category can be found in Table 6 on the following page. In addition to the board species and dimensions shown in Figure 9, the table shows the volumes produced in each grade. Visually graded No. 2 lumber is the most commonly produced in most cases, with the exception of jack pine 2 x 4s, where slightly more No. 1 grade material is produced than No. 2.

Figure 9. Lumber Production Among Great Lakes Sawmills



SOURCE: BBER SAWMILL SURVEY

[3] The sawmill survey was distributed in August 2018 and asked mills to report the amount of lumber produced "in the most recent year," without stipulating a specific time period. It can be assumed that the numbers given might represent calendar year 2017 or a one-year time period in 2017-18.

[4] In the survey, mills were asked to report lumber grades as No. 3, No, 2, or No. 1 or better. The category No. 1 or better includes No. 1 grade and "select structural" grade lumber. For the remainder of this report, that category will be referred to simply as "No. 1."

Table 6. For the most recent year, please estimate your facility's total lumber production (MMBF) for the following lumber species and grades

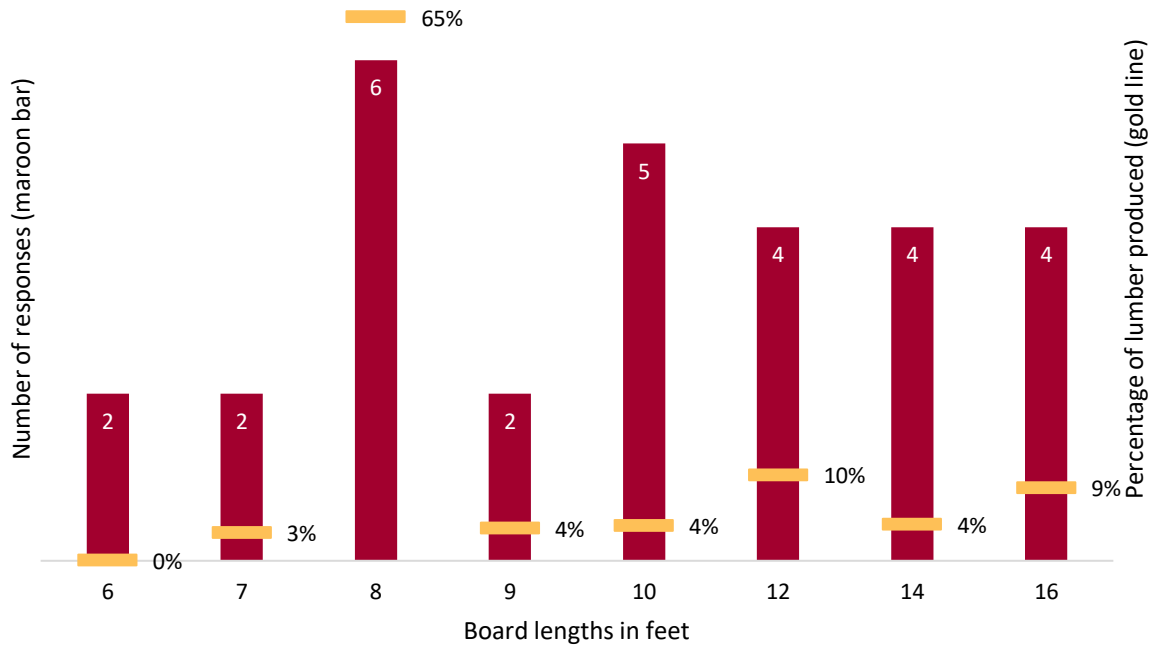
	2 x 4			*2 x 6*			*2 x 8*			
	#1 or better	#2	#3	#1 or better	#2	#3	#1 or better	#2	#3	**Total**
Red Pine	28.5	78.8	17.4	15.6	56.5	13.2	-	12.2	1.3	**223.5**
Jack Pine	10.1	11.7	5.3	4.3	7.0	2.2	-	0.2	0.0	**40.8**
Spruce	13.3	10.3	4.1	4.6	6.7	2.3	-	0.2	0.0	**41.5**
Balsam Fir	-	0.3	0.1	-	0.3	0.1	-	0.0	0.0	**0.7**
Total	**51.9**	**101.1**	**26.8**	**24.5**	**70.5**	**17.7**	**-**	**12.7**	**1.3**	**306.5**

*Totals may not sum due to rounding

SOURCE: BBER SAWMILL SURVEY

Regional sawmills were also asked to provide an estimate of length for the lumber species and grades they reported (e.g. "90% of our 2 x 6 lumber is 8 feet, and 10% is 10 feet"). Figure 10 shows, for each length, the number of mills that reported producing the length shown (maroon bars) and the percentage of the total lumber produced regionally of each length (gold lines). For example, six of the eight mills surveyed produce 8-foot lumber, but because of the large volume produced by those six mills, nearly two-thirds of all lumber produced in the region is 8 feet in length. On the other hand, five of the eight mills surveyed indicated that they produce 10-foot lumber, but only 4% of the total volume of lumber produced locally is cut at that length.

Figure 10. Number of Mills and Percentage of Lumber Produced by Board Length

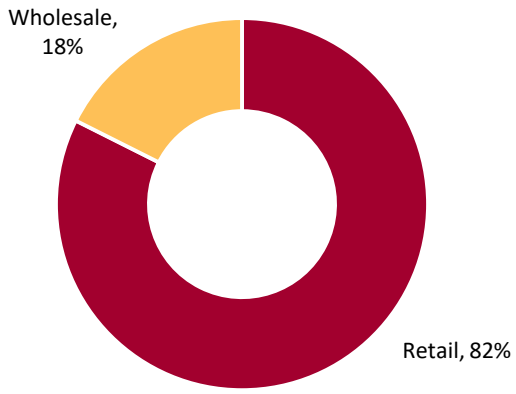


SOURCE: BBER SAWMILL SURVEY

Sawmills were asked to report the amount of lumber produced at their facility that is sold directly to retail or industrial accounts (e.g. Menard's, Home Depot) versus the amount sold to wholesalers. While most respondents reported selling some portion of their lumber to wholesalers – seven of the eight mills reported selling at least 5% – the largest mills tended to sell a greater share to retail accounts. Therefore, of the total volume of lumber suitable for CLT produced within the region, more than 80% is being sold to consumers through retailers (see Figure 11).

The amount of lumber currently being produced by sawmills is not necessarily reflective of the potential availability of lumber in the region. It can be assumed that regional mills might have the ability to produce longer, wider lumber if there was a demand for such a product and the price was competitive.

Figure 11. What percentage of lumber sales sold by your facility fall into the following categories?



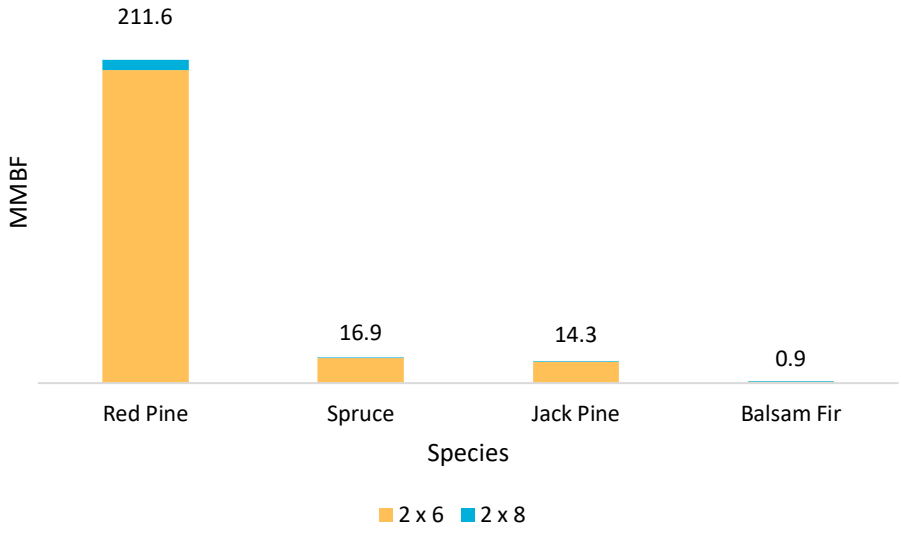
SOURCE: BBER SAWMILL SURVEY

Potential Production

In order to gauge the ability of regional mills to produce CLT-suitable lumber, the survey followed up by asking, "Assuming a profitable market is available and all lumber was sold, what is the maximum production capabilities at your sawmill?" Mills were given the option of 2 x 6 or 2 x 8 lumber only to encourage them to consider their potential ability for those dimensions, assuming there was a preference by CLT producers for wider lumber.

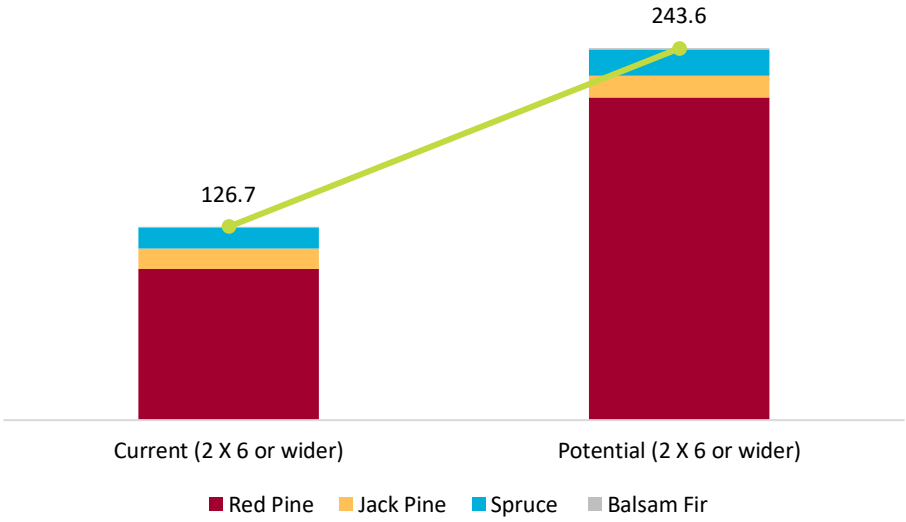
Figure 12 shows the mills' responses to the question. As shown in the figure, if there was a profitable market for softwood lumber in wider dimensions, mills could potentially produce more than 243 MMBF annually, with 211 MMBF of that predicted for red pine 2 x 6 lumber.

Figure 12. Assuming a profitable market is available and all lumber was sold, what is the maximum production capabilities at your sawmill? (2 x 6 or wider)



SOURCE: BBER SAWMILL SURVEY

Figure 13. Potential Increase in Production Capabilities (2 x 6 or wider)



SOURCE: BBER SAWMILL SURVEY

Figure 13 shows more detail regarding the potential increase in ability. The figure shows the mills' current reported production levels of 2 x 6 (or wider) lumber (126.7 MMBF) compared with their reported potential ability (243.6 MMBF). [5] Overall, mills reported a potential ability for 2 x 6 or wider lumber that is nearly double the amount they are currently producing (a 92% increase). While there were small potential increases reported in jack pine, spruce, and balsam fir, the main opportunity for growth is predicted in red pine. Combined, the eight surveyed mills estimated that they could increase production of 2 x 6 red pine lumber by 113 MMBF annually, if there was a profitable demand for that product.

It should be noted that this increase in production refers only to CLT-suitable lumber (softwood lumber in 2 x 6 or wider lumber of the appropriate grades). Some of the reported increase might reflect a movement from one dimension to another (i.e. producing less 2 x 4 lumber and more 2 x 6 lumber). Therefore, it should not be suggested that mills are likely (or able) to double their total production in response to an increase in demand for CLT-suitable lumber. Rather, the findings suggest that regional mills have the capabilities to provide a large volume of lumber that is suitable for CLT manufacturing if the demand and price were right.

More details on the volumes produced in each category can be found in Table 7 on the following page. In addition to the board species and dimensions, the table also shows the volumes produced in each grade (No. 3, No. 2, and No. 1). Also noted is that mills would be unlikely to produce a significant volume of 2 x 8 lumber, even if there was a demand for such a product. Instead, the largest potential volumes would likely be 2 x 6 lumber in grades No. 1 and No. 2, mostly in red pine, but with some small volumes in jack pine and spruce.

[5] Mills' reported production volume for 2 x 6 and 2 x 8 lumber (current and potential) were summed to create the category "2 x 6 or wider"

Table 7. Assuming a profitable market is available and all lumber was sold, what is the maximum production capabilities (MMBF) at your sawmill? (2 X 6 or wider)

Width	*2 x 6*			*2 x 8*			
Grade	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	**Total**
Red Pine	25.7	158.8	20.4	0.8	4.5	1.4	**211.6**
Jack Pine	4.2	6.7	3.1	0.1	0.1	0.1	**14.3**
Spruce	5.5	7.8	3.2	0.1	0.2	0.1	**16.9**
Balsam Fir	0.1	0.4	0.3	-	0.0	0.0	**0.9**
Total	**35.4**	**173.7**	**27.0**	**1.0**	**4.9**	**1.6**	**243.6**

*Total may not sum due to rounding

SOURCE: BBER SAWMILL SURVEY

Sawmills were asked about their facility's value-added manufacturing abilities. Three of the respondents indicated that their mill had re-manufacturing (molding, finger jointing, etc.) capabilities, and one indicated it produces semi-finished products or finished products (beams, millwork, pallets, etc.). These capabilities can be valuable if a mill is considering expanding into CLT production.

Finally, survey respondents were asked, "Would you or someone from your company be interested in receiving further communication and information about the project? (e.g. report results, CLT information)" All respondents indicated that they would be interested in further information, indicating an interest in learning more about the possibility of CLT manufacturing in the region.

Canadian Mills

According to an IBIS market report on Canadian sawmills, 90% of U.S. homes are built with softwood, but, at current mill capacities, U.S. is only able to meet 70% of its own softwood lumber needs. Nearly all of its remaining softwood lumber needs are fulfilled by Canadian exports. (Leach November 2017)

Two Canadian mills (Eacom Timber Corporation in Ear Falls, Ontario, and Resolute Forest Products in Thunder Bay, Ontario) were contacted to provide production level estimates but did not respond to the survey. One of those, Resolute Forest Products (RFP) is a major producer, representing roughly 5% of the Canadian softwood lumber market (Leach November 2017). Primarily a pulp and paper mill, RFP also operates 16 sawmills in Canada that produce construction-grade softwood lumber and has been growing its wood products segment in recent years.

Because Canadian lumber represents such a large portion of the softwood lumber used in the U.S., the BBER gathered data from secondary sources to quantify the volume of lumber coming from Canadian mills. Based on the Government of Canada's trade data for 2017, the BBER estimates that more than 1,200 MMBF of lumber was exported from Canada to Minnesota or Wisconsin, roughly 20% of that which (213 MMBF) came from Ontario (Government of Canada 2018).[6] In fact, Minnesota was Ontario's second largest export market. While not all of the lumber exported from Canada is suitable for CLT production, these statistics highlight the large quantity of softwood lumber that is currently being distributed to Minnesota and/or Wisconsin from Canadian mills. For example, if even a quarter of the lumber coming from Canada to Minnesota and Wisconsin was suitable for CLT, it would mean 300 MMBF of additional supply, roughly equal to what is being produced by regional mills is available in the Lake States

[6] http://www.ic.gc.ca/eic/site/tdo-dcd.nsf/eng/Home?OpenDocument#tag

Distributors

A parallel survey was developed for regional wholesalers, with questions similar to those asked of regional sawmills. Like the sawmill survey, questions asked of wholesalers included their familiarity with cross-laminated timber (CLT) and the amount of lumber the wholesaler distributed in various species, grades, and widths. In addition, wholesalers were asked for their feedback on ideal locations throughout the Midwest to source lumber suitable for CLT production.

The process for collecting data from regional wholesalers was as follows: First, the research team identified all lumber wholesalers in a roughly 200-mile radius from Duluth, Minnesota (Infogroup, Inc. 2019). Identified wholesalers included BlueLinx, Manion's Wholesale, Viking Forest Products, Weekes Forest Products, Grove Wholesale Lumber, Midwest Lumber Inc., and Pine Point Wood Products. Based on feedback from the regional sawmills and other forestry experts, the first four companies were identified as being good candidates for the survey, while it was suggested that the remaining three companies did not likely supply a product suitable for CLT production. Through phone calls and email communication, the research team identified the appropriate person within each organization to complete the survey and sent an electronic copy to each individual via email. In addition to data collected using the survey instrument, some follow-questions were asked of each company representative via email and phone conversations.

In total, data was requested on twelve wholesale facilities: six BlueLinx facilities (Maple Grove, Minneapolis, and Aitkin, Minnesota; and Madison, Schofield and Sparta, Wisconsin), two Manion's Wholesale facilities (Saint Cloud, Minnesota, and Superior, Wisconsin), three Weekes Forest Products facilities (Waukesha and Green Bay, Wisconsin, and Saint Paul, Minnesota), and Viking Forest Products in Eden Praire, Minnesota. We received information on 11 of the 12 locations from four company representatives. Data for the one facility that did not respond was estimated by using information collected on the company from the Reference USA database along with some estimates provided by a representative at the company's sister facility. Throughout this report, the twelve wholesale facilities are collectively referred to as "regional" wholesalers and the lumber they distribute is considered to be distributed "in the Great Lakes region."

It should be noted that two of the surveyed distributors are part of a larger corporate entity with additional locations throughout the country. Headquartered in Atlanta, Georgia, BlueLinx has a vast network of distribution centers located throughout the U.S. Similarly, Weekes Forest Products has eight distribution centers throughout the U.S.

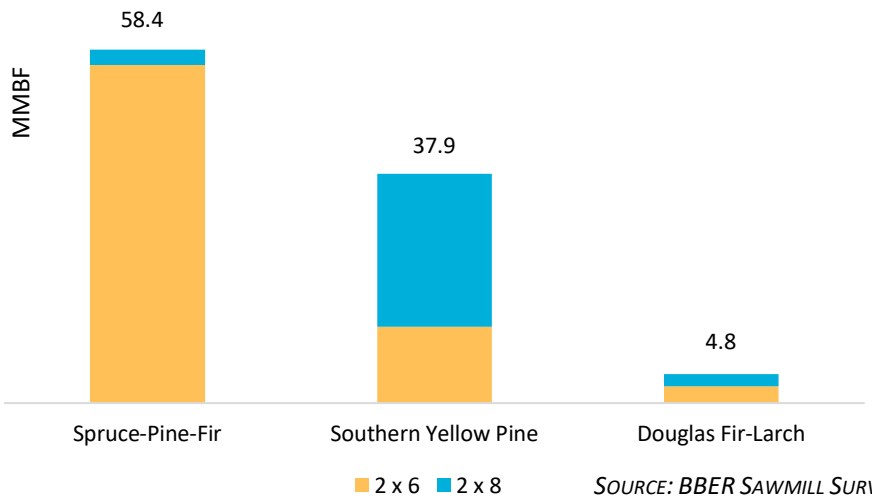
Current Lumber Distribution

As with the sawmill survey, wholesalers were first asked to indicate their familiarity with CLT production. Three of the four respondents indicated that they were familiar with the product, and one responded that they were not. Wholesalers were also asked whether their company distributed visually graded material, MSR material, or both. All four respondents indicated that their companies distributed both types of lumber.

Wholesalers were then asked to estimate the quantity of softwood dimension lumber that they distributed that meets the specifications required for CLT production. Specifically, wholesalers were asked about their volumes of spruce-pine-fir, southern yellow pine, and Douglas fir-larch and how much of each was distributed in grades No. 3, No. 2, and No. 1 (or at the appropriate MSR grades). Finally, since CLT producers prefer wider lumber, the survey asked wholesalers to specify the amount of 2 x 6 and 2 x 8 lumber only.

Results of the survey found that Great Lakes wholesalers distributed roughly 100 million board feet of lumber suitable for CLT or mass timber (see Figure 14). Roughly 60% of that total volume (58.4 MMBF) was spruce-pine-fir, and 37% was southern yellow pine. Only a very small volume of Douglas fir-larch was distributed in the region (4.8 MMBF). Of the spruce-pine-fir distributed regionally, the vast majority was in the form of 2 x 6 lumber, whereas a larger percentage of southern yellow pine was in the form of 2 x 8 lumber.

Figure 14. Lumber Distribution Among Great Lakes Wholesalers



SOURCE: BBER SAWMILL SURVEY

Tables 8 and 9 show more details regarding the volumes distributed in each category.[7] In addition to the board species and dimensions, the tables also show the volumes distributed by grade. Visually graded lumber is shown in Table 8, and MSR lumber is shown in Table 9. According to the wholesalers' responses, it was estimated that roughly 70% of the CLT-appropriate lumber distributed regionally was visually graded, while about 30% was MSR. Of the visually graded lumber, the majority being distributed was 2 x 6 spruce-pine-fir grade No. 2. The most common MSR lumber being distributed in the region was 2 x 6 spruce-pine-fir grade 1,650f. A significant volume of 2 x 8 southern yellow pine grade No. 1 was also distributed regionally.

Table 8. For the most recent year, please estimate your facility's distribution quantity of visually graded lumber (MMBF) for the following species and grades

Width	*2 x 6*			*2 x 8*			
Grade	No. 1	No. 2	No. 3	No. 1	No. 2	No. 3	**Total**
Douglas Fir-Larch	0.1	1.0	-	0.1	1.9	-	**3.1**
Southern Yellow Pine	1.1	4.2	-	11.1	7.1	-	**23.5**
Spruce-Pine-Fir	-	38.3	1.1	0.1	2.5	-	**42.0**
Total	**1.2**	**43.5**	**1.1**	**11.3**	**11.5**	**-**	**68.6**

*Total may not sum due to rounding

SOURCE: BBER DISTRIBUTOR SURVEY

[7] One respondent did not provide specific volumes for its MSR lumber but rather gave a total amount along with some examples of common species, grades, and widths. This information was used, along with information from the MSR Lumber Producers Council and other respondents' totals, to generate an estimate for that distributor.

Table 9. For the most recent year, please estimate your facility's distribution quantity of machine stress rated lumber (MMBF) for the following species and grades

Width	*2 x 6*					*2 x 8*					
Grade (pounds per square inch, psi)	1,650	1,800	2,400	2,700	2,850	1,650	1,800	2,400	2,700	2,850	**Total**
Douglas Fir-Larch	-	1.6	0.1	-	-	-	-	-	-	-	**1.7**
Southern Yellow Pine	-	-	0.2	7.2	-	-	-	4.0	-	3.0	**14.4**
Spruce-Pine-Fir	14.9	-	-	0.5	1.0	-	-	-	-	-	**16.4**
Total	**14.9**	**1.6**	**0.3**	**7.7**	**1.0**	**-**	**-**	**4.0**	**-**	**3.0**	**32.5**

*Total may not sum due to rounding *Source: BBER Distributor Survey*

In the case of spruce-pine-fir, there is a possibility that some of the regional wholesalers may be distributing lumber that was produced locally. While a large majority of the regional sawmills reported selling their product to retailers, the survey results estimated that roughly 18% of the total volume of lumber sold locally was sold to wholesalers. To account for the potential duplication, wholesalers were asked to estimate the percentage of spruce-pine-fir they currently distribute that comes from outside of Minnesota or Wisconsin. On average, the wholesalers reported that 96% of the spruce-pine-fir they distributed comes from outside of the region (mostly Canadian mills and a small portion from the Western U.S.), which suggests that the lumber being reported by sawmills and distributors is not being double-counted.

Potential Distribution

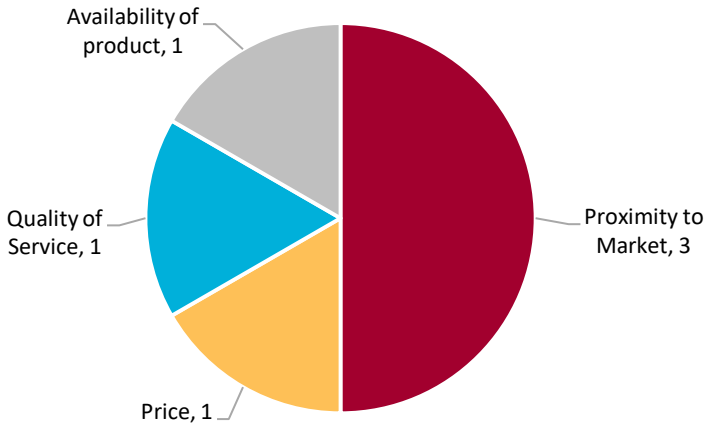
As a follow-up, wholesalers were asked, hypothetically, about their ability to provide a larger volume of lumber if requested. Each representative was asked about the ability to supply roughly double what was reported in the facility's survey response. All but one representative said they would have the ability to do so. Based on the representatives' responses, it appears that regional wholesalers could supply more than 200 MMBF in lumber if there was a demand for the product. And two of the representatives stated they could supply "any reasonable demand," suggesting that the actual amount available is likely even higher than 200 MMBF.

There also appears to be a potentially large volume of lumber that is being sold to regional secondary wood products manufacturers directly from large Canadian and western U.S. mills. The BBER research team asked the wholesale representatives whether most large customers (e.g. truss manufacturers, window and door manufacturers) buy primarily wholesale materials or directly from sawmills. The representatives stated that while some large manufacturers may buy wholesale due to lack of rail access and others buy a combination of mill-direct and wholesale lumber, the majority of large customers who buy MSR lumber buy directly from sawmills, most commonly Canadian mills.

Finally, wholesalers were asked, "In mass timber manufacturing, longer, wider lumber of higher grade is preferred. Given that, which city do you think would be the most competitive to source this lumber to the Midwest?" Choices given included Minneapolis, Chicago, Detroit, and Kansas City, as well as an option to name some other Midwest city. All of the distributors who responded to the question (n=3) selected

Minneapolis. Wholesalers were then asked, "What are the main reasons this city would be a good location to source this material?" They were allowed to select multiple options, including price, proximity to supplier, proximity to market, availability of product, quality of product, and quality of service. The reasons most commonly selected included proximity to market (3 respondents), price (n=1), quality of service (n=1), and availability of product (n=1), as shown in Figure 15.

Figure 15. What are the main reasons this city would be a good location to source this material?



SOURCE: BBER SAWMILL SURVEY

It should be noted that respondents were primarily located in Minnesota and/or Wisconsin, so their response to this question would likely be biased toward cities in Minnesota or Wisconsin, Minneapolis being the only such city included in the survey options. However, according to the Bureau of Transportation Statistics,[8] Minnesota has a well-developed transportation infrastructure, with nine major airports, four major water ports, 4,450 miles of freight railroad, and 260 miles of waterway. In addition, the state moved nearly $500 billion in freight in 2013, up 8% from 2007 (U.S. Department of Transportation 2016). This suggests that, while the respondents may have a preference for Minneapolis in part due to their familiarity with the area, it is, in fact, a competitive location because of its existing infrastructure.

Conclusions

- Surveys identified 300 MMBF of lumber currently being produced by sawmills within a roughly 250-mile radius of Duluth-Superior and another 100 MMBF being distributed by regional wholesalers.
- Roughly 125 MMBF of the SPFs lumber currently being produced by regional sawmills was suitable for CLT production (No. 3 or better, 2 x 6 or wider)
- A large portion of the SPFs lumber being produced by regional sawmills was in 2 x 4 dimensions, but mills report the capability to produce nearly 250 MMBF in 2 x 6 or wider lumber in grades No. 3 or better if there was a demand for such a product.
- When asked about a hypothetical volume of lumber roughly double their current distribution levels, regional wholesalers stated they would have no difficulties sourcing that amount if there was demand.
- In 2017, Minnesota and Wisconsin imported a combined 1,200 MMBF of lumber from Canadian producers. Not all of that was suitable for CLT production, but the large overall volume suggests that there is likely more CLT-suitable material available across the border.

[8] https://www.bts.gov/content/state-transportation-numbers

- Red pine was the dominant softwood species being produced by regional sawmills, and spruce-pine-fir was the most common species group being distributed in the region.
- Wholesalers overwhelmingly considered Minneapolis to be the most competitive Midwest city to source lumber suitable for CLT production, due mostly to its proximity to market.

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Chapter III. Economic Impact Analysis

This chapter estimates the potential economic impacts from a new cross-laminated timber (CLT) manufacturing firm or group of firms on the state of Minnesota and the seven-county Arrowhead region. The chapter describes the inputs used in modeling and provides results of three scenarios, representing a range of potential economic impacts.

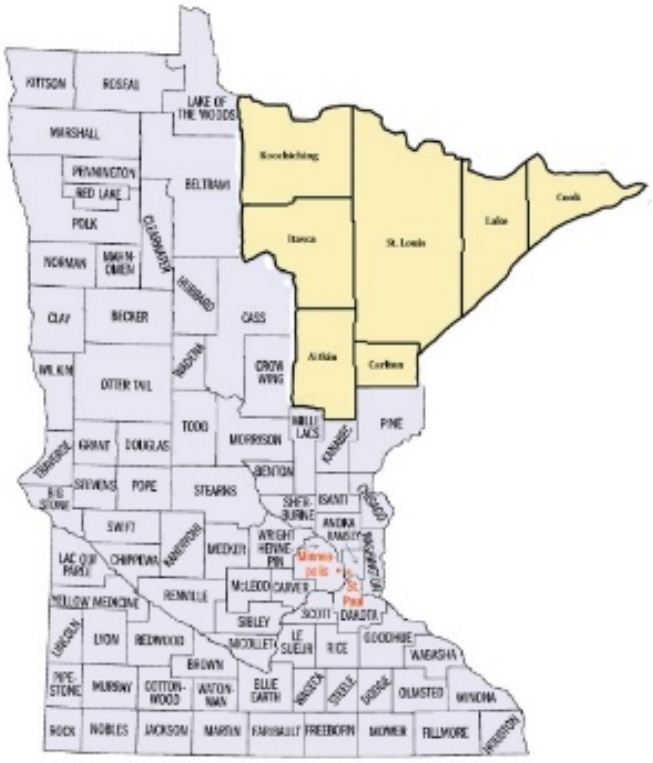
The BBER used the IMPLAN software version 3.1 to estimate economic impacts.[9] All scenarios were modeled using the most recent data available, which was for the year 2017. All results are shown in 2019 dollars.

Study Area

Two study areas were used for the economic impact analysis: the state of Minnesota and the seven-county Arrowhead region (Figure 16). The region consists of the following Minnesota counties: Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, and St. Louis. Both study areas were included so that policy makers might consider the potential impacts on either area, regardless of whether a firm is located in the Arrowhead region or elsewhere in the state.

The figures on the following pages provide insight on the regional economies of the two study areas as context for the results of the report.

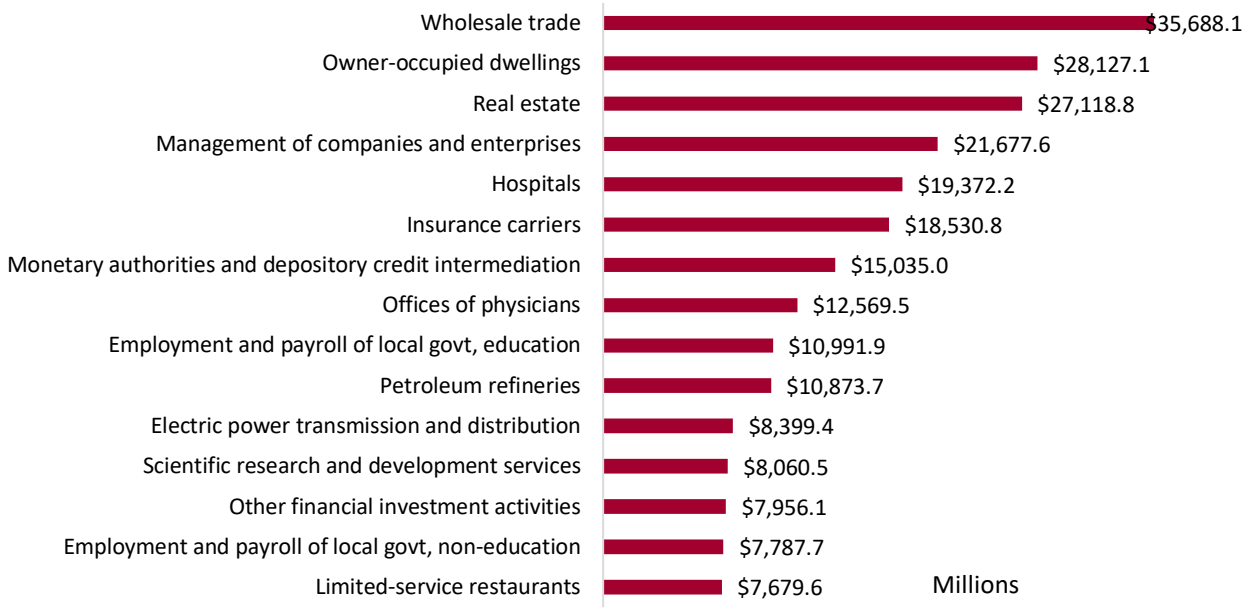
Figure 16. State of Minnesota and Arrowhead Region



SOURCE: WIKIPEDIA, BBER

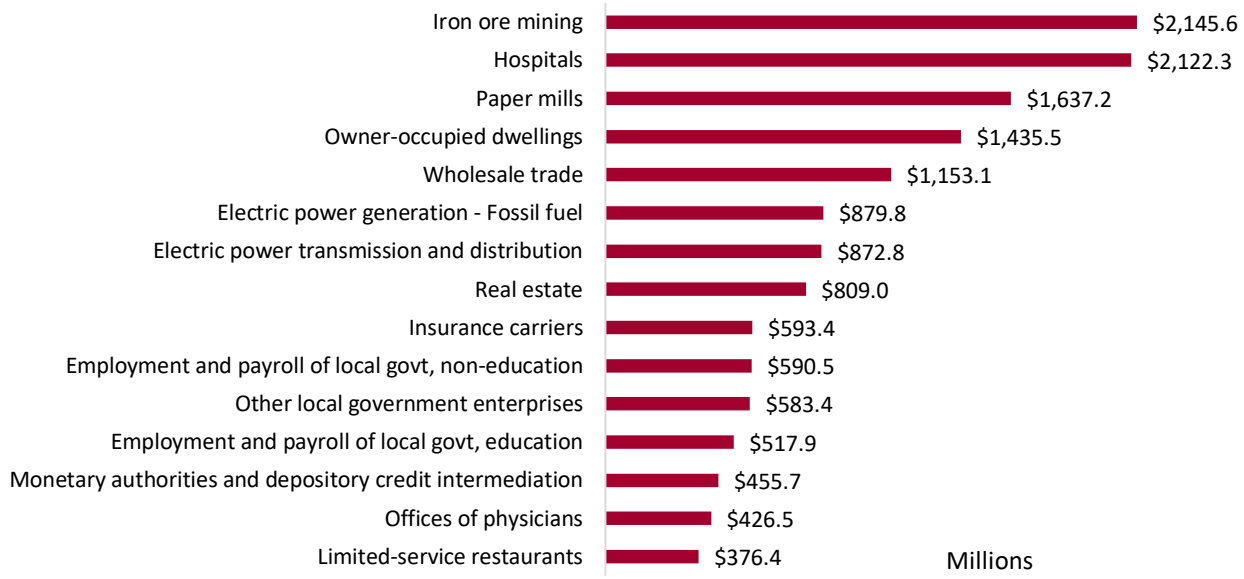
[9] For more information on data sources and assumptions relevant to economic impact modeling and the IMPLAN database, see Appendix E.

Figure 17. Top 15 Industries by Contribution to GDP (in Millions of Dollars), Minnesota, 2017



SOURCE: IMPLAN

Figure 18. Top 15 Industries by Contribution to GDP (in Millions of Dollars), Arrowhead Region, 2017



SOURCE: IMPLAN

Figures 17 and 18 show the top 15 industries[10] for each of the two study areas, as measured by contribution to GDP or value added. The 15 industries with the largest contributions to Minnesota's GDP are shown in Figure 17. These include wholesale trade, owner-occupied dwellings,[11] real estate, and management of companies and enterprises. The Arrowhead region's top industries can be seen in Figure 18. Iron ore mining, hospitals, and paper mills were the three largest contributors to the region's GDP in 2017.

It is interesting to note the similarities and differences between the two regions. In both areas, wholesale trade, real estate, hospitals, and insurance carriers are among the top industries. By contrast, Minnesota's economy depends more heavily on management of companies and enterprises, scientific research and development services, and petroleum refineries, while the Arrowhead region's economy depends more heavily on iron ore mining, paper mills, and electric power generation.

Later, in Results, the report will show which industries would be most impacted by a potential CLT manufacturing firm and will compare those industries with the top 15 shown in Figures 17 and 18.

Inputs

The BBER modeled three scenarios representing various sizes of CLT manufacturing firms. Inputs required for modeling included estimates of employment, wages, local purchases, and annual revenue. Data were collected from current CLT manufacturers, relevant literature, and the Reference USA database. When data was not available from secondary sources, the research team relied on IMPLAN data as inputs.

In 2018, there were six mass timber factories in production in the United States: International Beams (AL), Sterling Lumber (IL), Smartlam (MT), D.R. Johnson (OR), Freres (OR), and Euclid (UT).[12] These firms range in size from 20 (Euclid) to 400 employees (Freres).[13] However, some of the largest firms are classified primarily in industries such as logging and sawmilling. Of the firms that product CLT, Sterling Lumber is the largest at 100. While they produce industrial CLT and no architectural CLT, it offers a reasonable number of jobs for a large producer. These estimates were used to provide a reasonable range of firm sizes to use for the three scenarios.

Table 10. Scenario Inputs, Typical Year of Operations

	Number of employees	*Payroll and Benefits*	*Industry Sales*
Scenario I - Small CLT manufacturing firm	20	$1.1	$4.7
Scenario II - Mid-sized CLT manufacturing firm	50	$2.9	$11.7
Scenario III - Large firm or cluster of firms	100	$5.9	$23.3

SOURCE: IMPLAN, REFERENCE USA

Table 10 shows the estimated number of employees, payroll and benefits, and industry sales for the three scenarios used in modeling. Scenario I represents a small CLT manufacturing firm with 20 employees and roughly $4.7 million in annual sales. Scenario II represents a mid-sized firm with 50 employees and approximately $11.7 million in sales. Scenario III represents a large firm, or cluster of firms, with 100

[10] The study used IMPLAN's sectoring scheme, which includes 550 industries

[11] The industry, owner-occupied dwellings, includes imputed rental activity by homeowners. In this case, market rents are used to estimate the value to the property owner.

[12] Wood Innovations. 2018. Changing How America Builds: Mass Timber Momentum 2014-2018. United States Forest Service.

[13] Reference USA, 2019

employees and $23.3 million in sales. Industry sales and payroll estimates are based on IMPLAN's employee-to-sales ratios for the engineered wood products and truss manufacturing industry, an industry that includes CLT manufacturing.

Table 11. CLT Manufacturing Annual Expenditures

Sector	*Industry Title*	*Percentage*
3134	Dimension lumber	30.0%
5001	Employee compensation	23.1%
3166	Plastics materials and resins	8.9%
3461	Management of companies and enterprises	6.7%
3156	Refined petroleum products	5.1%
3118	Coated fabric coating	3.7%
3049	Electricity transmission and distribution	3.3%
3395	Wholesale trade distribution services	2.9%
3236	Hand tools	2.2%
3411	Truck transportation services	1.5%
3050	Natural gas distribution	1.3%
3178	Adhesives	1.1%
3177	Paints and coatings	0.9%

*Total will not sum to 100% as proprietor income, taxes, and other property type income are not included

SOURCE: OREGON BEST (2017), BRASHAW (2018), IMPLAN (2019)

Table 11 shows a list of annual expenditures typical of a CLT manufacturing firm. This list was taken from the 2017 Oregon BEST study and modified slightly based on feedback from interviews with existing CLT manufacturers.[14] The value in the final column represents the percentage of the firm's annual operating budget that was spent on each item.

As shown in the table, a typical CLT firm spends the largest percentage of its annual operating budget on dimension lumber, followed by employee compensation. Other expenses include plastics materials and resins, management of companies and enterprises, and petroleum products.

Results

Economic impact analysis tracks an initial economic shock or activity (like the direct spending of an operating CLT firm) through multiple rounds of industry and consumer spending to show the multiplier or ripple effects through a local economy. The initial shock or activity is considered the direct effect, the resulting increase in industry spending is the indirect effect, and the resulting increase in consumer spending is the induced effect.

This section summarizes the economic impacts for an operational CLT firm, based on spending from a typical year of operations. Results are shown for three scenarios that represent a possible range of economic impacts. The first scenario represents a small firm with 20 employees. The second represents a mid-sized firm with 50 employees, and the third scenario represents a large firm or cluster of firms employing 100 workers. Impacts of the three scenarios are shown for the state of Minnesota (Table 12) and for the Arrowhead region

[14] The percentage of spending on dimension lumber (23% in the Oregon BEST report) was increased to 30% for this study based on conversations with current CLT producers.

(Table 13). For ease of interpretation, only total effects are presented.[15] All results are shown in millions of dollars for the year 2019.

Table 12. Total Economic Impacts for CLT Manufacturing Firm, in Millions, State of Minnesota

	Employment	*Labor Income*	*Value Added*	*Output*
Scenario I	38	$2.5	$3.3	$8.2
Scenario II	95	$6.2	$8.2	$20.3
Scenario III	190	$12.4	$16.4	$40.6
Multiplier	1.9	1.9	2.3	1.7

SOURCE: IMPLAN

The first column of Table 12, labeled employment, estimates the number of jobs that an operational CLT firm could support directly and through indirect and induced effects throughout the state. Employment estimates are in terms of jobs, not in terms of full-time equivalent employees. In the state of Minnesota, it is estimated that a small CLT firm could create 38 jobs (Scenario I), while a large firm could create nearly 200 jobs statewide. The proposed firm has an employment multiplier of 1.9, meaning that for every job created directly in CLT manufacturing, another 0.9 jobs would be created through induced and indirect effects in related industries.

The second column, labeled labor income, shows all employee compensation, including wages, benefits, and proprietor income. This also includes labor income of workers employed by the CLT firm as well as those employed in related industries. Total effects for the three scenarios range from $2.5 million to $12.4 million in additional labor income, depending on the firm size. The labor income multiplier is also 1.9, suggesting that for every dollar in labor income paid to a CLT employee, another $0.90 is created elsewhere in the state.

The third column, value added, represents spending that goes specifically towards wages, rents, interest, and profits in the study area. It can be thought of as the difference between revenue and the cost of inputs. It is estimated that for the state of Minnesota, the impacts of a CLT firm could range from $3.3 million to $16.4 million in new value added spending depending on the firm size. The value added multiplier for a CLT firm is 2.3. This means that for every dollar contribution to the state's GDP by a CLT firm, another $1.30 is added by other industries.

Output, the last column in the table, is the total value of all local production required to sustain activities. The total output of a CLT firm could range from $8.2 million to $40.6 million a year throughout the state of Minnesota, depending on the size of the firm. The output multiplier for a CLT firm is 1.7.

Table 13. Total Economic Impacts for CLT Manufacturing Firm, in Millions, Arrowhead Region

	Employment	*Labor Income*	*Value Added*	*Output*
Scenario I	33	$1.9	$2.4	$6.8
Scenario II	82	$4.7	$6.0	$16.8
Scenario III	163	$9.5	$12.0	$33.6
Multiplier	1.6	1.4	1.7	1.4

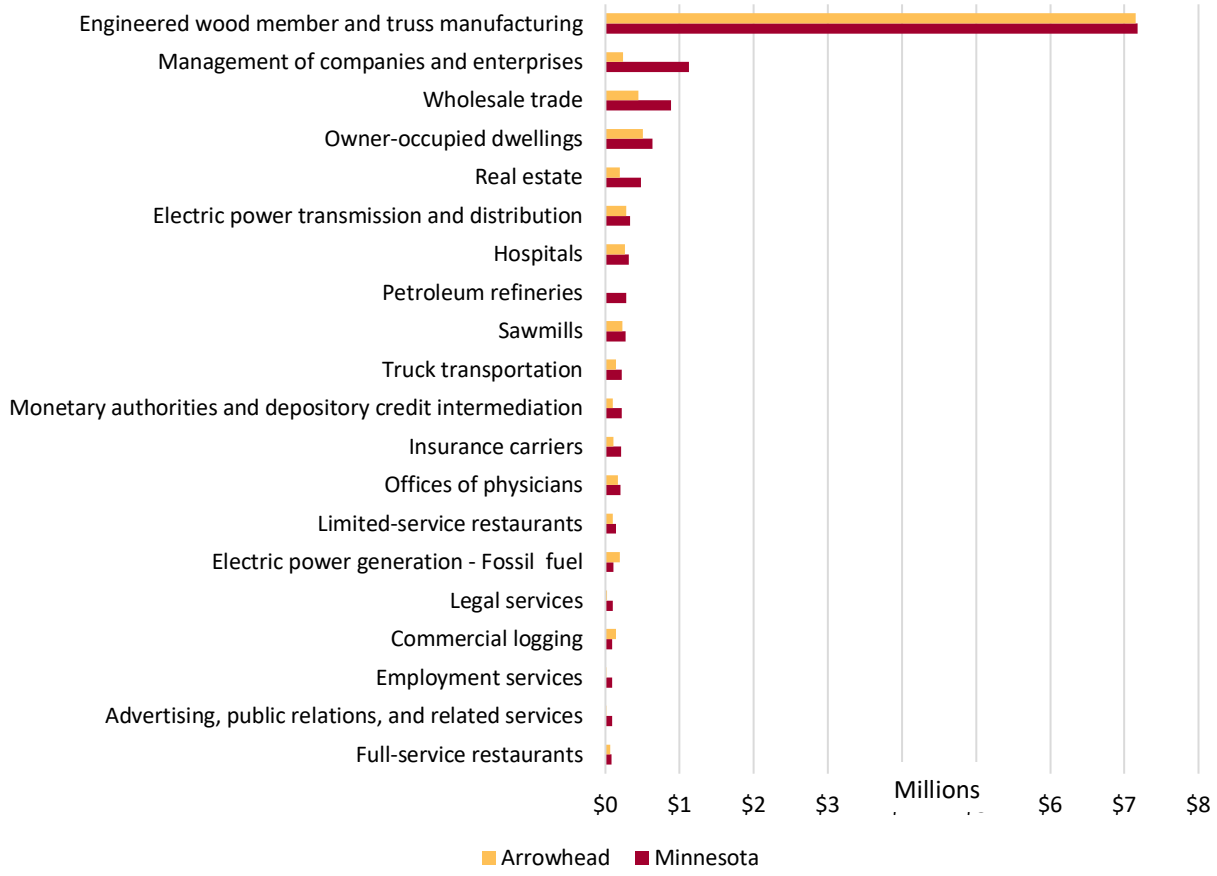
SOURCE: IMPLAN

Results in Table 13 show the total effects of the three scenarios for the Arrowhead region. Economic impacts

[15] For detailed results of modeling, including direct, indirect, and induced effects for all three scenarios, see Appendix F.

for the Arrowhead region are smaller than those for the state of Minnesota due to the smaller study area, but the results are significant nonetheless. A small CLT firm (i.e. 20 employees) located in the Arrowhead region could add $6.8 million in output, $2.4 million in value added, $1.9 million in labor income, and 33 workers to the region's economy. A large firm (i.e. 100 employees) could add more than $33 million in output, $12 million in value added spending, $9.5 million in labor income, and 163 jobs to the region's economy. In the Arrowhead region, the proposed CLT firm has an employment multiplier of 1.6, meaning that for every job created directly, another 0.6 jobs are created elsewhere in the seven-county region as a result.

Figure 19. Top Twenty Industries Impacted by CLT Firm (Scenario III), by Contribution to Value Added



SOURCE: IMPLAN

Figure 19 shows the top twenty industries impacted by the operation of a CLT firm for both study areas. Values shown are the total increase in value added to each industry as a result of a new CLT manufacturing firm. The industry most significantly impacted by the creation of a new CLT firm would be engineered wood member and truss manufacturing—the industry that includes CLT manufacturing. The impacts to that industry include the direct effects of the firm, which is why they are so much larger than the other industries shown. All of the other industries in the figure would be impacted through indirect or induced effects. Of these, management of companies and enterprise, wholesale trade, owner-occupied dwellings, and real estate are those most likely to benefit.

It is interesting to compare these findings with the top industries for each of the two study areas, as shown in Figures 17 and 18 (page 33). Many of the same industries appear in each of the three figures, including real estate, electric power transmission and distribution, and hospitals. However, there are some smaller industries that could significantly benefit from the addition of a CLT manufacturing firm somewhere in the Arrowhead region or the state. For example, sawmill, truck transportation, and commercial logging industries are not among the top 15 largest industries in either study area (Figures 17 and 18), but they would see significant economic benefits as a result of CLT manufacturing (Figure 19).

Conclusions

- Three scenarios were modeled and represent a range of firm sizes. Scenario I represents a small CLT manufacturing firm with 20 employees and roughly $4.7 million in annual sales. Scenario II represents a mid-sized firm with 50 employees and approximately $11.7 million in sales. Scenario III represents a large firm, or cluster of firms, with 100 employees and $23.3 million in sales.
- The largest annual expenditures for a CLT firm include dimension lumber, employee compensation, plastics materials and resins, and management of companies and enterprises.
- Results of modeling found that a small CLT firm with roughly 20 employees could contribute roughly $8.2 million in output, $3.3 million in value added, and $2.5 million in labor income to the state's economy. A large firm (100 employees) could have impacts of more than $40 million in output, $16.4 million in value added spending, and $12.4 million in labor income.
- Overall employment impacts for the three scenarios could range from 38 jobs statewide (for a small firm) to 190 jobs statewide (for a large firm). These jobs include the workers directly employed by a potential CLT firm as well as workers employed in other related industries.
- Impacts for the Arrowhead region would be smaller, yet significant, than those for the state of Minnesota. A small CLT firm (i.e. 20 employees) located in the Arrowhead region could add $6.8 million in output, $2.4 million in value added, $1.9 million in labor income, and 33 workers to the region's economy, while a large firm (i.e. 100 employees) could add more than $33 million in output, $12 million in value added, $9.5 million in labor income, and 163 workers to the region's economy.
- Industries that would be impacted the most by a CLT firm include engineered wood member and truss manufacturing (the industry that includes CLT manufacturing), management of companies and enterprises, and wholesale trade.
- While the sawmill, truck transportation, and commercial logging industries are not among the top 15 largest industries in either study area, they would see significant benefits as a result of CLT manufacturing.

Appendix A. Definitions Used in this Report

Board foot: A common wood measurement for a piece of lumber that is 12 inches wide, 12 inches long, and 1 inch thick (12 x 12 x 1); mainly for estimation purposes.

Carbon footprint: The amount of carbon dioxide and other carbon compounds emitted due to the consumption of fossil fuels by a particular person, group, etc.

Cross-laminated timber (CLT): A large-scale, prefabricated, engineered wood panel. A CLT panel is made up of several layers (typically three, five, or seven) of dimension lumber stacked in alternating directions, bonded with structural adhesives, and pressed to form a solid, rectangular panel.

CLT-suitable lumber: Lumber that meets CLT species, dimension, grade, and manufacturing specifications

Dimensional lumber: A type of lumber that is cut to specified industry-standard dimensions (e.g. 2 x 4, 2 x 6).

Direct effect: Initial new spending in the study area resulting from the project.

Dowel-laminated timber (DLT): A mass timber panel which can be used for floor, wall, and roof structures. In many ways, it is similar to Nail Laminated Timber (NLT), but utilizes dowels rather than nails to secure lumber, making it a 100% wood product.

Economic impact: The effect of an event on the economy in a specified area, ranging from a single neighborhood to the entire globe. It usually is measured by changes in business revenue, business profits, personal wages, and/or jobs.

Employment: Estimates (from U.S. Department of Commerce secondary data) are in terms of jobs, not in terms of full-time equivalent employees. Therefore, these jobs may be temporary, part-time, or short-term.

Engineered wood products: Also called composite wood, man-made wood, or manufactured board, these products are manufactured by binding or fixing the strands, particles, fibres, or veneers or boards of wood, together with adhesives, or other methods of fixation to form composite materials.

Glue-laminated timber (GLT): Glued laminated timber, also called glulam, is a type of structural engineered wood product comprising a number of layers of dimensional lumber bonded together with durable, moisture-resistant structural adhesives. In North America, the material providing the laminations is termed laminating stock or lamstock.

Indirect effect: The additional inter-industry spending from the direct impact. For example, increased sales in linen supply firms resulting from more motel sales would be an indirect effect of visitor spending.

Induced effect: The impact of additional household expenditures resulting from the direct and indirect impact. For example, motel employees spend the income they earn from increased tourism on housing, utilities, groceries, and other consumer goods.

Labor income: All forms of employment income, including employee compensation (wages and benefits) and proprietor income.

Leadership in Energy and Environmental Design (LEED): An ecology-oriented building certification program that is run under the auspices of the U.S. Green Building Council (USGBC).

Machine grading: A system used to determine relative strength and stiffness of lumber using mechanical tests.

Machine stress rated lumber (MSR): Lumber that is evaluated using machine stress rating equipment.

Margins: The value of wholesale and retail trade services provided in delivering commodities from producers' establishments to purchasers. Margin is calculated as sales receipts less the cost of the goods sold. It consists of the trade margin plus sales taxes and excise taxes that are collected by the trade establishment. (BEA)

Mass timber: A type of framing style characterized by the use of large-scale engineered wood panels (such as CLT) for floor, wall, and roof construction.

Modular construction: a process in which a building is constructed off-site, under controlled plant conditions, using the same materials and designing to the same codes and standards as conventionally built facilities.

Multipliers: Total production requirements within the study area for every unit of production sold to final demand. Total production will vary depending on whether induced effects are included and the method of inclusion. Multipliers may be constructed for output, employment, and every component of value added.

Nail-laminated timber (NLT): An engineered wood product created from stacking dimension lumber and fastening it together with nails. NLT, formerly known as heavy timber or mill decking, is the oldest form of mass timber.

Output: The value of local production required to sustain activities.

Prefabricated buildings: A building that is manufactured and constructed using prefabrication. It consists of factory-made components or units that are transported and assembled on-site to form the complete building.

Retail/Industrial Accounts: Accounts that require large amounts of lumber for retail (Home Depot, Menards, etc.) or industrial (construction) purposes.

Stick framing: A traditional construction method in which roofs, floor trusses and all framing is created on site from individual pieces of lumber, as opposed to using pre-engineered wood products.

Softwood lumber: Lumber that comes from the open-grained wood of coniferous trees (pine, spruce, etc.).

Structural Composite Lumber (SCL): A family of engineered wood products created by layering dried and graded wood veneers, strands or flakes with moisture resistant adhesive into blocks of material known as billets, which are subsequently resawn into specified sizes.

T3: Short for "Timber, Technology, Transit," T3 is a seven-story, 220,000-square-foot structure in downtown Minneapolis. At the time of its completion (2016), it was the largest mass timber building in the United States.

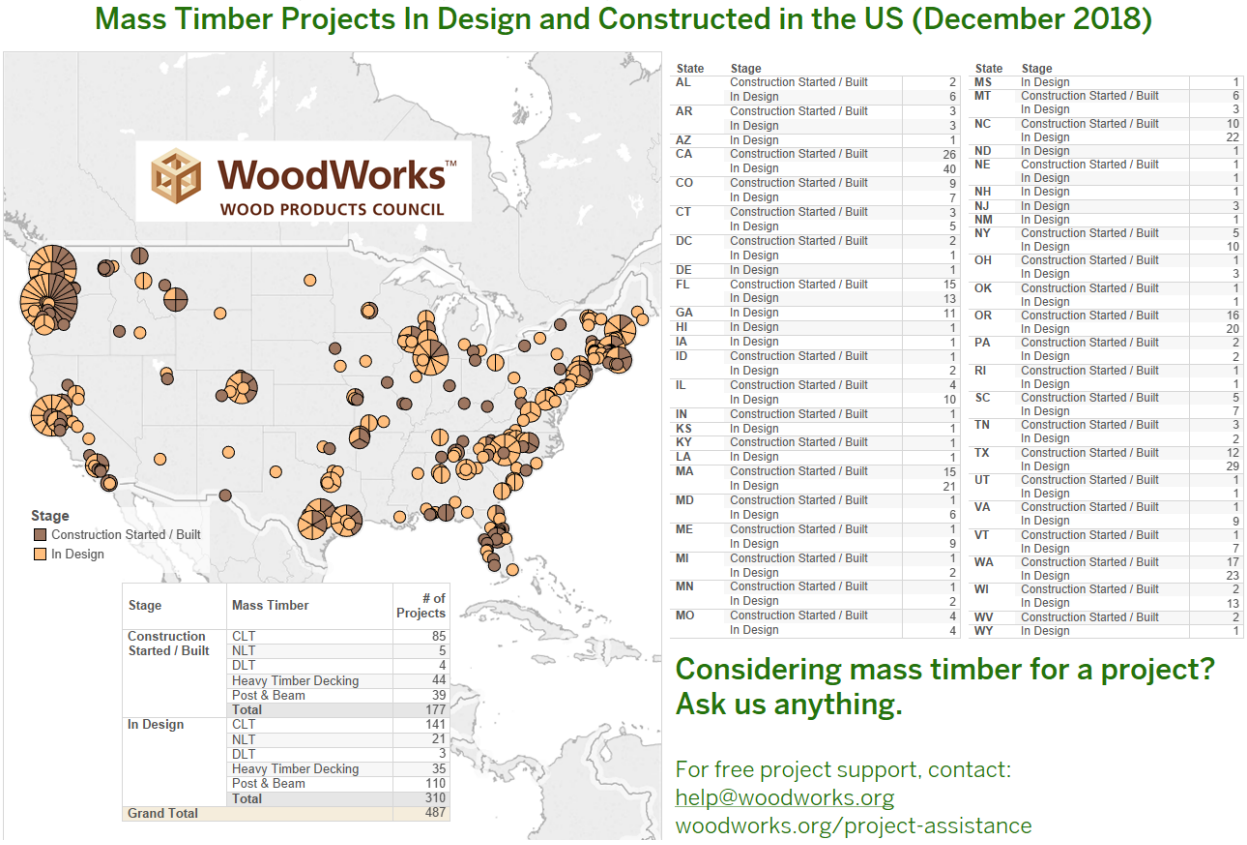
Value added: A measure of the impacting industry's contribution to the local community. It includes wages, rents, interest, and profits.

Visually grading: A system used to determine the relative strength and stiffness of lumber based on visual characteristics (knot size, slope of grain, etc.) of each piece.

Wood connectors: Components that attach one part of a building element to another. In the case of mass timber, the most common connectors are nails, dowels, and adhesives.

Appendix B. WoodWorks

Figure 20. Completed and Proposed Mass Timber Projects, U.S.



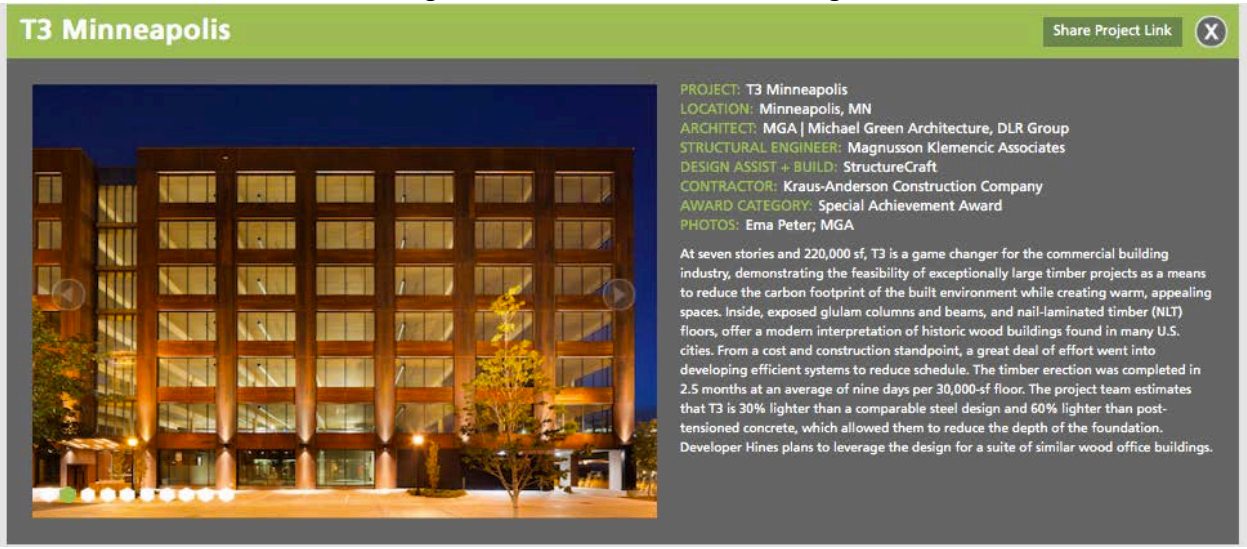
Stage	Mass Timber	# of Projects
Construction Started / Built	CLT	85
	NLT	5
	DLT	4
	Heavy Timber Decking	44
	Post & Beam	39
	Total	177
In Design	CLT	141
	NLT	21
	DLT	3
	Heavy Timber Decking	35
	Post & Beam	110
	Total	310
Grand Total		487

State	Stage	
AL	Construction Started / Built	2
	In Design	6
AR	Construction Started / Built	3
	In Design	3
AZ	In Design	1
CA	Construction Started / Built	26
	In Design	40
CO	Construction Started / Built	9
	In Design	7
CT	Construction Started / Built	3
	In Design	5
DC	Construction Started / Built	2
	In Design	1
DE	In Design	1
FL	Construction Started / Built	15
	In Design	13
GA	In Design	11
HI	In Design	1
IA	In Design	1
ID	Construction Started / Built	1
	In Design	2
IL	Construction Started / Built	4
	In Design	10
IN	Construction Started / Built	1
KS	In Design	1
KY	Construction Started / Built	1
LA	In Design	1
MA	Construction Started / Built	15
	In Design	21
MD	Construction Started / Built	1
	In Design	6
ME	Construction Started / Built	1
	In Design	9
MI	Construction Started / Built	1
	In Design	2
MN	Construction Started / Built	1
	In Design	2
MO	Construction Started / Built	4
	In Design	4

State	Stage	
MS	In Design	1
MT	Construction Started / Built	6
	In Design	3
NC	Construction Started / Built	10
	In Design	22
ND	In Design	1
NE	Construction Started / Built	1
	In Design	1
NH	In Design	1
NJ	In Design	3
NM	In Design	1
NY	Construction Started / Built	5
	In Design	10
OH	Construction Started / Built	1
	In Design	3
OK	Construction Started / Built	1
	In Design	1
OR	Construction Started / Built	16
	In Design	20
PA	Construction Started / Built	2
	In Design	2
RI	Construction Started / Built	1
	In Design	1
SC	Construction Started / Built	5
	In Design	7
TN	Construction Started / Built	3
	In Design	2
TX	Construction Started / Built	12
	In Design	29
UT	Construction Started / Built	1
	In Design	1
VA	Construction Started / Built	1
	In Design	9
VT	Construction Started / Built	1
	In Design	7
WA	Construction Started / Built	17
	In Design	23
WI	Construction Started / Built	2
	In Design	13
WV	Construction Started / Built	2
WY	In Design	1

SOURCE: (WOODWORKS 2018)

Figure 21. Characteristics of T3 Building



Source: (WoodWorks n.d.)

Appendix C. Housing Market Statistics

Housing Market Statistics: Nation, Midwest Region, and Minnesota Metropolitan Statistical Areas

Delton Alderman, Research Forest Products Technologist
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Summary

Housing market data has been collected and analyzed in support of a mass timber market development project for Minnesota. This overview of housing data is provided for the U.S, the Midwest Region and Minnesota Metropolitan Statistical Areas. The Midwest standard census region includes Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Further definitions for housing statistics are included in the glossary at the end of this report.

In 2017, there were an estimated 121,200,000 primary residences in the United States. The Midwest region was reported to have 26,687,000 units (United States Census Bureau-American Housing Survey, 2018a). The United States Energy Information Administration (2018) estimates there were 5,557,000 commercial buildings in the United States in 2016 and 1,237,000 were located in the Midwest region. Additionally, nearly 55 percent of Midwestern buildings were built before 1990 and 63 percent were one-story structures. The United States Census estimated $6,207 million dollars were spent on residential structures and $519 million were expended in the Midwest in 2017. In the same year, non-residential building expenditures were estimated at $624,135 million for the U.S. and $112,658 million were spent in the Midwest (United States Census-Construction Spending, 2018b).

This report includes building data for the Midwest; the state of Minnesota; and Metropolitan Statistical Areas for Minnesota and the United States. Included are residential housing data: single-family, multi-family, commercial real estate, and expenditures. Lastly, forecasts for residential and commercial real estate are presented.

New Housing Building Permits

National, Regional and State

Building permits are used as a leading economic indicator and permit data is used in the computation of The Conference Board's United States (U.S.) Leading Economic Index. Permits are considered as forward-looking and are valued as a good gauge for future housing supply levels that also may be utilized to identify pivot points in business cycles.

U.S. and Midwest (MW) housing permits issued have improved in the past few years as presented in Tables 1 and 2. In both instances, permit issuance does not approach levels recorded in the early 2000's. Single-Family (SF) housing remains about 50 percent less than the U.S. 2005 peak and 40 percent fewer than the 2004 high in the MW. SF housing construction generally consumes more softwood, hardwood, and wood composite products than any other type of building construction. According to results obtained from the National Association of Homebuilders (NAHB) National Impact of Home Building model analysis, constructing 1,000 average single-family homes generates 2,975 jobs and $111.0 million in taxes and fees for all levels of government (NAHB, 2016a).

Total multi-family (MF) housing is about 61 percent less than the U.S. 1972 peak and 68 percent less in the MW (1972). MF housing construction typically consumes less wood products than in SF construction.

Table 1. U.S. housing permits: 2000 to 2018.

	Total permits	Single-Family permits	2-4 Multi-Family unit permits	≥ 5 Multi-Family unit permits
2018: YTD[1]	1,313,000	857,000	38,000	417,000
2017	1,282,000	820,000	37,000	425,000
2016	1,207,000	751,000	35,000	421,000
2015	1,183,000	696,000	32,000	455,000
2014	1,052,000	640,000	30,000	382,000
2013	991,000	621,000	29,000	341,000
2012	830,000	519,000	26,000	285,000
2011	624,000	418,000	22,000	184,000
2010	605,000	447,000	22,000	135,000
2009	583,000	441,000	21,000	121,000
2008	905,000	576,000	34,000	295,000
2007	1,398,000	980,000	60,000	359,000
2006	1,839,000	1,378,000	77,000	384,000
2005	2,155,000	1,682,000	84,000	389,000
2004	2,070,000	1,613,000	90,000	366,000
2003	1,889,000	1,461,000	83,000	346,000
2002	1,748,000	1,333,000	74,000	341,000
2001	1,637,000	1,236,000	66,000	335,000
2000	1,592,000	1,198,000	65,000	329,000

Notes: [1] YTD; mean of January through September data.
Source: U.S. Census-Construction.

In the five or more unit MF segment, permits far exceed those reported in the early 2000's. The aforementioned improvement in the five or more unit MF segment is not readily observed in Table 2; as Census does not provide this level of segmentation. The construction of 1,000 average MF rental apartments generates 1,133 jobs and $42.4 million in taxes (NAHB, 2016b).

Table 2. MW[1] housing permits: 2000 to 2018.

	Total permits	Single-Family permits	Two Multi-Family unit permits or more
2018: YTD[2]	186,000	121,000	65,000
2017	195,000	121,000	74,000
2016	186,000	112,000	74,000
2015	171,000	105,000	66,000
2014	165,000	101,000	64,000
2013	157,000	102,000	55,000
2012	133,000	87,000	46,000
2011	103,000	71,000	32,000
2010	104,000	75,000	28,000
2009	100,000	75,000	25,000
2008	138,000	93,000	45,000
2007	212,000	154,000	58,000
2006	279,000	209,000	70,000
2005	354,000	279,000	75,000
2004	370,000	296,000	75,000
2003	371,000	287,000	84,000
2002	352,000	263,000	89,000
2001	334,000	253,000	81,000
2000	324,000	245,000	78,000

Notes: [1] MW (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin);
[2] Year-to-date (YTD) (mean of January through September 2018 data).
Source: U.S. Census-Construction, 2018c.

In 2017, the top five states for total permits issued in the Midwest are: Illinois, Ohio, Michigan, Minnesota, and Wisconsin. In regards to SF permits, the top five are Michigan, Ohio, Indiana, Minnesota, and Missouri. For five or more unit MF permits, the rankings are: Illinois, Minnesota, Ohio, Michigan, and Iowa (Table 3).

Table 3. MW housing permits by state*: 2017.

State	Total permits	Single-Family permits	2-4 Multi-Family unit permits	≥ 5 Multi-Family unit permits
Illinois	24,992	10,181	1,193	13,618
Indiana	21,664	16,075	522	5,067
Iowa	13,948	8,067	474	5,407
Kansas	8,984	6,046	715	2,223
Michigan	23,623	16,652	696	6,275
Minnesota	21,953	13,508	316	8,129
Missouri	18,811	12,109	1,082	5,620

Nebraska	8,863	5,436	294	3,133
Ohio	23,917	16,153	855	6,909
North Dakota	3,411	2,111	52	1,248
South Dakota	5,407	3,386	231	1,790
Wisconsin	19,545	11,769	831	6,945
Total	195,118	121,493	51,717	66,364

* Unadjusted data.
Source: U.S. Census-Construction, Building Permits Survey, 2018d.

Building permits issued in Minnesota track those of the U.S. in a general context. SF permitting is roughly 48 percent of its high. Conversely, MF permits are about 32 percent greater than 2004 (Table 4).

Table 4. Minnesota housing permits[1]: 2000 to 2018.

	Total permits	Single-Family permits	Multi-Family permits
2018: YTD[2]	2,328	1,245	1,083
2017	2,020	1,224	796
2016	1,964	1,135	829
2015	1,686	1,019	667
2014	1,402	862	540
2013	1,392	881	511
2012	1,242	712	530
2011	685	522	163
2010	793	560	233
2009	768	569	199
2008	904	697	207
2007	1,487	1,160	327
2006	2,289	1,816	473
2005	3,020	2,479	541
2004	3,399	2,576	823
2003	3,349	2,577	772
2002	3,051	2,172	879
2001	2,742	2,100	642
2000	2,709	2,063	646

[1] Seasonally adjusted annual data.
[2] YTD (total January through September 2018 data).
Source: Federal Reserve Bank of St. Louis, 2018.

Metropolitan Statistical Areas

Analysis of metropolitan statistical areas (MSA) yielded insight into MSA's where housing construction was strongest. Generally, greater Chicago, greater Minneapolis, greater Detroit, and greater Indianapolis issued the most permits (Tables 5 to 8).

Total building permits issued were the highest in Chicago and surrounding areas, followed by Minneapolis, and Detroit (Table 5). SF permits are the highest in Minneapolis, followed by Chicago (Table 6). Greater Chicago leads the 3 to 4-unit MF permits issued (Table 7) and Chicago, Minneapolis, and Detroit recorded the most five or greater MF units (Table 8).

Table 5. Top 10 Building permits: Total units, MW MSA's*: 2017.

MSA	Total units
Chicago-Naperville-Elgin, IL-IN-WI	22,132
Minneapolis-St. Paul-Bloomington, MN	15,100
Detroit-Warren-Dearborn, MI	10,089
Indianapolis-Carmel-Anderson, IN	9,079
Columbus, OH	8,892
St. Louis, MO-IL	7,295
Cincinnati, OH-KY-IN	6,465
Des Moines-West Des Moines, IA	6,367
Louisville-Jefferson County, KY-IN	5,785
Omaha-Council Bluffs, NE-IA	4,955
Total Midwest MSA's	155,171

*81 total MSA's are reported in the MW by U.S. Census-Construction.
Source: U.S. Census-Construction, Building Permits Survey, 2018d.

Table 6. Top 10 Building permits: SF units MW MSA's*: 2017.

MSA	Single-Family units
Minneapolis-St. Paul-Bloomington, MN	8,782
Chicago-Naperville-Elgin, IL-IN-WI	8,416
Detroit-Warren-Dearborn, MI	6,838
Indianapolis-Carmel-Anderson, IN	6,755
St. Louis, MO-IL	5,608
Cincinnati, OH-KY-IN	4,440
Columbus, OH	4,295
Des Moines-West Des Moines, IA	3,697
Louisville-Jefferson County, KY-IN	3,446
Omaha-Council Bluffs, NE-IA	3,158
Minneapolis-St. Paul-Bloomington, MN	8,782
Chicago-Naperville-Elgin, IL-IN-WI	8,416
Total Midwest MSA's	92,349

*81 total MSA's are reported in the MW by U.S. Census-Construction.

Source: U.S. Census-Construction, Building Permits Survey, 2018d.

Table 7. Top 10 Building permits: 2 to 4 MF units MW MSA's*: 2017.

MSA	Multi-Family units
Chicago-Naperville-Elgin, IL-IN-WI	1,024
Detroit-Warren-Dearborn, MI	332
Minneapolis-St. Paul-Bloomington, MN	236
Cleveland-Elyria, OH	199
Indianapolis-Carmel-Anderson, IN	197
Cedar Rapids, IA	184
Columbus, OH	158
Cincinnati, OH-KY-IN	145
Madison, WI	138
St. Louis, MO-IL	115
Total Midwest MSA's	4,648

*81 total MSA's are reported in the MW by U.S. Census-Construction.
Source: U.S. Census-Construction, Building Permits Survey, 2018d.

Table 8. Top 10 Building permits: MF 5 or more units MW MSA*: 2017.

MSA	5-units or more
Chicago-Naperville-Elgin, IL-IN-WI	12,692
Minneapolis-St. Paul-Bloomington, MN	6,082
Columbus, OH	4,439
Detroit-Warren-Dearborn, MI	2,919
Madison, WI	2,838
Des Moines-West Des Moines, IA	2,623
Louisville-Jefferson County, KY-IN	2,265
Indianapolis-Carmel-Anderson, IN	2,127
Milwaukee-Waukesha-West Allis, WI	1,975
Cincinnati, OH-KY-IN	1,880
Total: Midwest MSA's	58,074

*81 total MSAs are reported in the Midwest by U.S. Census-Construction.
Source: U.S. Census-Construction, Building Permits Survey, 2018d.

In Minnesota, the Minneapolis-St. Paul-Bloomington MSA is the clear leader in housing construction. Nearly 74 percent of total permits issued were in the greater Minneapolis MSA. Accordingly, 74 percent of SF permits and 75 percent of MF permits issued were in the Minneapolis-St. Paul-Bloomington MSA (Table 9).

Table 9. Building permits: Minnesota MSA's, 2017.

State	Total units	Single-Family units	2-4 Multi-Family units	≥ 5 Multi-Family units
Minneapolis-St. Paul-Bloomington	15,100	8,782	236	6,082
Fargo, ND-MN	1,891	1,065	0	826
Rochester	1,449	818	6	625
Duluth, MN-WI	665	508	4	153
Mankato-North Mankato	516	342	12	162
La Crosse-Onalaska, WI-MN	432	278	16	138
Grand Forks, ND-MN	417	227	4	186
Total: Minnesota	20,470	12,020	278	8,172

*7 total MSA's are reported in Minnesota by U.S. Census-Construction.
Source: U.S. Census-Construction, Building Permits Survey, 2018d.

New Housing Starts

National and Regional

Housing starts are considered as a leading indicator for the overall U.S. economy. Housing starts are not included as a component of the leading index, but are a coincident indicator. Changes in the rate of housing starts reveal substantive information regarding new housing demand and the outlook for the construction industry, including construction employment.

As presented in the permit section, aggregate housing starts do not come close to the levels reported in the early 2000's. SF housing starts remains about 50 percent less than the 2005 peak (U.S.) and 40 percent fewer than 2004 high in the MW (Tables 10 and 11).

Table 10. U.S. housing starts: 2000 to 2018.

	Total starts	Single-Family starts	2-4 Multi-Family unit starts	≥ 5 Multi-Family unit starts
2018: YTD[1]	1,265,000	885,000	13,000	367,000
2017	1,203,000	849,000	11,000	343,000
2016	1,174,000	782,000	12,000	381,000
2015	1,112,000	715,000	12,000	386,000
2014	1,003,000	648,000	14,000	342,000
2013	925,000	618,000	14,000	294,000
2012	781,000	535,000	11,000	234,000
2011	609,000	431,000	11,000	167,000
2010	587,000	471,000	11,000	104,000
2009	554,000	445,000	12,000	97,000
2008	906,000	622,000	18,000	266,000
2007	1,355,000	1,046,000	32,000	277,000

2006	1,801,000	1,465,000	43,000	293,000
2005	2,068,000	1,716,000	41,000	311,000
2004	1,956,000	1,611,000	42,000	303,000
2003	1,848,000	1,499,000	34,000	315,000
2002	1,705,000	1,359,000	39,000	308,000
2001	1,603,000	1,273,000	37,000	293,000
2000	1,569,000	1,231,000	39,000	299,000

Notes: [1] YTD; mean of January through September data.
Source: U.S. Census-Construction, 2018c.

Table 11. MW[1] housing starts[2]: 2000 to 2018.

	Total starts	Single-Family starts	Two Multi-Family unit starts or more
2018: YTD[2]	174,000	125,000	49,000
2017	180,000	131,000	49,000
2016	185,000	123,000	62,000
2015	150,000	105,000	45,000
2014	159,000	103,000	56,000
2013	149,000	102,000	47,000
2012	129,000	93,000	36,000
2011	103,000	77,000	26,000
2010	98,000	79,000	19,000
2009	95,000	74,000	21,000
2008	134,000	102,000	32,000
2007	206,000	168,000	38,000
2006	284,000	240,000	44,000
2005	357,000	305,000	52,000
2004	356,000	307,000	49,000
2003	373,000	309,000	64,000
2002	352,000	280,000	72,000
2001	330,000	269,000	61,000
2000	317,000	260,000	57,000

Notes: [1] MW (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin).
[2] YTD (mean of January through September 2018 data).
Source: U.S. Census-Construction, 2018c.

In the five or more unit MF segment, total U.S. 2017 starts are greater than those reported in the early 2003 – about 16 per cent greater (Table 10). However, improvement in the five or more unit MF segment is not readily observed in Table 11 as Census does not provide this level of segmentation.

Regional Expenditures

Housing construction spending data are considered a coincident indicator. The residential category includes SF homes, MF, and remodeling or improvement spending. Housing analysts' research construction spending for cues about the overall economy, as the housing construction industry is one of the first into a recession and historically, is an industry that recovers earliest with improving economic conditions. On a nominal basis, U.S. residential construction spending has not recovered (Tables 12 and 13). Similarly, in 2107, MW residential spending was about one-third of that reported in 2010 (Table 12).

Table 12. Annual value[1] of private residential construction put in place by region, 2006-2017.

	NE	MW	S	W	United States
2017	2,861	519	1,456	1,371	6,207
2016	2,724	889	1,181	1,266	6,059
2015	2,324	775	1,295	1,308	5,701
2014	1,227	484	1,272	1,146	4,128
2013	1,290	587	1,566	1,094	4,537
2012	1,191	837	1,348	1,296	4,672
2011	2,050	1,049	1,456	1,407	5,962
2010	2,129	1,530	2,462	1,455	7,576
2009	1,947	1,074	1,518	1,234	5,772
2008	1,417	1,084	1,242	1,151	4,894
2007	1,216	1,079	1,708	1,092	5,094
2006	1,335	965	1,289	760	4,349

[1] Millions of dollars, nominal.
Source: U.S. Census-Construction Spending, 2018b.

In 2017, U.S. private nonresidential construction expenditures were greatest in the commercial, manufacturing, and office sectors. MW nonresidential construction expenditures mirrored those reported for the U.S. (Table 13).

Table 13. Annual value[1] of private nonresidential construction put in place by region, 2017.

	Northeast	Midwest	South	West	United States
Lodging	5,834	4,085	10,397	7,669	27,985
Office	15,745	7,914	19,703	15,201	58,564
Commercial	12,224	16,529	35,978	19,907	84,637
Health Care	6,069	7,362	11,867	7,348	32,645
Educational	7,614	3,843	5,967	2,839	20,263
Religious	414	648	1,717	587	3,366
Amusement and Recreation	2,279	2,946	4,738	3,795	13,757
Transportation	1,527	343	1,664	1,158	4,692
Manufacturing	5,247	12,602	40,436	7,512	65,796

Total: nonresidential expenditures	57,033	56,386	132,851	66,160	312,430

[1] millions of dollars, nominal.
Source: U.S. Census-Construction, 2018b.

Residential and Commercial Real Estate Forecasts

Residential Real Estate

Residential real estate is comprised of SF, two to four-unit MF, and five units or more MF categories. Since the 2009 nadir of housing construction, housing has improved; though SF and MF construction levels remain well less than historical highs. Most analysts believe that the Millennial generation will drive future construction and sales, as many of the 67 million Millennials enter the work force and might have the opportunity to move out on their own.

Future housing construction forecasts are in a tight range, and none expect the U.S. market to approach historical levels in the near term. For instance. John Burns Real Estate Consulting project total housing starts of 1.29 million in 2019 and 1.25 million units in 2020 (Jerke, 2018). Zelman & Associates project 915,000 SF starts in 2019 (McManus, 2019). Vitner *et al.* (2019) forecast 1,300 million total starts in 2019 (920,000 SF and 380,00 MF) and 1,300 million total starts in 2020 (930,000 SF and 370,00 MF). Similarly, the Mortgage Bankers Association (2019) projects 1,320 million total starts in 2019 (900,000 SF and 385,00 MF) and 1,300 million total starts in 2020 (940,000 SF and 380,00 MF).

Commercial Real Estate

MF housing

Currently, and in the past few years, Class A apartments have been the majority of buildings completed; this category is/was built for more affluent renters. Sebree and Chang (2019) opine that "much of the rental demand will center on apartments that serve the traditional workforce: Class B and C properties." They also state that Minneapolis-St. Paul's "sustained apartment demand kept vacancy persistently tight, allowing steady rent growth. It is the only Midwest market to break into the top 20" [in the U.S.].

In 2019, increased MF completions will result in total apartment additions (since 2012) of greater than 2.1 million units. This quantity is a net inventory gain of about 13 percent in the past eight years. Despite the completion of the "most apartments since the 1980s, vacancy is forecast to remain at just 4.6 percent in 2019. With rising labor and materials costs, tighter lending, and a shortage of skilled construction labor available, the pace of construction should begin to ebb in 2020" (Sebree and Chang, 2019).

Nonresidential structures

Deloitte (2019) posits that a large proportion of their recent survey respondents plan to increase their capital commitment to commercial real estate (CRE), with the United States, Germany, and Canada as the prominent countries. This includes "…mixed-use properties and new business models such as properties with flexible leases and spaces are expected to attract an increased allocation of investment dollars." In addition, PwC Real Estate (2019) states that by 2020, "it's likely that all buildings in advanced economies will need to have sustainability ratings. What's more, the concept of sustainability will have broadened to mean creating 'places' where people enjoy living and working."

CRE expenditures

Daum *et al.* (2019) forecast that $545,291billion will be spent on nonresidential structures in 2019. Further they project $67,867 billion (2019) in the East North Central region (Illinois, Indiana, Michigan, Ohio, and Wisconsin); $69,945 in 2020; $71,482 in 2021; and $78,638 in 2022. For the West North Central region (Iowa, Kansas, Missouri, Minnesota, Nebraska, North Dakota, and South Dakota) $46,694 billion in 2019; $45,563 in 2020; $45,661 in 2021; and $47,371 in 2022.

In the East North Central region, the five top building categories – in order (based on projected expenditures) are: educational, commercial, office, manufacturing, and transportation. For the West North Central region, the top five are: educational, commercial, office, manufacturing, and transportation (Daum *et al.*, 2019).

Glossary

Housing Permits—The approval given by a local jurisdiction to proceed on a construction project. Not all areas of the country require a permit for construction.

Housing Starts—Start of construction occurs when excavation begins for the footings or foundation of a building. All housing units in a multifamily building are defined as being started when this excavation begins. Beginning with data for January 1992, estimates of housing starts include units in structures being totally rebuilt on an existing foundation.

Housing Unit—A housing unit, as defined for purposes of these data, is a house, an apartment, a group of rooms, or a single room intended for occupancy as separate living quarters. Separate living quarters are those in which the occupants live separately from any other individuals in the building and which have a direct access from the outside of the building or through a common hall. In accordance with this definition, each apartment unit in an apartment building is counted as one housing unit. Housing units, as distinguished from "HUD-code" manufactured (mobile) homes, include conventional "site-built" units, prefabricated, panelized, sectional, and modular units. Housing unit statistics also exclude group quarters (such as dormitories and rooming houses), transient accommodations (such as transient hotels, motels, and tourist courts), moved

or relocated buildings, and housing units created in an existing residential or nonresidential structure. Units in assisted living facilities are considered to be housing units, however, units in nursing homes are not considered to be housing units.

Metropolitan Areas—The titles and definitions for Metropolitan Areas (MAs), which are made up of Metropolitan Core-Based Statistical Areas (CBSAs), conform to those defined by the Office of Management and Budget, Executive Office of the President, as of December 2003. More information on Metropolitan Areas can be found at www.census.gov/programs-surveys/metro-micro.html.

Midwest Region—The standard Census geographic region is used in these statistics. Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin

Multifamily Housing—Residential buildings containing units built one on top of another and those built side-by-side which do not have a ground-to-roof wall and/or have common facilities (i.e., attic, basement, heating plant, plumbing, etc.)

Not Seasonally Adjusted—Data labeled "Not Seasonally Adjusted" refers to the fact that the data are not adjusted for seasonality using seasonal adjustment and not shown at an annual rate. Detailed information on seasonal adjustment can be found at: www.census.gov/srd/www/winx13/

Permit-Issuing Place—A geographic area that issues building or zoning permits for the construction of residential structures. The area may be a single municipality or county or a combination of multiple municipalities.

Residential Building—A residential building is a building consisting primarily of housing units. In a new building combining residential and nonresidential floor areas, every effort is made to include the residential units in these statistics, even if the primary function of the entire building is for nonresidential purposes.

Reported Data—Data labeled as "Reported Data" include the data reported from the respondent or from the Census Bureau's Survey of Construction (SOC) but exclude imputed data.

Seasonally Adjusted Annual Rate—Seasonal adjustment is the process of estimating and removing seasonal effects from a time series to better reveal certain non-seasonal features such as underlying trends and business cycles. Seasonal adjustment procedures estimate effects that occur in the same calendar month with similar magnitude and direction from year to year. In series whose seasonal effects come primarily from weather, the seasonal factors are estimates of average weather effects for each month.

Single-Family House—The single-family statistics include fully detached, semidetached (semi attached, side-by-side), row houses, and townhouses. In the case of attached units, each must be

separated from the adjacent unit by a ground-to-roof wall in order to be classified as a single-family structure. Also, these units must not share heating/air-conditioning systems or utilities. Units built one on top of another and those built side-by-side that do not have a ground-to-roof wall and/or have common facilities (i.e., attic, basement, heating plant, plumbing, etc.) are not included in the single-family statistics.

Unadjusted—For State data: Not seasonally adjusted; For MSA data: Not seasonally adjusted and not weighted.

Value of Construction Put in Place—The "value of construction put in place" is a measure of the value of construction installed or erected at the site during a given period. For an individual project, this includes—

1. Cost of materials installed or erected.
2. Cost of labor (both by contractors and force account) and a proportionate share of the cost of construction equipment rental.
3. Contractor's profit.
4. Cost of architectural and engineering work.
5. Miscellaneous overhead and office costs chargeable to the project on the owner's books.
6. Interest and taxes paid during construction (except for state and locally owned projects).

The total value-in-place for a given period is the sum of the value of work done on all projects underway during this period, regardless of when work on each individual project was started or when payment was made to the contractors. For some categories, published estimates represent payments made during a period rather than the value of work actually done during that period. For other categories, estimates are derived by distributing the total construction cost of the project by means of historic construction progress patterns.

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Appendix D. Construction Monitor Reports

Table 14. 2018 Minnesota Building Permit Summary

Construction Monitor

Minnesota Building Permit Summary
Year-to-Date 11/28/2018

Residential	Permits	Value	Units
Single Family Homes	3,268	$968,323,455	3264
Duplexes & Twin Homes	8	$1,765,065	16
Apartments & Condos	70	$890,941,514	8167
Other Residential Structures	460	$11,738,604	2
Swimming Pools & Spas	191	$9,464,526	0
Garages & Carports	674	$19,421,268	0
Res Rmdl, Addn, Int Fin	11,554	$407,250,886	0
Reroof Residential	885	$27,047,736	0
Total Residential Const	**17,110**	**$2,335,953,152**	**11,449**
Commercial	**Permits**	**Value**	**Units**
Offices/Banks/R&D/Professional	16	$100,999,705	0
Retail/Whsl/Dining/Personal	13	$60,958,918	0
Mixed Use	10	$284,159,294	122
Auto/Truck Sales & Service	1	$3,500,000	0
Parking Structures & Carports	9	$4,815,694	0
Motels, Hotels, & RV Parks	8	$108,145,462	0
Indus-Manuf, Whse-Shops,	11	$40,432,263	0
Public Transportation	1	$14,000	0
Hospitals & Other Institutions	3	$1,500,000	0
Churches & Other Religious	3	$2,179,000	0
Private Schools & Day Care	1	$1,670,044	0
Public Buildings & Projects	11	$128,921,802	0
Utilities (gas elect wtr swr)	172	$93,726,821	0
Parks, Recreation, Entertain,	5	$1,683,000	0
Agricultural Buildings & Sheds	49	$1,354,872	0
Other Non-Residential Buildings	195	$636,793,593	0
Comm Structures Other Than	115	$12,352,796	0
Comm Rmdl, Addn, Int Fin	4,123	$1,804,471,811	0
Reroof Commercial	496	$79,480,597	0
Total Commercial Const	**5,242**	**$3,367,159,552**	**122**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	335	$5,401,806	0
Alternative Commercial Energy	68	$17,639,844	0
Total Solar Const	**403**	**$23,041,650**	**0**
Total Minnesota Const	**22,755**	**$5,726,154,240**	**11,571**

Minnesota Building Permit Summary
Week 48 - 11/22/18 to 11/28/18 (permits over $10,000)

Residential	Permits	Value	Units
Single Family Homes	74	$16,777,145	74
Demolition	8	$389,931	0
Footing & Foundation	4	$36,300	0
Apartments & Condos	2	$120,692,840	514
Other Residential Structures	4	$98,000	0
Garages & Carports	17	$626,522	0
Res Rmdl, Addn, Int Fin	256	$11,834,209	0
Reroof Residential	4	$281,000	0
Total Residential Const	**369**	**$150,735,968**	**588**
Commercial	**Permits**	**Value**	**Units**
Offices/Banks/R&D/Professional	1	$72,000	0
Demolition (Commercial)	3	$306,045	0
Grading & Dust (Commercial)	3	$659,000	0
Footing & Foundation	5	$93,000	0
Retail/Whsl/Dining/Personal	1	$12,500,000	0
Other Non-Residential Buildings	6	$5,519,914	0
Comm Structures Other Than	2	$68,852	0
Comm Rmdl, Addn, Int Fin	97	$31,404,876	0
Reroof Commercial	16	$988,854	0
Total Commercial Const	**134**	**$51,612,544**	**0**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	11	$169,131	0
Alternative Commercial Energy	3	$36,120	0
Total Solar Const	**14**	**$205,251**	**0**
Total Minnesota Const	**517**	**$202,553,760**	**588**

Minnesota Single Family Builders
Year-to-Date 11/28/2018

	Builder	Homes	Value
1	D R Horton Inc	330	$89,196,730
2	Pulte Homes Of	201	$58,780,753
3	Lennar Homes	212	$58,751,781
4	Calatlantic Homes	180	$47,941,272
5	Capstone Homes	125	$31,734,436
6	Robert Thomas	79	$26,309,000
7	Hanson Builders Inc	56	$20,193,559
8	Engelsma	1	$16,017,730
9	Eternity Homes LLC	44	$13,091,811
10	Brandl Anderson	45	$12,688,187
11	M/I Homes Of	36	$9,340,100
12	Sharper Homes Inc	28	$9,019,155
13	Keyland Homes	29	$8,007,800
14	Jonathan Homes Of	19	$7,825,648
15	Wooddale Builders	14	$7,815,000
16	One Ten Ten Homes	26	$7,548,812
17	Donnay Homes Inc	23	$7,332,062
18	Youngfield Homes	21	$7,061,509
19	Tollberg Homes	24	$6,804,760
20	Gonyea Homes Inc	13	$5,839,727
21	Distinctive Design	22	$5,656,915
22	Boulder Const LLC	24	$5,570,179
23	M/I Homes of	21	$5,558,000
24	Bigelow Homes Inc	24	$5,501,225
25	Myhomesource LLC	25	$5,390,000
26	Th Const Of Anoka	20	$5,383,235
27	The Ryland	19	$5,283,243
28	Price Custom Homes	22	$5,010,447
29	Twin Cities Habitat	26	$4,881,240
30	Weekley Homes LLC	20	$4,669,624
31	NIH Homes LLC	11	$4,659,031
32	Charles Cudd Co	10	$4,499,255
33	Distinctive Design	18	$4,240,342
34	Hnh Homes Llc	1	$4,000,000
35	Penz Custom Homes	17	$3,931,563
36	Med City Builders	12	$3,787,396
37	Eagle Building Co Llc	36	$3,765,936
38	Friemann Co Inc	20	$3,713,000
39	Meadow Creek	16	$3,711,437
40	Timbercrest LLC	22	$3,626,700
41	Fieldstone Family	15	$3,591,938
42	McDonald Const Inc	7	$3,542,600
43	Dewitt Bro Home Inc	4	$3,459,080
44	Stone Cottage Const	12	$3,416,000
45	Dean Johnson Homes	12	$3,409,900
46	Sustainable 9 Design	5	$3,372,157
47	R Fleming Const	9	$3,348,479
48	Paul Emmerich Const	13	$3,195,517
49	City Homes LLC	3	$3,130,722
50	JMS Custom Homes	10	$3,036,683
51	Summit Custom	1	$3,000,000
52	Stonegate Builders	8	$2,974,775
53	Creative Homes Inc	10	$2,960,948
54	TC Const	15	$2,868,400
55	Pietsch Builders Inc	10	$2,857,391

Minnesota Garage and Carport Builders
Year-to-Date 11/28/2018

	Builder	Permits	Value
1	Minneapolis Garage	93	$1,923,088
2	Sussel Corp	85	$1,711,019
3	Brennan Companies	1	$880,500
4	Western Const Inc	22	$481,959
5	Eagle Building Co	5	$291,515
6	Built Right	1	$240,000
7	Jack The Carpenter	8	$161,387
8	Ken Heim Repair &	1	$160,000
9	KJ Walk Inc	1	$153,000
10	Personal Pride	1	$150,000
11	Anderson Reda Inc	1	$150,000

Minnesota Residential Builders
Week 48 - 11/22/18 to 11/28/18

	Builder	Permits	Value
1	Doran Const	1	$98,300,000
2	Eagle Building Co	41	$4,057,451
3	Pulte Homes Of	8	$2,768,000
4	D R Horton Inc	3	$1,216,446
5	Locale Design Build	1	$1,197,796
6	Hanson Builders Inc	3	$1,104,000
7	Refined Remodeling	1	$1,000,104
8	Flannery Const Inc	7	$935,572
9	Wooddale Builders	1	$680,000
10	Terra Firma Bldg &	2	$635,000

Minnesota Multi-Family Builders
Year-to-Date 11/28/2018

	Builder	Units	Value
1	Frana Companies	219	$247,569,393
2	Doran Const	542	$122,731,434
3	MA Mortenson	946	$75,692,982
4	Weis Builders	891	$69,857,293
5	Ryan Companies	174	$35,868,201
6	Eagle Building Co	439	$35,171,581
7	Stevens Const Corp	165	$29,000,000
8	Urban On First Llc	355	$28,380,000
9	Frerichs Const Co	75	$24,974,517
10	New Market Bank	144	$22,392,840

Minnesota Other Residential Builders
Year-to-Date 11/28/2018

	Builder	Permits	Value
1	Renewal By	113	$23,553,763
2	Flannery Const Inc	67	$10,131,812
3	Weis Builders	1	$8,200,000
4	Project One Const	3	$3,297,400
5	Frerichs Const Co	5	$2,801,204
6	Pella Northland	134	$2,718,740
7	Pella Northland	131	$2,358,392
8	Superior Mechanical	3	$2,350,000
9	Ecco Const	1	$2,279,000
10	NL Tollefson Inc	2	$2,231,350
11	Custom Remodelers	127	$2,025,142
12	J G Hause Const Inc	19	$2,001,000
13	WL Hall Co	1	$1,961,265
14	Refined Remodeling	4	$1,922,104
15	Theisen Renovations	9	$1,910,000
16	Dovetail Renovation	9	$1,880,000
17	Lindus Const	86	$1,688,800
18	Terra Firma Bldg &	17	$1,508,624
19	Anchor Builders LLc	7	$1,472,451
20	Fred Nordahl Const	8	$1,455,000
21	Trehus Builders Inc	26	$1,440,267
22	White Crane Const	18	$1,368,633
23	Scherer Bros Lumber	72	$1,365,237

Minnesota Commercial Builders
Year-to-Date 11/28/2018

	Builder	Permits	Value
1	Kraus Anderson	48	$210,470,859
2	Weis Builders	4	$148,620,153
3	Weis Builders	24	$108,875,445
4	RJ Ryan Const	42	$103,781,768
5	Mcgough Const	78	$100,220,018
6	Independent School	1	$88,355,000
7	Gardner Builders	87	$84,432,262
8	MA Mortenson	48	$81,529,710
9	Adolfson & Peterson	16	$77,807,109
10	RJM Const	10	$74,188,000
11	Jorgenson Const	34	$65,147,042
12	RJM Const	40	$58,009,701
13	Ryan Companies	31	$57,891,574
14	Mcgough Const	5	$54,331,164
15	Shaw Lundquist	8	$45,111,800
16	Knutson Const	38	$41,208,316
17	Greiner Const	28	$39,215,380
18	Benike Const	79	$39,042,792
19	North Loop Partners	1	$38,725,341
20	Terra General	19	$35,174,994

Minnesota Owner-Builders
Year-to-Date 11/28/2018

	Construction Type	Permits	Value
1	Single Family	111	$31,279,856
2	Garages & Carports	218	$5,888,170
3	Res Rmdl, Addn, Int	1701	$44,263,253
4	Commercial	112	$6,607,998

Minnesota Commercial Builders
Week 48 - 11/22/18 to 11/28/18

	Builder	Permits	Value
1	Ltf Const Co Llc	1	$12,500,000
2	Mcgough Const	2	$11,159,000
3	Kraus Anderson	2	$5,542,740
4	Greystone Const	1	$1,778,234
5	Met Con Const/Met-	1	$1,553,000
6	Opus Design Build	1	$1,259,250
7	VIB Properties Llc	1	$1,200,000
8	Gardner Builders	3	$945,000
9	Flannery Const Inc	5	$856,803
10	Mcgough Const	1	$850,000

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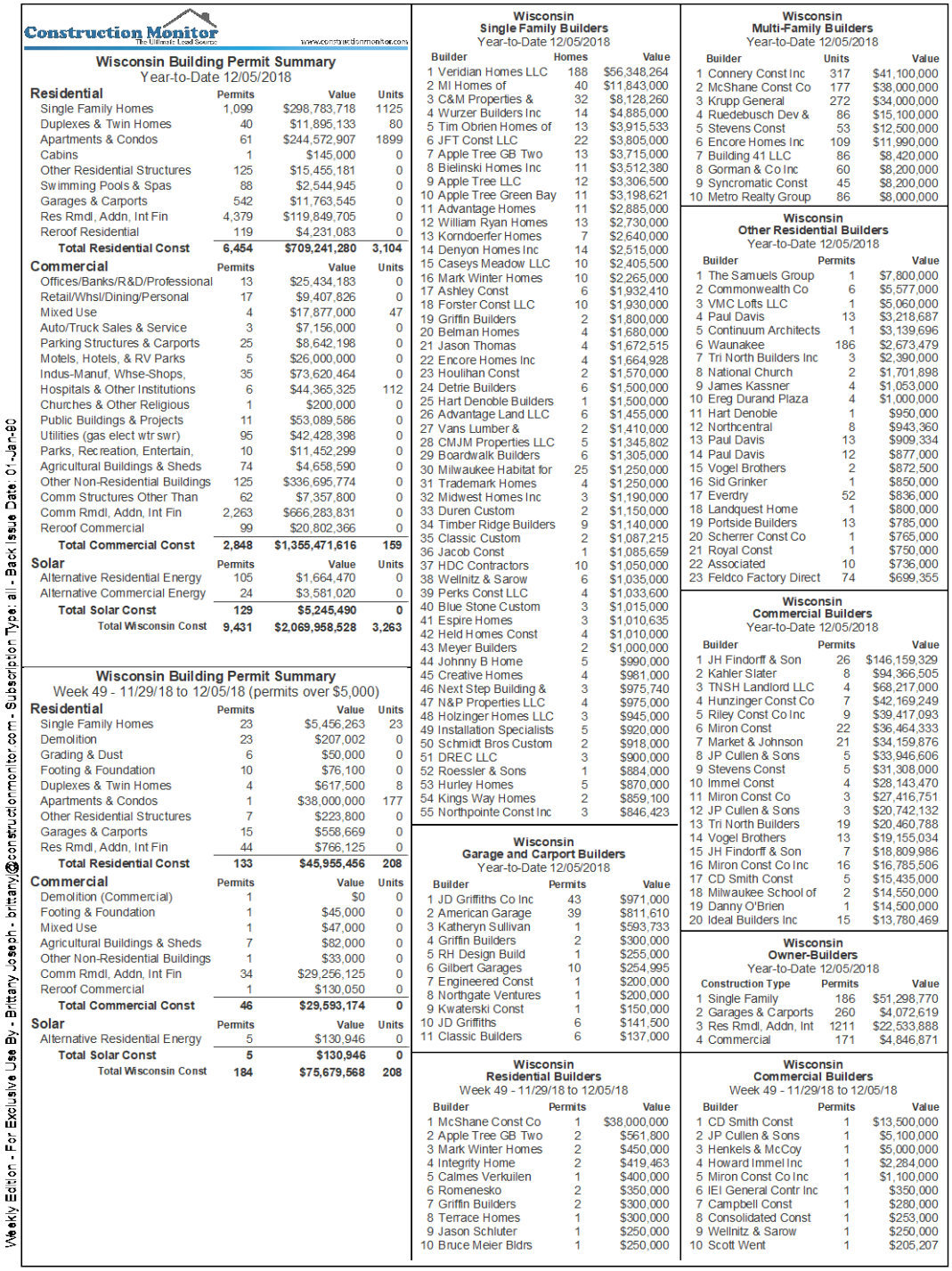
SOURCE: CONSTRUCTION MONITOR 2018

Table 15. 2018 Wisconsin Building Permit Summary



Construction Monitor
The Ultimate Lead Source
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Wisconsin Building Permit Summary
Year-to-Date 12/05/2018

Residential	Permits	Value	Units
Single Family Homes	1,099	$298,783,718	1125
Duplexes & Twin Homes	40	$11,895,133	80
Apartments & Condos	61	$244,572,907	1899
Cabins	1	$145,000	0
Other Residential Structures	125	$15,455,181	0
Swimming Pools & Spas	88	$2,544,945	0
Garages & Carports	542	$11,763,545	0
Res Rmdl, Addn, Int Fin	4,379	$119,849,705	0
Reroof Residential	119	$4,231,083	0
Total Residential Const	**6,454**	**$709,241,280**	**3,104**
Commercial	**Permits**	**Value**	**Units**
Offices/Banks/R&D/Professional	13	$25,434,183	0
Retail/Whsl/Dining/Personal	17	$9,407,826	0
Mixed Use	4	$17,877,000	47
Auto/Truck Sales & Service	3	$7,156,000	0
Parking Structures & Carports	25	$8,642,198	0
Motels, Hotels, & RV Parks	5	$26,000,000	0
Indus-Manuf, Whse-Shops,	35	$73,620,464	0
Hospitals & Other Institutions	6	$44,365,325	112
Churches & Other Religious	1	$200,000	0
Public Buildings & Projects	11	$53,089,586	0
Utilities (gas elect wtr swr)	95	$42,428,398	0
Parks, Recreation, Entertain,	10	$11,452,299	0
Agricultural Buildings & Sheds	74	$4,658,590	0
Other Non-Residential Buildings	125	$336,695,774	0
Comm Structures Other Than	62	$7,357,800	0
Comm Rmdl, Addn, Int Fin	2,263	$666,283,831	0
Reroof Commercial	99	$20,802,366	0
Total Commercial Const	**2,848**	**$1,355,471,616**	**159**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	105	$1,664,470	0
Alternative Commercial Energy	24	$3,581,020	0
Total Solar Const	**129**	**$5,245,490**	**0**
Total Wisconsin Const	**9,431**	**$2,069,958,528**	**3,263**

Wisconsin Building Permit Summary
Week 49 - 11/29/18 to 12/05/18 (permits over $5,000)

Residential	Permits	Value	Units
Single Family Homes	23	$5,456,263	23
Demolition	23	$207,002	0
Grading & Dust	6	$50,000	0
Footing & Foundation	10	$76,100	0
Duplexes & Twin Homes	4	$617,500	8
Apartments & Condos	1	$38,000,000	177
Other Residential Structures	7	$223,800	0
Garages & Carports	15	$558,669	0
Res Rmdl, Addn, Int Fin	44	$766,125	0
Total Residential Const	**133**	**$45,955,456**	**208**
Commercial	**Permits**	**Value**	**Units**
Demolition (Commercial)	1	$0	0
Footing & Foundation	1	$45,000	0
Mixed Use	1	$47,000	0
Agricultural Buildings & Sheds	7	$82,000	0
Other Non-Residential Buildings	1	$33,000	0
Comm Rmdl, Addn, Int Fin	34	$29,256,125	0
Reroof Commercial	1	$130,050	0
Total Commercial Const	**46**	**$29,593,174**	**0**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	5	$130,946	0
Total Solar Const	**5**	**$130,946**	**0**
Total Wisconsin Const	**184**	**$75,679,568**	**208**

Wisconsin Single Family Builders
Year-to-Date 12/05/2018

Builder	Homes	Value
1 Veridian Homes LLC	188	$56,348,264
2 MI Homes of	40	$11,843,000
3 C&M Properties &	32	$8,128,260
4 Wurzer Builders Inc	14	$4,885,000
5 Tim Obrien Homes of	13	$3,915,533
6 JFT Const LLC	22	$3,805,000
7 Apple Tree GB Two	13	$3,715,000
8 Bielinski Homes Inc	11	$3,512,380
9 Apple Tree LLC	12	$3,306,500
10 Apple Tree Green Bay	11	$3,198,621
11 Advantage Homes	11	$2,885,000
12 William Ryan Homes	13	$2,730,000
13 Korndoerfer Homes	7	$2,640,000
14 Denyon Homes Inc	14	$2,515,000
15 Caseys Meadow LLC	10	$2,405,500
16 Mark Winter Homes	10	$2,265,000
17 Ashley Const	6	$1,932,410
18 Forster Const LLC	10	$1,930,000
19 Griffin Builders	2	$1,800,000
20 Belman Homes	4	$1,680,000
21 Jason Thomas	4	$1,672,515
22 Encore Homes Inc	4	$1,664,928
23 Houlihan Const	2	$1,570,000
24 Detrie Builders	6	$1,500,000
25 Hart Denoble Builders	1	$1,500,000
26 Advantage Land LLC	6	$1,455,000
27 Vans Lumber &	2	$1,410,000
28 CMJM Properties LLC	5	$1,345,802
29 Boardwalk Builders	6	$1,305,000
30 Milwaukee Habitat for	25	$1,250,000
31 Trademark Homes	4	$1,250,000
32 Midwest Homes Inc	3	$1,190,000
33 Duren Custom	2	$1,150,000
34 Timber Ridge Builders	9	$1,140,000
35 Classic Custom	2	$1,087,215
36 Jacob Const	1	$1,085,659
37 HDC Contractors	10	$1,050,000
38 Wellnitz & Sarow	6	$1,035,000
39 Perks Const LLC	4	$1,033,600
40 Blue Stone Custom	3	$1,015,000
41 Espire Homes	3	$1,010,635
42 Held Homes Const	4	$1,010,000
43 Meyer Builders	2	$1,000,000
44 Johnny B Home	5	$990,000
45 Creative Homes	4	$981,000
46 Next Step Building &	3	$975,740
47 N&P Properties LLC	4	$975,000
48 Holzinger Homes LLC	3	$945,000
49 Installation Specialists	5	$920,000
50 Schmidt Bros Custom	2	$918,000
51 DREC LLC	3	$900,000
52 Roessler & Sons	1	$884,000
53 Hurley Homes	5	$870,000
54 Kings Way Homes	2	$859,100
55 Northpointe Const Inc	3	$846,423

Wisconsin Garage and Carport Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 JD Griffiths Co Inc	43	$971,000
2 American Garage	39	$811,610
3 Katheryn Sullivan	1	$593,733
4 Griffin Builders	2	$300,000
5 RH Design Build	1	$255,000
6 Gilbert Garages	10	$254,995
7 Engineered Const	1	$200,000
8 Northgate Ventures	1	$200,000
9 Kwaterski Const	1	$150,000
10 JD Griffiths	6	$141,500
11 Classic Builders	6	$137,000

Wisconsin Residential Builders
Week 49 - 11/29/18 to 12/05/18

Builder	Permits	Value
1 McShane Const Co	1	$38,000,000
2 Apple Tree GB Two	2	$561,800
3 Mark Winter Homes	2	$450,000
4 Integrity Home	2	$419,463
5 Calmes Verkuilen	1	$400,000
6 Romenesko	2	$350,000
7 Griffin Builders	2	$300,000
8 Terrace Homes	1	$300,000
9 Jason Schluter	1	$250,000
10 Bruce Meier Bldrs	1	$250,000

Wisconsin Multi-Family Builders
Year-to-Date 12/05/2018

Builder	Units	Value
1 Connery Const Inc	317	$41,100,000
2 McShane Const Co	177	$38,000,000
3 Krupp General	272	$34,000,000
4 Ruedebusch Dev &	86	$15,100,000
5 Stevens Const	53	$12,500,000
6 Encore Homes Inc	109	$11,990,000
7 Building 41 LLC	86	$8,420,000
8 Gorman & Co Inc	60	$8,200,000
9 Syncromatic Const	45	$8,200,000
10 Metro Realty Group	86	$8,000,000

Wisconsin Other Residential Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 The Samuels Group	1	$7,800,000
2 Commonwealth Co	6	$5,577,000
3 VMC Lofts LLC	1	$5,060,000
4 Paul Davis	13	$3,218,687
5 Continuum Architects	1	$3,139,696
6 Waunakee	186	$2,673,479
7 Tri North Builders Inc	3	$2,390,000
8 National Church	2	$1,701,898
9 James Kassner	4	$1,053,000
10 Ereg Durand Plaza	4	$1,000,000
11 Hart Denoble	1	$950,000
12 Northcentral	8	$943,360
13 Paul Davis	13	$909,334
14 Paul Davis	12	$877,000
15 Vogel Brothers	2	$872,500
16 Sid Grinker	1	$850,000
17 Everdry	52	$836,000
18 Landquest Home	1	$800,000
19 Portside Builders	13	$785,000
20 Scherrer Const Co	1	$765,000
21 Royal Const	1	$750,000
22 Associated	10	$736,000
23 Feldco Factory Direct	74	$699,355

Wisconsin Commercial Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 JH Findorff & Son	26	$146,159,329
2 Kahler Slater	8	$94,366,505
3 TNSH Landlord LLC	4	$68,217,000
4 Hunzinger Const Co	7	$42,169,249
5 Riley Const Co Inc	9	$39,417,093
6 Miron Const	22	$36,464,333
7 Market & Johnson	21	$34,159,876
8 JP Cullen & Sons	5	$33,946,606
9 Stevens Const	5	$31,308,000
10 Immel Const	4	$28,143,470
11 Miron Const Co	3	$27,416,751
12 JP Cullen & Sons	3	$20,742,132
13 Tri North Builders	19	$20,460,788
14 Vogel Brothers	13	$19,155,034
15 JH Findorff & Son	7	$18,809,986
16 Miron Const Co Inc	16	$16,785,506
17 CD Smith Const	5	$15,435,000
18 Milwaukee School of	2	$14,550,000
19 Danny O'Brien	1	$14,500,000
20 Ideal Builders Inc	15	$13,780,469

Wisconsin Owner-Builders
Year-to-Date 12/05/2018

Construction Type	Permits	Value
1 Single Family	186	$51,298,770
2 Garages & Carports	260	$4,072,619
3 Res Rmdl, Addn, Int	1211	$22,533,888
4 Commercial	171	$4,846,871

Wisconsin Commercial Builders
Week 49 - 11/29/18 to 12/05/18

Builder	Permits	Value
1 CD Smith Const	1	$13,500,000
2 JP Cullen & Sons	1	$5,100,000
3 Henkels & McCoy	1	$5,000,000
4 Howard Immel Inc	1	$2,284,000
5 Miron Const Co Inc	1	$1,100,000
6 IEI General Contr Inc	1	$350,000
7 Campbell Const	1	$280,000
8 Consolidated Const	1	$253,000
9 Wellnitz & Sarow	1	$250,000
10 Scott Went	1	$205,207

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SOURCE: CONSTRUCTION MONITOR 2018

Table 16. 2018 Iowa Building Permit Summary

Construction Monitor
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Iowa Building Permit Summary
Year-to-Date 12/05/2018

Residential	Permits	Value	Units
Single Family Homes	2,167	$532,128,948	2162
Duplexes & Twin Homes	31	$5,257,428	62
Apartments & Condos	261	$231,858,539	2468
Mobile Homes	1	$21,214	0
Other Residential Structures	79	$4,386,873	0
Swimming Pools & Spas	169	$4,702,284	0
Garages & Carports	198	$5,072,310	0
Res Rmdl, Addn, Int Fin	1,543	$45,748,566	0
Reroof Residential	180	$2,141,529	0
Total Residential Const	**4,629**	**$831,317,632**	**4,692**
Commercial	**Permits**	**Value**	**Units**
Offices/Banks/R&D/Professional	51	$135,272,586	0
Retail/Whsl/Dining/Personal	40	$79,165,050	0
Mixed Use	2	$10,760,000	0
Auto/Truck Sales & Service	7	$7,829,595	0
Parking Structures & Carports	4	$41,306,100	0
Motels, Hotels, & RV Parks	3	$27,031,616	0
Indus-Manuf, Whse-Shops,	68	$375,322,199	0
Hospitals & Other Institutions	8	$63,278,961	0
Churches & Other Religious	1	$1,800,000	0
Private Schools & Day Care	1	$2,772,000	0
Public Buildings & Projects	22	$55,976,965	0
Utilities (gas elect wtr swr)	5	$665,314	0
Parks, Recreation, Entertain,	13	$17,266,926	0
Agricultural Buildings & Sheds	21	$1,232,444	0
Other Non-Residential Buildings	71	$151,773,896	0
Comm Structures Other Than	16	$1,620,469	0
Comm Rmdl, Addn, Int Fin	1,207	$685,155,480	0
Reroof Commercial	55	$5,920,850	0
Total Commercial Const	**1,595**	**$1,664,150,528**	**0**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	124	$1,521,596	0
Alternative Commercial Energy	14	$878,766	0
Total Solar Const	**138**	**$2,400,362**	**0**
Total Iowa Const	**6,362**	**$2,497,868,544**	**4,692**

Iowa Building Permit Summary
Week 49 - 11/29/18 to 12/05/18 (permits over $5,000)

Residential	Permits	Value	Units
Single Family Homes	37	$10,159,649	37
Demolition	6	$0	0
Apartments & Condos	1	$5,513,439	65
Garages & Carports	1	$8,640	0
Res Rmdl, Addn, Int Fin	8	$176,160	0
Total Residential Const	**53**	**$15,857,888**	**102**
Commercial	**Permits**	**Value**	**Units**
Retail/Whsl/Dining/Personal	3	$1,596,378	0
Auto/Truck Sales & Service	1	$188,319	0
Other Non-Residential Buildings	5	$89,269,394	0
Comm Rmdl, Addn, Int Fin	8	$473,420	0
Total Commercial Const	**17**	**$91,527,504**	**0**
Total Iowa Const	**70**	**$107,385,392**	**102**

Iowa
Single Family Builders
Year-to-Date 12/05/2018

Builder	Homes	Value
1 Hubbell Homes	169	$40,633,203
2 Classic Builders Inc	129	$33,143,234
3 Jerrys Homes Inc	137	$28,602,151
4 Greenland Homes Inc	107	$22,204,929
5 Orton Homes	64	$18,546,675
6 Genesis Homes	82	$15,873,174
7 Happe Homes LLP	52	$12,359,148
8 Tanzanite Homes	32	$8,955,504
9 Grayhawk Homes of	24	$7,169,731
10 MJ Properties LLC	24	$6,585,684
11 Happe Homes LLC	28	$6,505,506
12 Neighborhood	14	$6,446,266
13 Element 119 LLC	27	$5,783,493
14 Stanbros Dev Llc	18	$5,029,782
15 Meadowbrook	20	$5,023,673
16 Oakstone Homes Inc	17	$5,022,031
17 Shadow Creek	16	$4,874,718
18 Savannah Homes Inc	23	$4,525,673
19 Mainbuilt	4	$4,281,553
20 Erickson Balmer	23	$4,259,922
21 Caliber Iowa LLC	18	$4,209,920
22 Sage Homes Inc	15	$4,127,046
23 KRM Development	12	$3,909,275
24 Drake Homes Of Iowa	11	$3,879,301
25 Skogman Const Co of	32	$3,822,446
26 DS Solid Const LLC	13	$3,816,430
27 Skogman Homes	29	$3,521,233
28 Kimberley	10	$3,457,993
29 Greater Des Moines	27	$3,303,256
30 Dreamscape	7	$2,995,110
31 Grand Rail	10	$2,875,000
32 CCS Homes	10	$2,620,020
33 Diamond Builders of	15	$2,609,500
34 Highland	6	$2,334,362
35 Rock Creek Builders	8	$2,172,120
36 Bella Homes	4	$2,117,271
37 Grayhawk Homes Of	7	$2,106,512
38 Arkos Custom Homes	6	$2,101,042
39 Robson Homes Inc	10	$2,084,314
40 Landmark	9	$2,078,437
41 Acadia Custom	5	$2,076,691
42 Evergreen Homes of	8	$2,063,339
43 Flynn Development	4	$2,061,635
44 Wegher Const Co	2	$2,035,000
45 Venture Homes	9	$2,010,673
46 Metro Homes LLC	6	$2,005,000
47 Kimberley Dev Corp	6	$1,985,168
48 Keystone Homes LLC	9	$1,938,522
49 Frampton Homes	6	$1,930,141
50 Kruse Construction	6	$1,900,503
51 Ironcrest Homes	5	$1,874,416
52 Affinity Homes	5	$1,834,596
53 Fortis Built LLC	2	$1,818,154
54 Ironwood Homes LLC	2	$1,800,771
55 Dan Homes LLC	5	$1,720,964

Iowa
Garage and Carport Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 Jerrys Homes Inc	2	$435,632
2 Perry Reid	9	$420,000
3 JCorp Inc	4	$274,540
4 TWG Development,	1	$270,000
5 Homes by Dephillips	1	$150,000
6 Jensen Group	1	$138,000
7 Ikerson Concrete	1	$81,114
8 Jayz A Better	1	$80,000
9 Affordable Const	5	$79,714
10 Edward Rose	1	$75,510
11 Coach House	3	$55,862

Iowa
Residential Builders
Week 49 - 11/29/18 to 12/05/18

Builder	Permits	Value
1 Rochon Corp of	1	$5,513,439
2 Denton Homes	3	$1,674,136
3 Happe Homes LLP	7	$1,404,336
4 Jerrys Homes Inc	6	$1,253,032
5 Greenland Homes	6	$1,223,688
6 Happe Homes LLC	4	$653,734
7 Classic Builders Inc	2	$526,498
8 Colonial Homes	1	$454,000
9 Ron's Homes	1	$410,509
10 Cedarbrook Builders	1	$396,447

Iowa
Multi-Family Builders
Year-to-Date 12/05/2018

Builder	Units	Value
1 Nelson Const	187	$26,951,000
2 Jerrys Homes Inc	246	$19,369,259
3 Hubbell	62	$17,151,999
4 JCorp Inc	192	$15,369,514
5 Todd Hackett Const	178	$14,230,000
6 Jensen Group	144	$14,106,000
7 Perry Reid	174	$13,749,054
8 High Development	171	$13,650,000
9 TWG Development,	168	$13,500,000
10 Hubbell Const	144	$8,260,000

Iowa
Other Residential Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 Wegher Const Co	1	$1,900,000
2 Estes Const	1	$1,300,000
3 Hinch Co Inc	1	$766,108
4 Hubbell Homes	14	$538,015
5 Hubbell Const	5	$476,123
6 Silent Rivers Inc	6	$465,000
7 Maintenance Pro	16	$457,150
8 Allstate Renovations	1	$432,000
9 Andrew Howard	1	$400,000
10 Jensen Group	4	$377,000
11 Mercy Hospital	1	$372,637
12 Feldco Factory Direct	37	$365,578
13 Downing Const	1	$350,000
14 SOS LLC	1	$315,000
15 Blaze Restoration Inc	7	$314,899
16 Sage Construction	2	$306,000
17 Abode Construction	14	$274,080
18 Jared Kerkhoff	1	$265,000
19 Grand Homes &	3	$259,200
20 AT Solutions LLC	1	$250,000
21 Federal Home Loan	1	$250,000
22 KRM Development	2	$247,919
23 HR Lancaster Const	3	$240,000

Iowa
Commercial Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 Turner Const	1	$166,680,000
2 Larson Construction	8	$106,159,972
3 Graham Const Co	41	$63,551,385
4 Ryan Companies	9	$60,374,450
5 Microsoft	1	$53,460,894
6 Facebook	3	$49,175,000
7 CA/Argent Coralville	2	$37,271,655
8 McComas-Lacina	8	$37,234,481
9 The Weitz Company	6	$36,474,100
10 Baxter Const Co	1	$33,000,000
11 Kleiman	2	$32,842,000
12 Neumann Brothers	19	$29,597,065
13 Tricon General	19	$26,284,960
14 Altoona City Hall	1	$25,198,637
15 The Walsh Group	1	$24,000,000
16 Rick Novak Const.	2	$19,325,114
17 Venter Spooner Inc	11	$18,919,859
18 Graham	2	$18,600,000
19 Ryan Companies	9	$18,547,262
20 Garling Construction	21	$18,502,332

Iowa
Owner-Builders
Year-to-Date 12/05/2018

Construction Type	Permits	Value
1 Single Family	90	$24,565,945
2 Garages & Carports	103	$1,862,419
3 Res Rmdl, Addn, Int	558	$13,621,125
4 Commercial	51	$3,969,120

Iowa
Commercial Builders
Week 49 - 11/29/18 to 12/05/18

Builder	Permits	Value
1 Larson Construction	2	$85,545,868
2 Downing Const Inc	2	$1,593,626
3 Sunset Crest Retail,	1	$917,525
4 McCon Building Corp	1	$614,514
5 Gregson Const	1	$238,784
6 Onsite Solutions	1	$59,120
7 Seiler Construction	1	$49,985

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SOURCE: CONSTRUCTION MONITOR 2018

Bureau of Business and Economic Research
Center for Economic Development
University of Minnesota Duluth

Table 17. 2018 North Dakota Building Permit Summary

Construction Monitor
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North Dakota Building Permit Summary
Year-to-Date 12/05/2018

Residential	Permits	Value	Units
Single Family Homes	1,246	$291,952,410	1250
Duplexes & Twin Homes	50	$10,367,978	100
Apartments & Condos	38	$106,283,166	1300
Other Residential Structures	195	$3,827,483	0
Swimming Pools & Spas	23	$852,813	0
Garages & Carports	262	$5,688,330	0
Res Rmdl, Addn, Int Fin	1,490	$32,533,641	0
Reroof Residential	3	$37,926	0
Total Residential Const	**3,307**	**$451,543,712**	**2,650**
Commercial	**Permits**	**Value**	**Units**
Offices/Banks/R&D/Professional	19	$11,903,177	0
Retail/Whsl/Dining/Personal	34	$39,385,220	0
Mixed Use	1	$7,500,000	30
Auto/Truck Sales & Service	3	$8,850,000	0
Parking Structures & Carports	2	$340,000	0
Indus-Manuf, Whse-Shops,	17	$14,680,214	0
Hospitals & Other Institutions	7	$66,058,205	0
Churches & Other Religious	1	$8,685,000	0
Private Schools & Day Care	1	$500,000	0
Public Buildings & Projects	9	$45,173,780	0
Utilities (gas elect wtr swr)	4	$5,148,609	0
Parks, Recreation, Entertain,	6	$3,303,260	0
Agricultural Buildings & Sheds	31	$575,623	0
Other Non-Residential Buildings	91	$52,588,849	0
Comm Structures Other Than	95	$31,083,889	0
Comm Rmdl, Addn, Int Fin	764	$192,777,581	0
Reroof Commercial	9	$679,215	0
Total Commercial Const	**1,094**	**$489,232,608**	**30**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	1	$5,000	0
Alternative Commercial Energy	3	$60,000	0
Total Solar Const	**4**	**$65,000**	**0**
Total North Dakota Const	**4,405**	**$940,841,344**	**2,680**

North Dakota Building Permit Summary
Week 49 - 11/29/18 to 12/05/18 (permits over $5,000)

Residential	Permits	Value	Units
Single Family Homes	33	$7,685,593	33
Footing & Foundation	1	$5,000	0
Swimming Pools & Spas	1	$20,000	0
Garages & Carports	9	$265,202	0
Res Rmdl, Addn, Int Fin	44	$468,236	0
Total Residential Const	**88**	**$8,444,031**	**33**
Commercial	**Permits**	**Value**	**Units**
Demolition (Commercial)	1	$0	0
Footing & Foundation	1	$33,650	0
Retail/Whsl/Dining/Personal	1	$5,000	0
Hospitals & Other Institutions	1	$500,000	0
Agricultural Buildings & Sheds	2	$70,000	0
Other Non-Residential Buildings	5	$2,975,000	0
Comm Structures Other Than	1	$293,900	0
Comm Rmdl, Addn, Int Fin	27	$4,267,649	0
Total Commercial Const	**39**	**$8,145,199**	**0**
Total North Dakota Const	**127**	**$16,589,230**	**33**

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North Dakota Single Family Builders
Year-to-Date 12/05/2018

Builder	Homes	Value
1 Jordahl Custom	159	$34,083,250
2 Thomsen Homes LLC	144	$27,254,300
3 Brookstone Property	69	$11,406,080
4 Verity Homes Inc	43	$8,676,323
5 Dabbert Custom	41	$7,749,200
6 Heritage Homes LLC	23	$7,378,000
7 Verity Homes of	27	$5,242,943
8 Platinum Home Contr	20	$5,159,000
9 Krueger Const Inc	12	$4,872,000
10 Titan Homes Inc	10	$4,634,000
11 Chris Hawley	1	$4,100,000
12 Limelight Builders	15	$3,939,995
13 K&L Homes Inc	19	$3,935,108
14 Sattler Homes Inc	18	$3,914,164
15 Venture Homes LLC	11	$3,298,050
16 Monarch Homes LLC	11	$3,051,000
17 Huntington Homes	15	$3,000,000
18 Diversity Homes Inc	12	$2,566,867
19 Investcore Inc	13	$2,514,728
20 Apex Builders LLC	10	$2,374,749
21 Tomlinson & Sons Inc	2	$2,336,500
22 Seacrest Custom	7	$2,155,175
23 Designer Homes Of	5	$2,134,000
24 John Schneider Const	7	$2,032,015
25 EID Co Buildings Inc	9	$1,995,237
26 J&L Construction	14	$1,934,600
27 Kochmann Brothers	4	$1,930,000
28 Joe Vetter	9	$1,916,423
29 J E Properties	9	$1,889,500
30 Equity Home Builders	6	$1,845,000
31 Crist Const Inc	4	$1,580,800
32 Holly & Company	4	$1,580,000
33 Footitt Homes Inc	2	$1,579,000
34 Rusch Homes LLC	7	$1,553,129
35 Radiant Creative	2	$1,450,000
36 Four Seasons Const	18	$1,403,000
37 Copper Ridge Design	7	$1,400,000
38 Dietrich Const Co	2	$1,370,000
39 Stoneshire Builders	6	$1,283,827
40 Plecity Kowalski	2	$1,275,000
41 Hallmark Homes	4	$1,223,887
42 Legend Homes Inc	4	$1,182,611
43 Adams Development	6	$1,134,000
44 Tooz Const Inc	1	$1,111,111
45 PrairieLand Homes	6	$1,104,000
46 Bachmeier Custom	4	$1,100,000
47 Terry Becker	2	$1,077,583
48 Sullivan Construction	4	$1,063,520
49 Windows Plus Inc	5	$1,030,000
50 Schwab Messer	4	$1,012,998
51 Olaf Anderson Const	1	$1,000,000
52 A&R Drywall	3	$999,000
53 Knutson Homes Inc	5	$994,913
54 K & B Homes	4	$992,554
55 Creative Touch	3	$983,105

North Dakota Garage and Carport Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 Hopfauf Custom	1	$203,637
2 Craft Builders	1	$186,000
3 JNR Construction	1	$145,000
4 Venable Enterprises	1	$123,000
5 Marc Davis	1	$117,555
6 Morton Buildings Inc	2	$117,458
7 Mindt Const	3	$103,000
8 Chapple Carpentry	1	$99,187
9 Meadowlands Park	6	$97,000
10 Goebel Construction	2	$91,655
11 Shaun Kessler	1	$87,400

North Dakota Residential Builders
Week 49 - 11/29/18 to 12/05/18

Builder	Permits	Value
1 Tooz Const Inc	1	$1,111,111
2 Franklin	8	$800,000
3 Investcore Inc	4	$605,000
4 Venture Building	3	$405,000
5 Rich Stradling	1	$395,059
6 Heritage Homes	1	$370,000
7 Paula Rae Homes &	1	$347,000
8 Legend Homes Inc	1	$346,589
9 Hanson Bros Inc	1	$340,000
10 Seacrest Custom	1	$260,489

North Dakota Multi-Family Builders
Year-to-Date 12/05/2018

Builder	Units	Value
1 Enclave	222	$17,624,000
2 Dietrich Const Co	174	$11,247,291
3 Kilbourne Const	139	$11,100,695
4 Roers Const Co LLC	124	$9,897,742
5 Terry Welle	81	$7,699,000
6 Eagleridge Partners	88	$6,800,000
7 FMI Constr LLC	84	$6,700,000
8 MBA Development	80	$6,400,000
9 DFI AU LLC	76	$6,111,565
10 Eagle Ridge	5	$6,000,000

North Dakota Other Residential Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 Hight Construction	2	$1,018,000
2 Kochmann Brothers	6	$665,300
3 Goldmark	2	$569,000
4 Accent Contracting	27	$525,000
5 Schmit Brothers	10	$502,000
6 ABC Seamless	22	$398,828
7 Ready Builders	2	$395,000
8 Azure Const	1	$369,000
9 Premium Decks Inc	23	$349,500
10 T&S Custom Homes	4	$321,000
11 Rick Halvorson Const	8	$317,276
12 Jordahl Custom	12	$307,400
13 Bob Footitt Const Inc	1	$300,000
14 Craft Builders	3	$288,000
15 Huntington Homes	2	$285,000
16 Sandin Family RLT	1	$275,000
17 KRO Rentals LLP	1	$265,000
18 Dan Lindquist Const	5	$264,000
19 Mindt Const	2	$255,000
20 Luxury Builders Inc	6	$253,000
21 Eclipse Carpentry	6	$248,400
22 Renovare LLC	2	$247,000
23 John Schneider	1	$235,878

North Dakota Commercial Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 Yates-Northwest, A	2	$47,280,000
2 McGough	7	$32,515,770
3 PKG Contracting &	2	$27,407,000
4 Mortenson	4	$22,050,000
5 Olaf Anderson Const	30	$18,004,000
6 Meinecke Johnson	10	$13,765,300
7 Park Const Co	1	$13,549,906
8 Lee Jones & Son	5	$12,791,741
9 Gehrtz Const	15	$12,599,641
10 CRG Inc	7	$11,471,000
11 Paces Lodging Corp	20	$8,884,024
12 Gast Construction	6	$8,588,389
13 Kiehm Const	1	$8,000,000
14 Rolac Contr Inc	13	$7,983,500
15 JE Dunn Const	3	$7,708,600
16 Enclave	28	$7,352,600
17 Enclave	3	$7,167,921
18 Kolling & Kolling Inc	7	$7,007,494
19 Roers Const Co LLC	18	$6,889,331
20 MBA Development	13	$6,884,141

North Dakota Owner-Builders
Year-to-Date 12/05/2018

Construction Type	Permits	Value
1 Single Family	81	$17,719,986
2 Garages & Carports	146	$2,579,760
3 Res Rmdl, Addn, Int	582	$8,828,837
4 Commercial	57	$1,692,273

North Dakota Commercial Builders
Week 49 - 11/29/18 to 12/05/18

Builder	Permits	Value
1 Scull Construction	1	$2,500,000
2 Kolling & Kolling Inc	2	$2,086,000
3 SB Inc	1	$560,000
4 Great States Const	1	$260,000
5 Southpaw USA Inc	1	$250,000
6 RI Properties LLC	1	$240,000
7 RJ Stallman	1	$160,800
8 JDP Electric	1	$150,000
9 Hafele Construction	1	$127,197
10 Dakota West	3	$124,652

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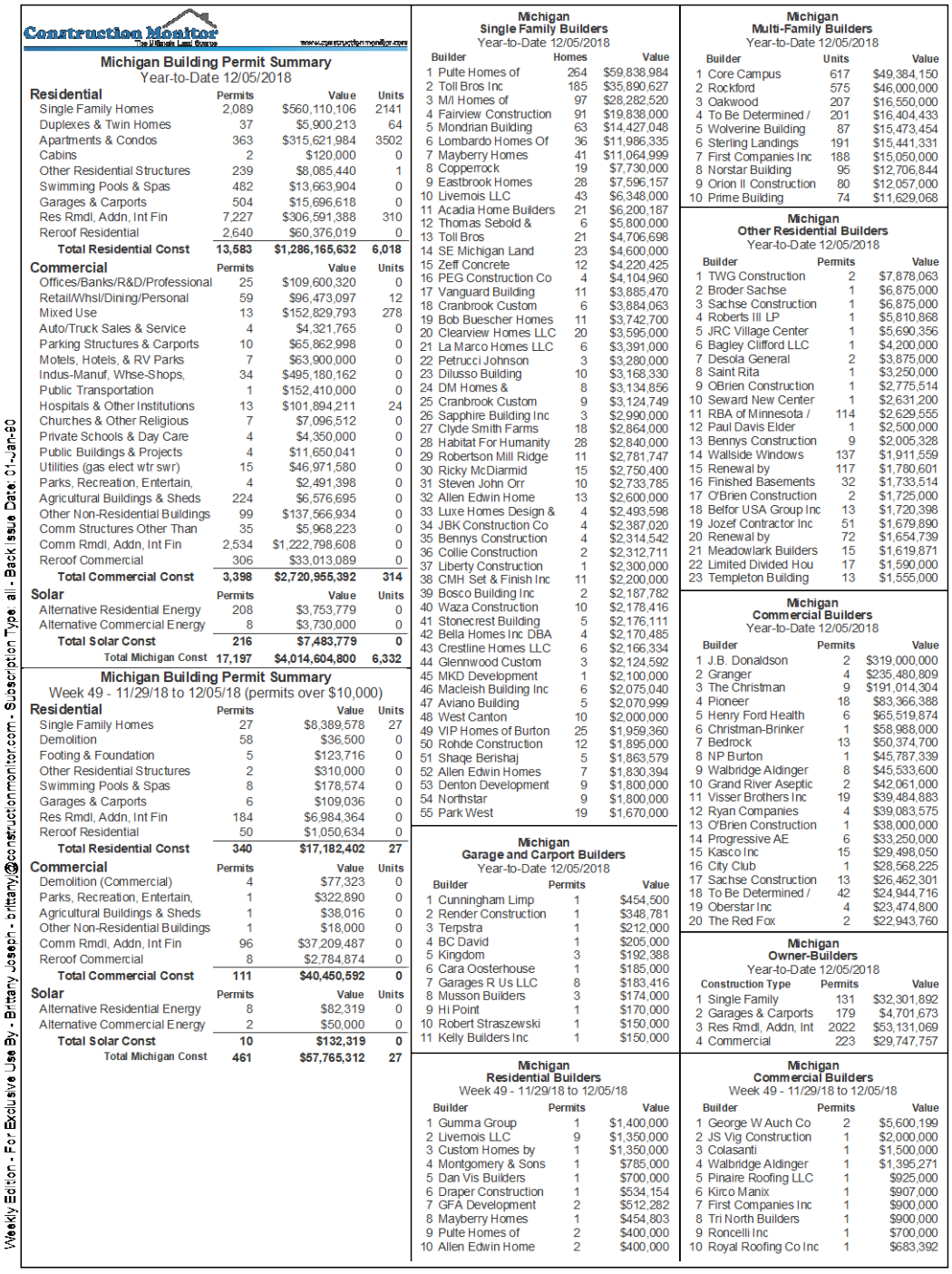
SOURCE: CONSTRUCTION MONITOR 2018

Table 18. 2018 Michigan Building Permit Summary



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Michigan Building Permit Summary
Year-to-Date 12/05/2018

Residential	Permits	Value	Units
Single Family Homes	2,089	$560,110,106	2141
Duplexes & Twin Homes	37	$5,900,213	64
Apartments & Condos	363	$315,621,984	3502
Cabins	2	$120,000	0
Other Residential Structures	239	$8,085,440	1
Swimming Pools & Spas	482	$13,663,904	0
Garages & Carports	504	$15,696,618	0
Res Rmdl, Addn, Int Fin	7,227	$306,591,388	310
Reroof Residential	2,640	$60,376,019	0
Total Residential Const	**13,583**	**$1,286,165,632**	**6,018**
Commercial	**Permits**	**Value**	**Units**
Offices/Banks/R&D/Professional	25	$109,600,320	0
Retail/Whsl/Dining/Personal	59	$96,473,097	12
Mixed Use	13	$152,829,793	278
Auto/Truck Sales & Service	4	$4,321,765	0
Parking Structures & Carports	10	$65,862,998	0
Motels, Hotels, & RV Parks	7	$63,900,000	0
Indus-Manuf, Whse-Shops,	34	$495,180,162	0
Public Transportation	1	$152,410,000	0
Hospitals & Other Institutions	13	$101,894,211	24
Churches & Other Religious	7	$7,096,512	0
Private Schools & Day Care	4	$4,350,000	0
Public Buildings & Projects	4	$11,650,041	0
Utilities (gas elect wtr swr)	15	$46,971,580	0
Parks, Recreation, Entertain,	4	$2,491,398	0
Agricultural Buildings & Sheds	224	$6,576,695	0
Other Non-Residential Buildings	99	$137,566,934	0
Comm Structures Other Than	35	$5,968,223	0
Comm Rmdl, Addn, Int Fin	2,534	$1,222,798,608	0
Reroof Commercial	306	$33,013,089	0
Total Commercial Const	**3,398**	**$2,720,955,392**	**314**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	208	$3,753,779	0
Alternative Commercial Energy	8	$3,730,000	0
Total Solar Const	**216**	**$7,483,779**	**0**
Total Michigan Const	**17,197**	**$4,014,604,800**	**6,332**

Michigan Building Permit Summary
Week 49 - 11/29/18 to 12/05/18 (permits over $10,000)

Residential	Permits	Value	Units
Single Family Homes	27	$8,389,578	27
Demolition	58	$36,500	0
Footing & Foundation	5	$123,716	0
Other Residential Structures	2	$310,000	0
Swimming Pools & Spas	8	$178,574	0
Garages & Carports	6	$109,036	0
Res Rmdl, Addn, Int Fin	184	$6,984,364	0
Reroof Residential	50	$1,050,634	0
Total Residential Const	**340**	**$17,182,402**	**27**
Commercial	**Permits**	**Value**	**Units**
Demolition (Commercial)	4	$77,323	0
Parks, Recreation, Entertain,	1	$322,890	0
Agricultural Buildings & Sheds	1	$38,016	0
Other Non-Residential Buildings	1	$18,000	0
Comm Rmdl, Addn, Int Fin	96	$37,209,487	0
Reroof Commercial	8	$2,784,874	0
Total Commercial Const	**111**	**$40,450,592**	**0**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	8	$82,319	0
Alternative Commercial Energy	2	$50,000	0
Total Solar Const	**10**	**$132,319**	**0**
Total Michigan Const	**461**	**$57,765,312**	**27**

Michigan
Single Family Builders
Year-to-Date 12/05/2018

	Builder	Homes	Value
1	Pulte Homes of	264	$59,838,984
2	Toll Bros Inc	185	$35,890,627
3	M/I Homes of	97	$28,282,520
4	Fairview Construction	91	$19,838,000
5	Mondrian Building	63	$14,427,048
6	Lombardo Homes Of	36	$11,986,335
7	Mayberry Homes	41	$11,064,999
8	Copperrock	19	$7,730,000
9	Eastbrook Homes	28	$7,596,157
10	Livernois LLC	43	$6,348,000
11	Acadia Home Builders	21	$6,200,187
12	Thomas Sebold &	6	$5,800,000
13	Toll Bros	21	$4,706,698
14	SE Michigan Land	23	$4,600,000
15	Zeff Concrete	12	$4,220,425
16	PEG Construction Co	4	$4,104,960
17	Vanguard Building	11	$3,885,470
18	Cranbrook Custom	6	$3,884,063
19	Bob Buescher Homes	11	$3,742,700
20	Clearview Homes LLC	20	$3,595,000
21	La Marco Homes LLC	6	$3,391,000
22	Petrucci Johnson	3	$3,280,000
23	Dilusso Building	10	$3,168,330
24	DM Homes &	8	$3,134,856
25	Cranbrook Custom	9	$3,124,749
26	Sapphire Building Inc	3	$2,990,000
27	Clyde Smith Farms	18	$2,864,000
28	Habitat For Humanity	28	$2,840,000
29	Robertson Mill Ridge	11	$2,781,747
30	Ricky McDiarmid	15	$2,750,400
31	Steven John Orr	10	$2,733,785
32	Allen Edwin Home	13	$2,600,000
33	Luxe Homes Design &	4	$2,493,598
34	JBK Construction Co	4	$2,387,020
35	Bennys Construction	4	$2,314,542
36	Collie Construction	2	$2,312,711
37	Liberty Construction	1	$2,300,000
38	CMH Set & Finish Inc	11	$2,200,000
39	Bosco Building Inc	2	$2,187,782
40	Waza Construction	10	$2,178,416
41	Stonecrest Building	5	$2,176,111
42	Bella Homes Inc DBA	4	$2,170,485
43	Crestline Homes LLC	6	$2,166,334
44	Glennwood Custom	3	$2,124,592
45	MKD Development	1	$2,100,000
46	Macleish Building Inc	6	$2,075,040
47	Aviano Building	5	$2,070,999
48	West Canton	10	$2,000,000
49	VIP Homes of Burton	25	$1,959,360
50	Rohde Construction	12	$1,895,000
51	Shaqe Berishaj	5	$1,863,579
52	Allen Edwin Homes	7	$1,830,394
53	Denton Development	9	$1,800,000
54	Northstar	9	$1,800,000
55	Park West	19	$1,670,000

Michigan
Garage and Carport Builders
Year-to-Date 12/05/2018

	Builder	Permits	Value
1	Cunningham Limp	1	$454,500
2	Render Construction	1	$348,781
3	Terpstra	1	$212,000
4	BC David	1	$205,000
5	Kingdom	3	$192,388
6	Cara Oosterhouse	1	$185,000
7	Garages R Us LLC	8	$183,416
8	Musson Builders	3	$174,000
9	Hi Point	1	$170,000
10	Robert Straszewski	1	$150,000
11	Kelly Builders Inc	1	$150,000

Michigan
Residential Builders
Week 49 - 11/29/18 to 12/05/18

	Builder	Permits	Value
1	Gumma Group	1	$1,400,000
2	Livernois LLC	9	$1,350,000
3	Custom Homes by	1	$1,350,000
4	Montgomery & Sons	1	$785,000
5	Dan Vis Builders	1	$700,000
6	Draper Construction	1	$534,154
7	GFA Development	2	$512,282
8	Mayberry Homes	1	$454,803
9	Pulte Homes of	2	$400,000
10	Allen Edwin Home	2	$400,000

Michigan
Multi-Family Builders
Year-to-Date 12/05/2018

	Builder	Units	Value
1	Core Campus	617	$49,384,150
2	Rockford	575	$46,000,000
3	Oakwood	207	$16,550,000
4	To Be Determined /	201	$16,404,433
5	Wolverine Building	87	$15,473,454
6	Sterling Landings	191	$15,441,331
7	First Companies Inc	188	$15,050,000
8	Norstar Building	95	$12,706,844
9	Orion II Construction	80	$12,057,000
10	Prime Building	74	$11,629,068

Michigan
Other Residential Builders
Year-to-Date 12/05/2018

	Builder	Permits	Value
1	TWG Construction	2	$7,878,063
2	Broder Sachse	1	$6,875,000
3	Sachse Construction	1	$6,875,000
4	Roberts III LP	1	$5,810,868
5	JRC Village Center	1	$5,690,356
6	Bagley Clifford LLC	1	$4,200,000
7	Desola General	2	$3,875,000
8	Saint Rita	1	$3,250,000
9	OBrien Construction	1	$2,775,514
10	Seward New Center	1	$2,631,200
11	RBA of Minnesota /	114	$2,629,555
12	Paul Davis Elder	1	$2,500,000
13	Bennys Construction	9	$2,005,328
14	Wallside Windows	137	$1,911,559
15	Renewal by	117	$1,780,601
16	Finished Basements	32	$1,733,514
17	O'Brien Construction	2	$1,725,000
18	Belfor USA Group Inc	13	$1,720,398
19	Jozef Contractor Inc	51	$1,679,890
20	Renewal by	72	$1,654,739
21	Meadowlark Builders	15	$1,619,871
22	Limited Divided Hou	17	$1,590,000
23	Templeton Building	13	$1,555,000

Michigan
Commercial Builders
Year-to-Date 12/05/2018

	Builder	Permits	Value
1	J.B. Donaldson	2	$319,000,000
2	Granger	4	$235,480,809
3	The Christman	9	$191,014,304
4	Pioneer	18	$83,366,388
5	Henry Ford Health	6	$65,519,874
6	Christman-Brinker	1	$58,988,000
7	Bedrock	13	$50,374,700
8	NP Burton	1	$45,787,339
9	Walbridge Aldinger	8	$45,533,600
10	Grand River Aseptic	2	$42,061,000
11	Visser Brothers Inc	19	$39,484,883
12	Ryan Companies	4	$39,083,575
13	O'Brien Construction	1	$38,000,000
14	Progressive AE	6	$33,250,000
15	Kasco Inc	15	$29,498,050
16	City Club	1	$28,568,225
17	Sachse Construction	13	$26,462,301
18	To Be Determined /	42	$24,944,716
19	Oberstar Inc	4	$23,474,800
20	The Red Fox	2	$22,943,760

Michigan
Owner-Builders
Year-to-Date 12/05/2018

	Construction Type	Permits	Value
1	Single Family	131	$32,301,892
2	Garages & Carports	179	$4,701,673
3	Res Rmdl, Addn, Int	2022	$53,131,069
4	Commercial	223	$29,747,757

Michigan
Commercial Builders
Week 49 - 11/29/18 to 12/05/18

	Builder	Permits	Value
1	George W Auch Co	2	$5,600,199
2	JS Vig Construction	1	$2,000,000
3	Colasanti	1	$1,500,000
4	Walbridge Aldinger	1	$1,395,271
5	Pinaire Roofing LLC	1	$925,000
6	Kirco Manix	1	$907,000
7	First Companies Inc	1	$900,000
8	Tri North Builders	1	$900,000
9	Roncelli Inc	1	$700,000
10	Royal Roofing Co Inc	1	$683,392

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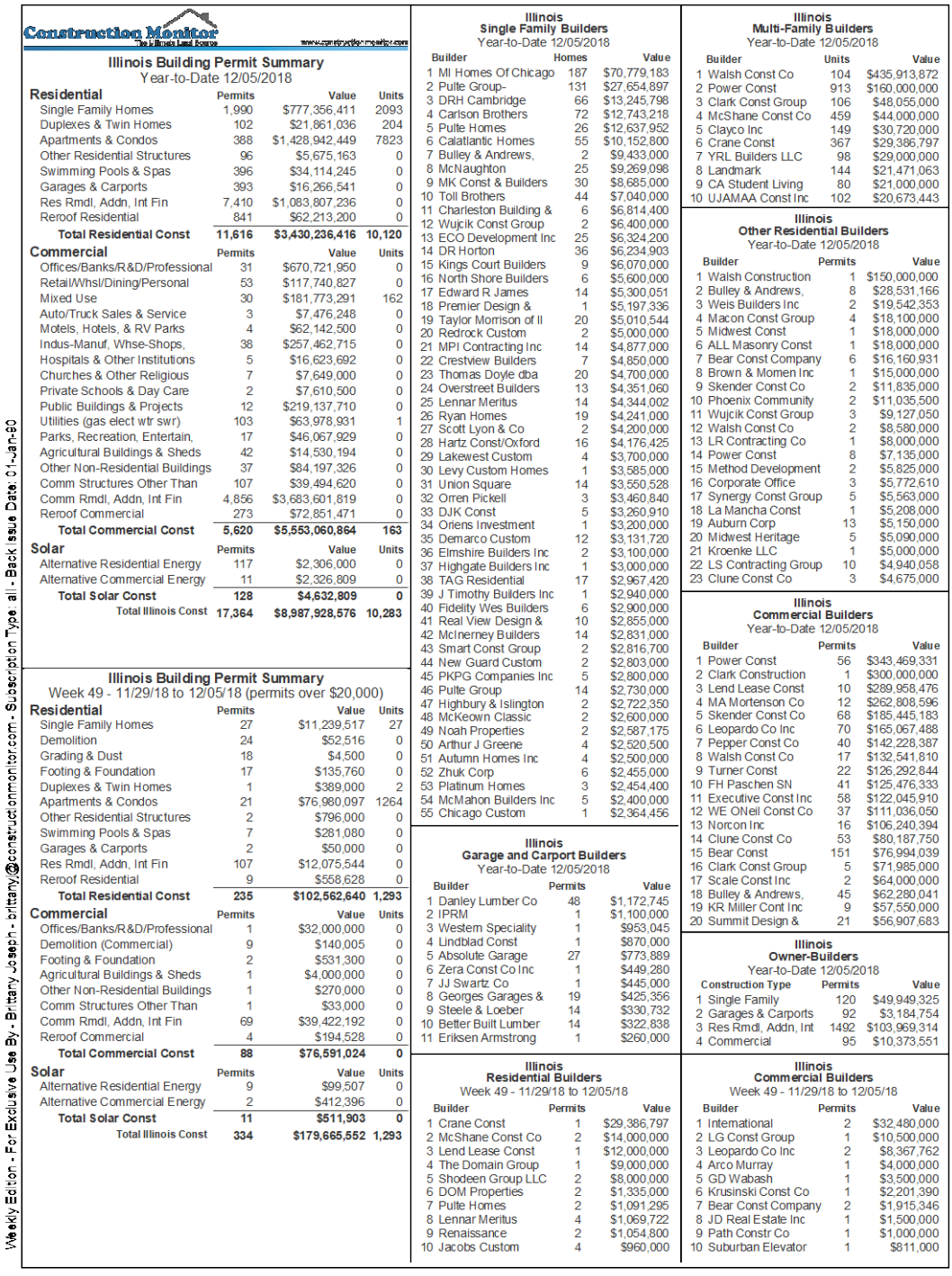
SOURCE: CONSTRUCTION MONITOR 2018

Table 19. 2018 Illinois Building Permit Summary



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Illinois Building Permit Summary
Year-to-Date 12/05/2018

Residential	Permits	Value	Units
Single Family Homes	1,990	$777,356,411	2093
Duplexes & Twin Homes	102	$21,861,036	204
Apartments & Condos	388	$1,428,942,449	7823
Other Residential Structures	96	$5,675,163	0
Swimming Pools & Spas	396	$34,114,245	0
Garages & Carports	393	$16,266,541	0
Res Rmdl, Addn, Int Fin	7,410	$1,083,807,236	0
Reroof Residential	841	$62,213,200	0
Total Residential Const	**11,616**	**$3,430,236,416**	**10,120**
Commercial	**Permits**	**Value**	**Units**
Offices/Banks/R&D/Professional	31	$670,721,950	0
Retail/Whsl/Dining/Personal	53	$117,740,827	0
Mixed Use	30	$181,773,291	162
Auto/Truck Sales & Service	3	$7,476,248	0
Motels, Hotels, & RV Parks	4	$62,142,500	0
Indus-Manuf, Whse-Shops,	38	$257,462,715	0
Hospitals & Other Institutions	5	$16,623,692	0
Churches & Other Religious	7	$7,649,000	0
Private Schools & Day Care	2	$7,610,500	0
Public Buildings & Projects	12	$219,137,710	0
Utilities (gas elect wtr swr)	103	$63,978,931	1
Parks, Recreation, Entertain,	17	$46,067,929	0
Agricultural Buildings & Sheds	42	$14,530,194	0
Other Non-Residential Buildings	37	$84,197,326	0
Comm Structures Other Than	107	$39,494,620	0
Comm Rmdl, Addn, Int Fin	4,856	$3,683,601,819	0
Reroof Commercial	273	$72,851,471	0
Total Commercial Const	**5,620**	**$5,553,060,864**	**163**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	117	$2,306,000	0
Alternative Commercial Energy	11	$2,326,809	0
Total Solar Const	**128**	**$4,632,809**	**0**
Total Illinois Const	**17,364**	**$8,987,928,576**	**10,283**

Illinois Building Permit Summary
Week 49 - 11/29/18 to 12/05/18 (permits over $20,000)

Residential	Permits	Value	Units
Single Family Homes	27	$11,239,517	27
Demolition	24	$52,516	0
Grading & Dust	18	$4,500	0
Footing & Foundation	17	$135,760	0
Duplexes & Twin Homes	1	$389,000	2
Apartments & Condos	21	$76,980,097	1264
Other Residential Structures	2	$796,000	0
Swimming Pools & Spas	7	$281,080	0
Garages & Carports	2	$50,000	0
Res Rmdl, Addn, Int Fin	107	$12,075,544	0
Reroof Residential	9	$558,628	0
Total Residential Const	**235**	**$102,562,640**	**1,293**
Commercial	**Permits**	**Value**	**Units**
Offices/Banks/R&D/Professional	1	$32,000,000	0
Demolition (Commercial)	9	$140,005	0
Footing & Foundation	2	$531,300	0
Agricultural Buildings & Sheds	1	$4,000,000	0
Other Non-Residential Buildings	1	$270,000	0
Comm Structures Other Than	1	$33,000	0
Comm Rmdl, Addn, Int Fin	69	$39,422,192	0
Reroof Commercial	4	$194,528	0
Total Commercial Const	**88**	**$76,591,024**	**0**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	9	$99,507	0
Alternative Commercial Energy	2	$412,396	0
Total Solar Const	**11**	**$511,903**	**0**
Total Illinois Const	**334**	**$179,665,552**	**1,293**

Illinois
Single Family Builders
Year-to-Date 12/05/2018

	Builder	Homes	Value
1	MI Homes Of Chicago	187	$70,779,183
2	Pulte Group-	131	$27,654,897
3	DRH Cambridge	66	$13,245,798
4	Carlson Brothers	72	$12,743,218
5	Pulte Homes	26	$12,637,952
6	Calatlantic Homes	55	$10,152,800
7	Bulley & Andrews,	2	$9,433,000
8	McNaughton	25	$9,269,098
9	MK Const & Builders	30	$8,685,000
10	Toll Brothers	44	$7,040,000
11	Charleston Building &	6	$6,814,400
12	Wujcik Const Group	2	$6,400,000
13	ECO Development Inc	25	$6,324,200
14	DR Horton	36	$6,234,903
15	Kings Court Builders	9	$6,070,000
16	North Shore Builders	6	$5,600,000
17	Edward R James	14	$5,300,051
18	Premier Design &	1	$5,197,336
19	Taylor Morrison of Il	20	$5,010,544
20	Redrock Custom	2	$5,000,000
21	MPI Contracting Inc	14	$4,877,000
22	Crestview Builders	7	$4,850,000
23	Thomas Doyle dba	20	$4,700,000
24	Overstreet Builders	13	$4,351,060
25	Lennar Meritus	14	$4,344,002
26	Ryan Homes	19	$4,241,000
27	Scott Lyon & Co	2	$4,200,000
28	Hartz Const/Oxford	16	$4,176,425
29	Lakewest Custom	4	$3,700,000
30	Levy Custom Homes	1	$3,585,000
31	Union Square	14	$3,550,528
32	Orren Pickell	3	$3,460,840
33	DJK Const	5	$3,260,910
34	Oriens Investment	1	$3,200,000
35	Demarco Custom	12	$3,131,720
36	Elmshire Builders Inc	2	$3,100,000
37	Highgate Builders Inc	1	$3,000,000
38	TAG Residential	17	$2,967,420
39	J Timothy Builders Inc	1	$2,940,000
40	Fidelity Wes Builders	6	$2,900,000
41	Real View Design &	10	$2,855,000
42	McInerney Builders	14	$2,831,000
43	Smart Const Group	2	$2,816,700
44	New Guard Custom	2	$2,803,000
45	PKPG Companies Inc	5	$2,800,000
46	Pulte Group	14	$2,730,000
47	Highbury & Islington	2	$2,722,350
48	McKeown Classic	2	$2,600,000
49	Noah Properties	2	$2,587,175
50	Arthur J Greene	4	$2,520,500
51	Autumn Homes Inc	4	$2,500,000
52	Zhuk Corp	6	$2,455,000
53	Platinum Homes	3	$2,454,400
54	McMahon Builders Inc	5	$2,400,000
55	Chicago Custom	1	$2,364,456

Illinois
Garage and Carport Builders
Year-to-Date 12/05/2018

	Builder	Permits	Value
1	Danley Lumber Co	48	$1,172,745
2	IPRM	1	$1,100,000
3	Western Speciality	1	$953,045
4	Lindblad Const	1	$870,000
5	Absolute Garage	27	$773,889
6	Zera Const Co Inc	1	$449,280
7	JJ Swartz Co	1	$445,000
8	Georges Garages &	19	$425,356
9	Steele & Loeber	14	$330,732
10	Better Built Lumber	14	$322,838
11	Eriksen Armstrong	1	$260,000

Illinois
Residential Builders
Week 49 - 11/29/18 to 12/05/18

	Builder	Permits	Value
1	Crane Const	1	$29,386,797
2	McShane Const Co	2	$14,000,000
3	Lend Lease Const	1	$12,000,000
4	The Domain Group	1	$9,000,000
5	Shodeen Group LLC	2	$8,000,000
6	DOM Properties	2	$1,335,000
7	Pulte Homes	2	$1,091,295
8	Lennar Meritus	4	$1,069,722
9	Renaissance	2	$1,054,800
10	Jacobs Custom	4	$960,000

Illinois
Multi-Family Builders
Year-to-Date 12/05/2018

	Builder	Units	Value
1	Walsh Const Co	104	$435,913,872
2	Power Const	913	$160,000,000
3	Clark Const Group	106	$48,055,000
4	McShane Const Co	459	$44,000,000
5	Clayco Inc	149	$30,720,000
6	Crane Const	367	$29,386,797
7	YRL Builders LLC	98	$29,000,000
8	Landmark	144	$21,471,063
9	CA Student Living	80	$21,000,000
10	UJAMAA Const Inc	102	$20,673,443

Illinois
Other Residential Builders
Year-to-Date 12/05/2018

	Builder	Permits	Value
1	Walsh Construction	1	$150,000,000
2	Bulley & Andrews,	8	$28,531,166
3	Weis Builders Inc	2	$19,542,353
4	Macon Const Group	4	$18,100,000
5	Midwest Const	1	$18,000,000
6	ALL Masonry Const	1	$18,000,000
7	Bear Const Company	6	$16,160,931
8	Brown & Momen Inc	1	$15,000,000
9	Skender Const Co	2	$11,835,000
10	Phoenix Community	2	$11,035,500
11	Wujcik Const Group	3	$9,127,050
12	Walsh Const Co	2	$8,580,000
13	LR Contracting Co	1	$8,000,000
14	Power Const	8	$7,135,000
15	Method Development	2	$5,825,000
16	Corporate Office	3	$5,772,610
17	Synergy Const Group	5	$5,563,000
18	La Mancha Const	1	$5,208,000
19	Auburn Corp	13	$5,150,000
20	Midwest Heritage	5	$5,090,000
21	Kroenke LLC	1	$5,000,000
22	LS Contracting Group	10	$4,940,058
23	Clune Const Co	3	$4,675,000

Illinois
Commercial Builders
Year-to-Date 12/05/2018

	Builder	Permits	Value
1	Power Const	56	$343,469,331
2	Clark Construction	1	$300,000,000
3	Lend Lease Const	10	$289,958,476
4	MA Mortenson Co	12	$262,808,596
5	Skender Const Co	68	$185,445,183
6	Leopardo Co Inc	70	$165,067,488
7	Pepper Const Co	40	$142,228,387
8	Walsh Const Co	17	$132,541,810
9	Turner Const	22	$126,292,844
10	FH Paschen SN	41	$125,476,333
11	Executive Const Inc	58	$122,045,910
12	WE ONeil Const Co	37	$111,036,050
13	Norcon Inc	16	$106,240,394
14	Clune Const Co	53	$80,187,750
15	Bear Const	151	$76,994,039
16	Clark Const Group	5	$71,985,000
17	Scale Const Inc	2	$64,000,000
18	Bulley & Andrews,	45	$62,280,041
19	KR Miller Cont Inc	9	$57,550,000
20	Summit Design &	21	$56,907,683

Illinois
Owner-Builders
Year-to-Date 12/05/2018

	Construction Type	Permits	Value
1	Single Family	120	$49,949,325
2	Garages & Carports	92	$3,184,754
3	Res Rmdl, Addn, Int	1492	$103,969,314
4	Commercial	95	$10,373,551

Illinois
Commercial Builders
Week 49 - 11/29/18 to 12/05/18

	Builder	Permits	Value
1	International	2	$32,480,000
2	LG Const Group	1	$10,500,000
3	Leopardo Co Inc	2	$8,367,762
4	Arco Murray	1	$4,000,000
5	GD Wabash	1	$3,500,000
6	Krusinski Const Co	1	$2,201,390
7	Bear Const Company	2	$1,915,346
8	JD Real Estate Inc	1	$1,500,000
9	Path Constr Co	1	$1,000,000
10	Suburban Elevator	1	$811,000

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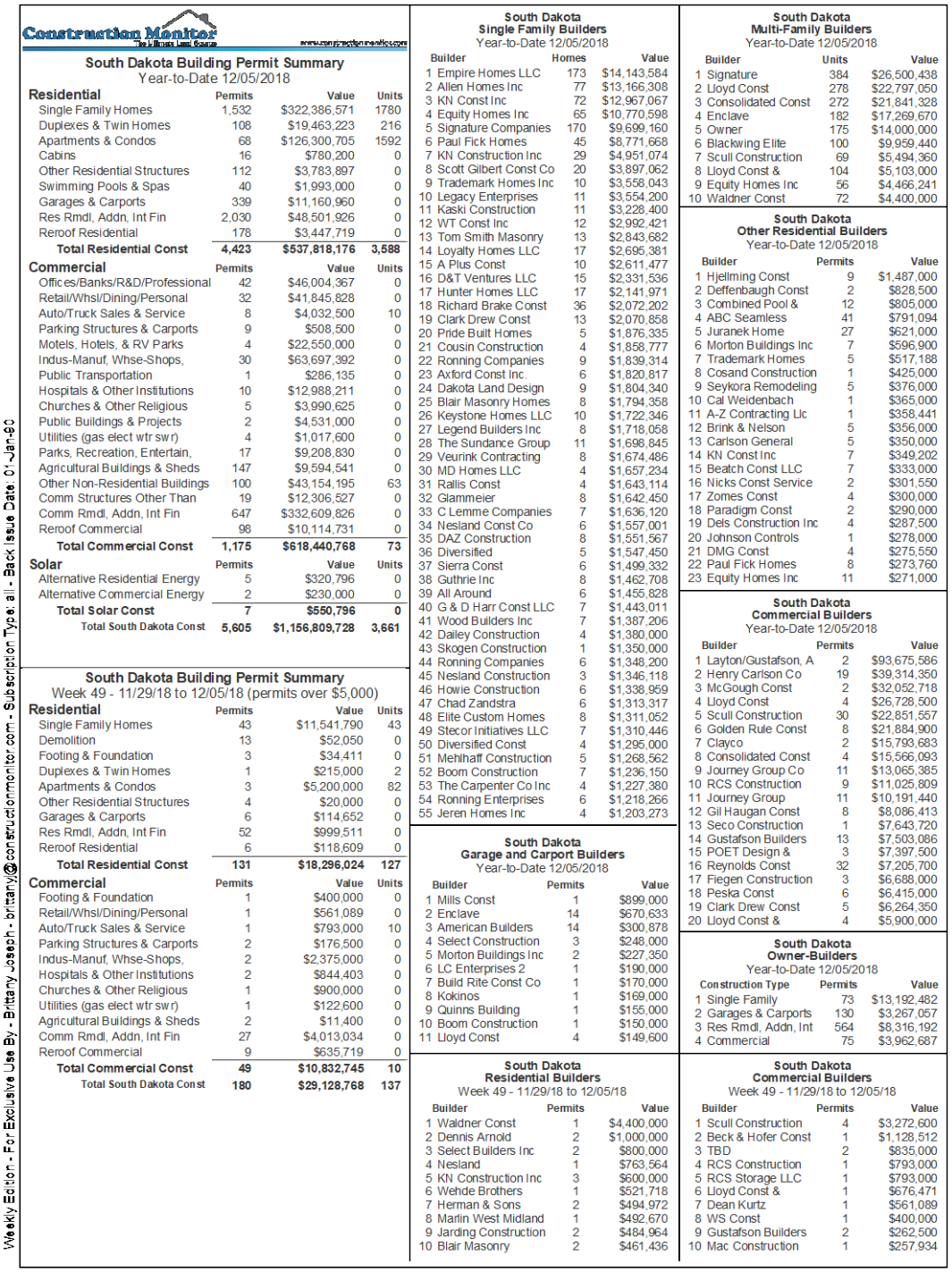
SOURCE: CONSTRUCTION MONITOR 2018

Bureau of Business and Economic Research
Center for Economic Development
University of Minnesota Duluth

Table 20. 2018 South Dakota Building Permit Summary



Construction Monitor
The Intermountain Region's Construction Source
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South Dakota Building Permit Summary
Year-to-Date 12/05/2018

Residential	Permits	Value	Units
Single Family Homes	1,532	$322,386,571	1780
Duplexes & Twin Homes	108	$19,463,223	216
Apartments & Condos	68	$126,300,705	1592
Cabins	16	$780,200	0
Other Residential Structures	112	$3,783,897	0
Swimming Pools & Spas	40	$1,993,000	0
Garages & Carports	339	$11,160,960	0
Res Rmdl, Addn, Int Fin	2,030	$48,501,926	0
Reroof Residential	178	$3,447,719	0
Total Residential Const	**4,423**	**$537,818,176**	**3,588**
Commercial	**Permits**	**Value**	**Units**
Offices/Banks/R&D/Professional	42	$46,004,367	0
Retail/Whsl/Dining/Personal	32	$41,845,828	0
Auto/Truck Sales & Service	8	$4,032,500	10
Parking Structures & Carports	9	$508,500	0
Motels, Hotels, & RV Parks	4	$22,550,000	0
Indus-Manuf, Whse-Shops,	30	$63,697,392	0
Public Transportation	1	$286,135	0
Hospitals & Other Institutions	10	$12,988,211	0
Churches & Other Religious	5	$3,990,625	0
Public Buildings & Projects	2	$4,531,000	0
Utilities (gas elect wtr swr)	4	$1,017,600	0
Parks, Recreation, Entertain,	17	$9,208,830	0
Agricultural Buildings & Sheds	147	$9,594,541	0
Other Non-Residential Buildings	100	$43,154,195	63
Comm Structures Other Than	19	$12,306,527	0
Comm Rmdl, Addn, Int Fin	647	$332,609,826	0
Reroof Commercial	98	$10,114,731	0
Total Commercial Const	**1,175**	**$618,440,768**	**73**
Solar	**Permits**	**Value**	**Units**
Alternative Residential Energy	5	$320,796	0
Alternative Commercial Energy	2	$230,000	0
Total Solar Const	**7**	**$550,796**	**0**
Total South Dakota Const	**5,605**	**$1,156,809,728**	**3,661**

South Dakota Building Permit Summary
Week 49 - 11/29/18 to 12/05/18 (permits over $5,000)

Residential	Permits	Value	Units
Single Family Homes	43	$11,541,790	43
Demolition	13	$52,050	0
Footing & Foundation	3	$34,411	0
Duplexes & Twin Homes	1	$215,000	2
Apartments & Condos	3	$5,200,000	82
Other Residential Structures	4	$20,000	0
Garages & Carports	6	$114,652	0
Res Rmdl, Addn, Int Fin	52	$999,511	0
Reroof Residential	6	$118,609	0
Total Residential Const	**131**	**$18,296,024**	**127**
Commercial	**Permits**	**Value**	**Units**
Footing & Foundation	1	$400,000	0
Retail/Whsl/Dining/Personal	1	$561,089	0
Auto/Truck Sales & Service	1	$793,000	10
Parking Structures & Carports	2	$176,500	0
Indus-Manuf, Whse-Shops,	2	$2,375,000	0
Hospitals & Other Institutions	2	$844,403	0
Churches & Other Religious	1	$900,000	0
Utilities (gas elect wtr swr)	1	$122,600	0
Agricultural Buildings & Sheds	2	$11,400	0
Comm Rmdl, Addn, Int Fin	27	$4,013,034	0
Reroof Commercial	9	$635,719	0
Total Commercial Const	**49**	**$10,832,745**	**10**
Total South Dakota Const	**180**	**$29,128,768**	**137**

South Dakota Single Family Builders
Year-to-Date 12/05/2018

Builder	Homes	Value
1 Empire Homes LLC	173	$14,143,584
2 Allen Homes Inc	77	$13,166,308
3 KN Const Inc	72	$12,967,067
4 Equity Homes Inc	65	$10,770,598
5 Signature Companies	170	$9,699,160
6 Paul Fick Homes	45	$8,771,668
7 KN Construction Inc	29	$4,951,074
8 Scott Gilbert Const Co	20	$3,897,062
9 Trademark Homes Inc	10	$3,558,043
10 Legacy Enterprises	11	$3,554,200
11 Kaski Construction	11	$3,228,400
12 WT Const Inc	12	$2,992,421
13 Tom Smith Masonry	13	$2,843,682
14 Loyalty Homes LLC	17	$2,695,381
15 A Plus Const	10	$2,611,477
16 D&T Ventures LLC	15	$2,331,536
17 Hunter Homes LLC	17	$2,141,971
18 Richard Brake Const	36	$2,072,202
19 Clark Drew Const	13	$2,070,858
20 Pride Built Homes	5	$1,876,335
21 Cousin Construction	4	$1,858,777
22 Ronning Companies	9	$1,839,314
23 Axford Const Inc.	6	$1,820,817
24 Dakota Land Design	9	$1,804,340
25 Blair Masonry Homes	8	$1,794,358
26 Keystone Homes LLC	10	$1,722,346
27 Legend Builders Inc	8	$1,718,058
28 The Sundance Group	11	$1,698,845
29 Veurink Contracting	8	$1,674,486
30 MD Homes LLC	4	$1,657,234
31 Rallis Const	4	$1,643,114
32 Glammeier	8	$1,642,450
33 C Lemme Companies	7	$1,636,120
34 Nesland Const Co	6	$1,557,001
35 DAZ Construction	8	$1,551,567
36 Diversified	5	$1,547,450
37 Sierra Const	6	$1,499,332
38 Guthrie Inc	8	$1,462,708
39 All Around	6	$1,455,828
40 G & D Harr Const LLC	7	$1,443,011
41 Wood Builders Inc	7	$1,387,206
42 Dailey Construction	4	$1,380,000
43 Skogen Construction	1	$1,350,000
44 Ronning Companies	6	$1,348,200
45 Nesland Construction	3	$1,346,118
46 Howie Construction	6	$1,338,959
47 Chad Zandstra	6	$1,313,317
48 Elite Custom Homes	8	$1,311,052
49 Stecor Initiatives LLC	7	$1,310,446
50 Diversified Const	4	$1,295,000
51 Mehlhaff Construction	5	$1,268,562
52 Boom Construction	7	$1,236,150
53 The Carpenter Co Inc	4	$1,227,380
54 Ronning Enterprises	6	$1,218,266
55 Jeren Homes Inc	4	$1,203,273

South Dakota Garage and Carport Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 Mills Const	1	$899,000
2 Enclave	14	$670,633
3 American Builders	14	$300,878
4 Select Construction	3	$248,000
5 Morton Buildings Inc	2	$227,350
6 LC Enterprises 2	1	$190,000
7 Build Rite Const Co	1	$170,000
8 Kokinos	1	$169,000
9 Quinns Building	1	$155,000
10 Boom Construction	1	$150,000
11 Lloyd Const	4	$149,600

South Dakota Residential Builders
Week 49 - 11/29/18 to 12/05/18

Builder	Permits	Value
1 Waldner Const	1	$4,400,000
2 Dennis Arnold	2	$1,000,000
3 Select Builders Inc	2	$800,000
4 Nesland	1	$763,564
5 KN Construction Inc	3	$600,000
6 Wehde Brothers	1	$521,718
7 Herman & Sons	2	$494,972
8 Marlin West Midland	1	$492,670
9 Jarding Construction	2	$484,964
10 Blair Masonry	2	$461,436

South Dakota Multi-Family Builders
Year-to-Date 12/05/2018

Builder	Units	Value
1 Signature	384	$26,500,438
2 Lloyd Const	278	$22,797,050
3 Consolidated Const	272	$21,841,328
4 Enclave	182	$17,269,670
5 Owner	175	$14,000,000
6 Blackwing Elite	100	$9,959,440
7 Scull Construction	69	$5,494,360
8 Lloyd Const &	104	$5,103,000
9 Equity Homes Inc	56	$4,466,241
10 Waldner Const	72	$4,400,000

South Dakota Other Residential Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 Hjellming Const	9	$1,487,000
2 Deffenbaugh Const	2	$828,500
3 Combined Pool &	12	$805,000
4 ABC Seamless	41	$791,094
5 Juranek Home	27	$621,000
6 Morton Buildings Inc	7	$596,900
7 Trademark Homes	5	$517,188
8 Cosand Construction	1	$425,000
9 Seykora Remodeling	5	$376,000
10 Cal Weidenbach	1	$365,000
11 A-Z Contracting Llc	1	$358,441
12 Brink & Nelson	5	$356,000
13 Carlson General	5	$350,000
14 KN Const Inc	7	$349,202
15 Beatch Const LLC	7	$333,000
16 Nicks Const Service	2	$301,550
17 Zomes Const	4	$300,000
18 Paradigm Const	2	$290,000
19 Dels Construction Inc	4	$287,500
20 Johnson Controls	1	$278,000
21 DMG Const	4	$275,550
22 Paul Fick Homes	8	$273,760
23 Equity Homes Inc	11	$271,000

South Dakota Commercial Builders
Year-to-Date 12/05/2018

Builder	Permits	Value
1 Layton/Gustafson, A	2	$93,675,586
2 Henry Carlson Co	19	$39,314,350
3 McGough Const	2	$32,052,718
4 Lloyd Const	4	$26,728,500
5 Scull Construction	30	$22,851,557
6 Golden Rule Const	8	$21,884,900
7 Clayco	2	$15,793,683
8 Consolidated Const	4	$15,566,093
9 Journey Group Co	11	$13,065,385
10 RCS Construction	9	$11,025,809
11 Journey Group	11	$10,191,440
12 Gil Haugan Const	8	$8,086,413
13 Seco Construction	1	$7,643,720
14 Gustafson Builders	13	$7,503,086
15 POET Design &	3	$7,397,500
16 Reynolds Const	32	$7,205,700
17 Fiegen Construction	3	$6,688,000
18 Peska Const	6	$6,415,000
19 Clark Drew Const	5	$6,264,350
20 Lloyd Const &	4	$5,900,000

South Dakota Owner-Builders
Year-to-Date 12/05/2018

Construction Type	Permits	Value
1 Single Family	73	$13,192,482
2 Garages & Carports	130	$3,267,057
3 Res Rmdl, Addn, Int	564	$8,316,192
4 Commercial	75	$3,962,687

South Dakota Commercial Builders
Week 49 - 11/29/18 to 12/05/18

Builder	Permits	Value
1 Scull Construction	4	$3,272,600
2 Beck & Hofer Const	1	$1,128,512
3 TBD	2	$835,000
4 RCS Construction	1	$793,000
5 RCS Storage LLC	1	$793,000
6 Lloyd Const &	1	$676,471
7 Dean Kurtz	1	$561,089
8 WS Const	1	$400,000
9 Gustafson Builders	2	$262,500
10 Mac Construction	1	$257,934

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SOURCE: CONSTRUCTION MONITOR 2018

Appendix E. Input-Output Modeling

Data Sources

This study uses the IMPLAN Group's input-output modeling data and software (IMPLAN version 3.1). The IMPLAN database contains county, state, zip code, and federal economic statistics, which are specialized by region, not estimated from national averages. Using classic input-output analysis in combination with region-specific Social Accounting Matrices and Multiplier Models, IMPLAN provides a highly accurate and adaptable model for its users. IMPLAN data files use the following federal government data sources:

- U.S. Bureau of Economic Analysis Benchmark Input-Output Accounts of the U.S.
- U.S. Bureau of Economic Analysis Output Estimates
- U.S. Bureau of Economic Analysis Regional Economic Information Systems (REIS) Program
- U.S. Bureau of Labor Statistics Covered Employment and Wages (CEW) Program
- U.S. Bureau of Labor Statistics Consumer Expenditure Survey
- U.S. Census Bureau County Business Patterns
- U.S. Census Bureau Decennial Census and Population Surveys
- U.S. Census Bureau Economic Censuses and Surveys
- U.S. Department of Agriculture Census

IMPLAN data files consist of the following components: employment, industry output, value added, institutional demands, national structural matrices, and inter-institutional transfers. Economic impacts are made up of direct, indirect, and induced impacts. The data used was the most recent IMPLAN data available, which is for the year 2017. All data are reported in 2018 dollars.

Economic impacts are made up of direct, indirect, and induced impacts. The following are suggested assumptions for accepting the impact model: IMPLAN input/output is a production-based model, and employment numbers (from U.S. Department of Commerce secondary data) treat both full- and part-time individuals as being employed.

Regional data for the impact models for value added, employment, and output are supplied by IMPLAN for this impact. Employment assumptions were provided to the model to enable construction of the impact model. From these data, social accounts, production, absorption, and byproducts information were generated from the national level data and were incorporated into the model. All region study definitions and impact model assumptions were agreed on before work with the models began.

Modeling Assumptions

The following are suggested assumptions for accepting the impact model:[16]

Backward-Linkages: IMPLAN is a backward-linkage model, meaning that it measures the increased demand on industries that produce intermediate inputs as a result of increases in production. However, if an industry increases production, there will also be an increased supply of output for other industries to use in their production. Models that measure this type of relationship are called forward-linkage models. To highlight this concept, consider the example of a new sawmill beginning its operations in a state. The increased production as a result of the sawmill's operations will increase the demand for lumber, creating an increase in activity in the logging industry, as well as other supporting industries such as electric transmission and distribution. IMPLAN's results will include those impacts, but will exclude effects on any wood product manufacturers located nearby that might be impacted by the newly available supply of lumber.

Employment: IMPLAN input-output is a production-based model, and employment numbers (from U.S. Department of Commerce secondary data) treat both full- and part-time individuals as being employed.

Fixed prices and no supply constraints: IMPLAN is a fixed-price model. This means that the modeling software assumes no price adjustment in response to supply constraints or other factors. In other words, the model assumes that firms can increase their production as needed and are not limited by availability of labor or inputs and that firms in the local economy are not operating at full capacity.

Fixed production patterns: Input-output (I-O) models assume inputs are used in fixed proportion, without any substitution of inputs, across a wide range of production levels. This assumption assumes that an industry must double its inputs (including both purchases and employment) to double its output. In many instances, an industry will increase output by offering overtime, improving productivity, or improvements in technology.

Industry homogeneity: I-O models typically assume that all firms within an industry have similar production processes. Any industries that fall outside the typical spending pattern for an industry should be adjusted using IMPLAN's Analysis-by-Parts technique.

Leakages: A small area can have a high level of leakage. Leakages are any payments made to imports or value added sectors, which do not in turn re-spend the dollars within the region. What's more, a study area that is actually part of a larger functional economic region will likely miss some important linkages. For example, workers who live and spend outside the study area may actually hold local jobs.

[16] Bureau of Economic Analysis https://www.bea.gov/papers/pdf/WP_IOMIA_RIMSII_020612.pdf

Appendix F. Detailed Results

Table 21. Scenario I Impacts, State of Minnesota

Impact Type	*Employment*	*Labor Income*	*Value Added*	*Output*
Direct Effect	20	$1.3	$1.5	$4.7
Indirect Effect	6	$0.5	$0.8	$1.7
Induced Effect	12	$0.6	$1.0	$1.8
Total Effect	38	$2.5	$3.3	$8.2

SOURCE: IMPLAN

Table 22. Scenario I Impacts, Arrowhead Region

Impact Type	*Employment*	*Labor Income*	*Value Added*	*Output*
Direct Effect	20	$1.3	$1.4	$4.7
Indirect Effect	4	$0.2	$0.4	$1.0
Induced Effect	8	$0.3	$0.6	$1.1
Total Effect	33	$1.9	$2.4	$6.8

SOURCE: IMPLAN

Table 23. Scenario II Impacts, State of Minnesota

Impact Type	*Employment*	*Labor Income*	*Value Added*	*Output*
Direct Effect	50	$3.3	$3.6	$11.7
Indirect Effect	15	$1.4	$2.0	$4.2
Induced Effect	30	$1.5	$2.6	$4.4
Total Effect	95	$6.2	$8.2	$20.3

SOURCE: IMPLAN

Table 24. Scenario II Impacts, Arrowhead Region

Impact Type	*Employment*	*Labor Income*	*Value Added*	*Output*
Direct Effect	50	$3.3	$3.6	$11.7
Indirect Effect	11	$0.6	$0.9	$2.4
Induced Effect	21	$0.8	$1.5	$2.7
Total Effect	82	$4.7	$6.0	$16.8

SOURCE: IMPLAN

Table 25. Scenario III Impacts, State of Minnesota

Impact Type	*Employment*	*Labor Income*	*Value Added*	*Output*
Direct Effect	100	$6.7	$7.2	$23.3
Indirect Effect	31	$2.7	$4.1	$8.4
Induced Effect	60	$3.1	$5.2	$8.8
Total Effect	190	$12.4	$16.4	$40.6

SOURCE: IMPLAN

Table 26. Scenario III Impacts, Arrowhead Region

Impact Type	*Employment*	*Labor Income*	*Value Added*	*Output*
Direct Effect	100	$6.7	$7.2	$23.3
Indirect Effect	22	$1.2	$1.9	$4.8
Induced Effect	42	$1.7	$3.0	$5.4
Total Effect	163	$9.5	$12.0	$33.6

SOURCE: IMPLAN